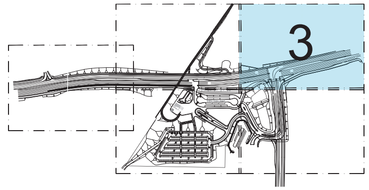


Keynote (SHEET 3)
SCALE 1:7500

LANDSCAPE LEGEND

- PV1 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 4 COLOUR MIX
- PV2 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 2 COLOUR MIX - 85%/15%
- PV3 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 2 COLOUR MIX - 15%/85%
- PV4 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm SINGLE COLOUR

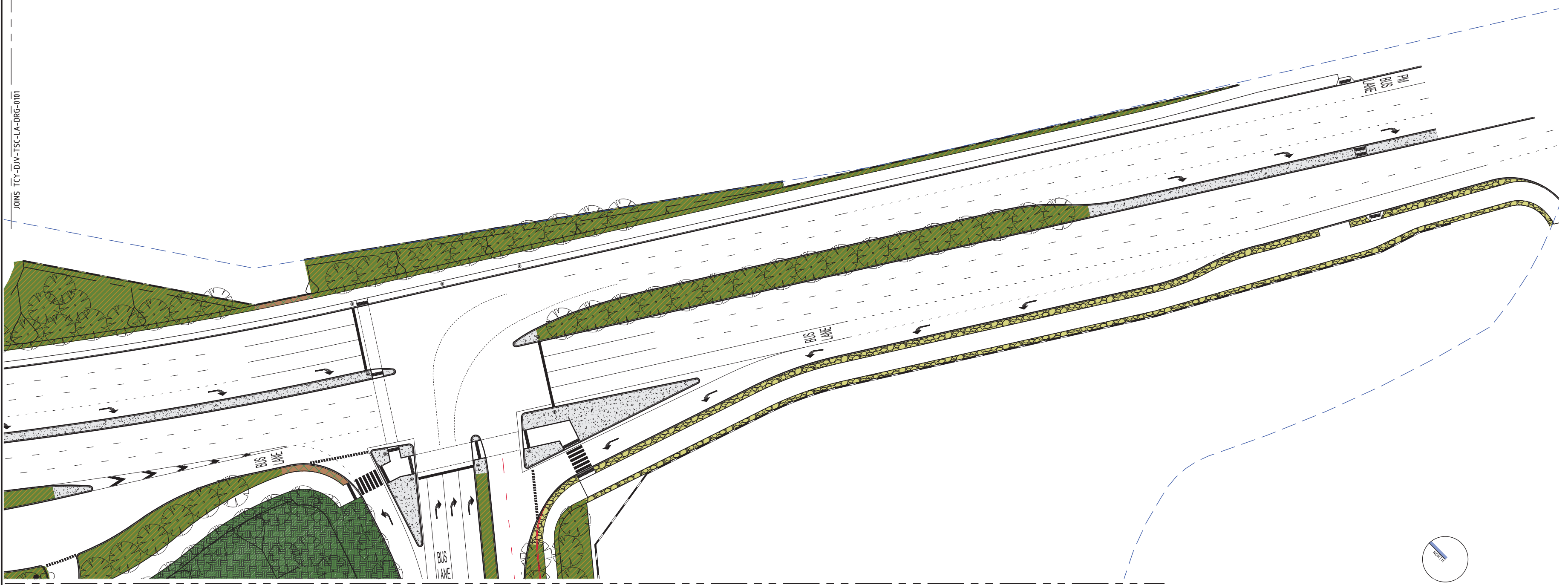
NOTE: PV1 to PV4 to be composed of a mix of different coloured brick pavers. ALL MAIN PAVERS TO BE CLAY PAVERS. Refer to TCY-DJV-TSB-LA-DRG-0050 for more details.

- PV5 - Urbanstone Engineered Stone Silver Grey Shotblast 400 Series 400mm x 200mm x 60mm
- PV6 - Urbanstone Engineered Stone Silver Grey Shotblast 400 Series 600mm x 400mm x 60mm
- PV7 - Standard Grey Brushed In-situ Concrete
- MU - Mulched Only Areas
- CL - Crushed Limestone
- GB - Overall Garden Bed Areas
- SM - Basin / Swale Plant Mix
- New Trees
- Feature Landscape Seating Elements
- Potential Location for Artwork
- RW - Landscape Seating Walls
- RW - Limestone Retaining Walls REFER TO CIVIL DOCUMENTATION PACKAGE
- RANFORD ROAD STATION REFER TO ARCHITECTURAL DOCUMENTATION PACKAGE
- Architectural Shade Structures REFER TO ARCHITECTURAL DOCUMENTATION PACKAGE
- TCL Landscape Corridor REFER TO LANDSCAPE CORRIDOR DOCUMENTATION PACKAGE
- DEVELOPMENT ENVELOPE BOUNDARY
- RAIL RESERVE BOUNDARY
- LIGHTING COLUMN WITH SINGLE OR DOUBLE OUTREACH ARM AND LED LUMINAIRE REFER TO ELECTRICAL DWG FOR DETAIL

NOTES:
- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
- PLANTING AREAS INDICATIVE ONLY.
- TCL LANDSCAPE CORRIDOR WITHIN THE RANFORD ROAD STATION BOUNDARIES TO BE REVIEWED AS DESIGN PROGRESSES.

DISCLAIMER:
- THESE DESIGNS AND PLANS ARE OWNED BY NEWest ALLIANCE AND CANNOT BE REPRODUCED WITHOUT WRITTEN PERMISSION.
- DO NOT SCALE OFF THESE DRAWINGS.

0 5 10 15 20 25 50
SCALE (m) 1:500 (A1) ; 1:1000 (A3)



LANDSCAPE MASTERPLAN - SURFACE FINISHES - SHEET 3 OF 5

SCALE 1:500

DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHKD	APP
A	03.07.20	15% DESIGN ISSUE	TL	TL_PF	FM	
A1	07.05.20	REFERENCE DESIGN ISSUE	TL	TL_PF	FM	

ORIG SIZE A1 — 0 10 20 30 40 50 100mm — AT ORIGINAL PLOT SIZE

NEWest Alliance

TCY-DJV-TSC-LA-DRG-0102

REFERENCES

SCALE : 1:500 (@ A1)
DATUM :
HORIZONTAL: PCG20
VERTICAL: AHD71
PTA ACCEPTANCE STAMP

DESIGNED TL
DRAWN TL/PF
CHECKED FM
APPROVED FOR ISSUE
EXECUTIVE DIRECTOR
PTA Division / External Company
DATE

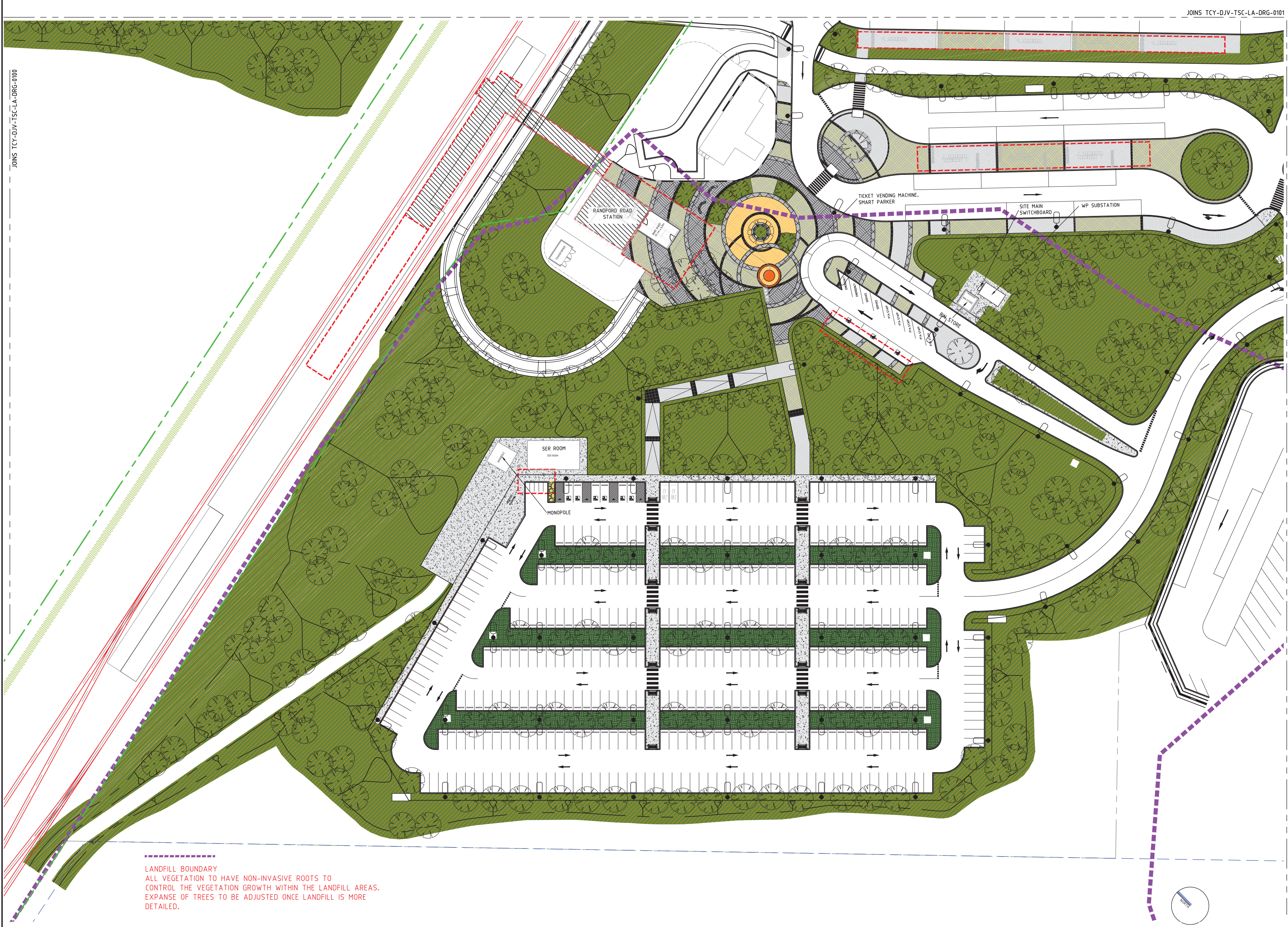
Government of Western Australia Public Transport Authority

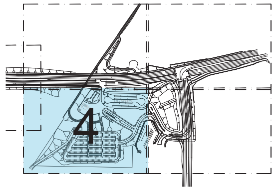
THORNLIE COCKBURN LINK

RANFORD ROAD STATION
LANDSCAPE MASTERPLAN
LA SURFACE FINISHES - SHEET 3

PTA Drawing No: REV : A

CAD DRAWING PATHNAME C:\Pedro Faustino Files\#Working Files\METRONET Project\TCL Rail\TSC - Ranford Road Station\Detailed Design\TCY-DJV-TSC-LA-DRG-0102.dwg





Keynote (SHEET 4)
SCALE 1:7500

LANDSCAPE LEGEND

- PV1 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 4 COLOUR MIX
- PV2 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 2 COLOUR MIX - 85%/15%
- PV3 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 2 COLOUR MIX - 15%/85%
- PV4 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm SINGLE COLOUR

NOTE: PV1 to PV4 to be composed of a mix of different coloured brick pavers. ALL MAIN PAVERS TO BE CLAY PAVERS. Refer to TCY-DJV-TSB-LA-DRG-0050 for more details.

- PV5 - Urbanstone Engineered Stone Silver Grey Shotblast 400 Series 400mm x 200mm x 60mm
- PV6 - Urbanstone Engineered Stone Silver Grey Shotblast 400 Series 600mm x 400mm x 60mm
- PV7 - Standard Grey Brushed In-situ Concrete
- MU - Mulched Only Areas
- CL - Crushed Limestone
- GB - Overall Garden Bed Areas
- SM - Basin / Swale Plant Mix
- New Trees
- Feature Landscape Seating Elements
- Potential Location for Artwork
- RW - Landscape Seating Walls
- RW - Limestone Retaining Walls REFER TO CIVIL DOCUMENTATION PACKAGE
- RANFORD ROAD STATION REFER TO ARCHITECTURAL DOCUMENTATION PACKAGE
- Architectural Shade Structures REFER TO ARCHITECTURAL DOCUMENTATION PACKAGE
- TCL Landscape Corridor REFER TO LANDSCAPE CORRIDOR DOCUMENTATION PACKAGE
- DEVELOPMENT ENVELOPE BOUNDARY
- RAIL RESERVE BOUNDARY
- LIGHTING COLUMN WITH SINGLE OR DOUBLE OUTREACH ARM AND LED LUMINAIRE REFER TO ELECTRICAL DWG FOR DETAIL

NOTES:
- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
- PLANTING AREAS INDICATIVE ONLY.
- TCL LANDSCAPE CORRIDOR WITHIN THE RANFORD ROAD STATION BOUNDARIES TO BE REVIEWED AS DESIGN PROGRESSES.

DISCLAIMER:
- THESE DESIGNS AND PLANS ARE OWNED BY NEWest ALLIANCE AND CANNOT BE REPRODUCED WITHOUT WRITTEN PERMISSION.
- DO NOT SCALE OFF THESE DRAWINGS.

0 5 10 15 20 25 50
SCALE (m) 1:500 (A1) ; 1:1000 (A3)

LANDSCAPE MASTERPLAN - SURFACE FINISHES - SHEET 4 OF 5

SCALE 1:500

REV	DATE	AMENDMENT	DSN	DRN	CHKD	APP
A	03.07.20	15% DESIGN ISSUE	TL	TL_PF	FM	
A1	07.05.20	REFERENCE DESIGN ISSUE	TL	TL_PF	FM	

ORIG SIZE A1 — 0 10 20 30 40 50 100mm AT ORIGINAL PLOT SIZE

This document must not be copied without PTA's written permission, and the contents thereof must not be imparted to a third party nor be used for any unauthorised purpose.

NEWest Alliance

TCY-DJV-TSC-LA-DRG-0103

REFERENCES

SCALE : 1:500 (@ A1)
DATUM : HORIZONTAL: PCG20 VERTICAL: AHD71
PTA ACCEPTANCE STAMP

DESIGNED TL
DRAWN TL/PF
CHECKED FM
APPROVED FOR ISSUE
EXECUTIVE DIRECTOR PTA Division / External Company
DATE

DETAILED DESIGN

Government of Western Australia Public Transport Authority

THORNLIE COCKBURN LINK

RANFORD ROAD STATION
LANDSCAPE MASTERPLAN
LA SURFACE FINISHES - SHEET 4

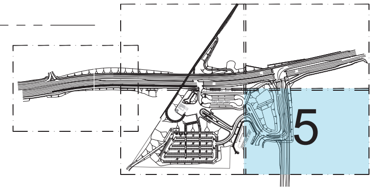
PTA Drawing No:
REV : A

CAD DRAWING PATHNAME C:\Pedro Faustino Files\#Working Files\METRONET Project\TCL Rail\TSC - Ranford Road Station\Detailed Design\TCY-DJV-TSC-LA-DRG-0103.dwg

LANDFILL BOUNDARY
ALL VEGETATION TO HAVE NON-INVASIVE ROOTS TO CONTROL THE VEGETATION GROWTH WITHIN THE LANDFILL AREAS. EXPANSE OF TREES TO BE ADJUSTED ONCE LANDFILL IS MORE DETAILED.

LANDSCAPE MASTERPLAN - SURFACE FINISHES - SHEET 5 OF 5

SCALE 1:500



Keynote (SHEET 5)
SCALE 1:7500

LANDSCAPE LEGEND

- PV1 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 4 COLOUR MIX
- PV2 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 2 COLOUR MIX - 85%/15%
- PV3 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm 2 COLOUR MIX - 15%/85%
- PV4 - MIDLAND BRICKS CLAY PAVERS 230mm x 114mm x 60mm SINGLE COLOUR

NOTE: PV1 to PV4 to be composed of a mix of different coloured brick pavers. ALL MAIN PAVERS TO BE CLAY PAVERS. Refer to TCY-DJV-TSB-LA-DRG-0050 for more details.

- PV5 - Urbanstone Engineered Stone Silver Grey Shotblast 400 Series 400mm x 200mm x 60mm
- PV6 - Urbanstone Engineered Stone Silver Grey Shotblast 400 Series 600mm x 400mm x 60mm
- PV7 - Standard Grey Brushed In-situ Concrete
- MU - Mulched Only Areas
- CL - Crushed Limestone
- GB - Overall Garden Bed Areas
- SM - Basin / Swale Plant Mix
- New Trees
- Feature Landscape Seating Elements
- Potential Location for Artwork
- RW - Landscape Seating Walls
- RW - Limestone Retaining Walls REFER TO CIVIL DOCUMENTATION PACKAGE
- RANFORD ROAD STATION REFER TO ARCHITECTURAL DOCUMENTATION PACKAGE
- Architectural Shade Structures REFER TO ARCHITECTURAL DOCUMENTATION PACKAGE
- TCL Landscape Corridor REFER TO LANDSCAPE CORRIDOR DOCUMENTATION PACKAGE
- DEVELOPMENT ENVELOPE BOUNDARY
- RAIL RESERVE BOUNDARY
- LIGHTING COLUMN WITH SINGLE OR DOUBLE OUTREACH ARM AND LED LUMINAIRE REFER TO ELECTRICAL DWG FOR DETAIL

NOTES:
- ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
- PLANTING AREAS INDICATIVE ONLY.
- TCL LANDSCAPE CORRIDOR WITHIN THE RANFORD ROAD STATION BOUNDARIES TO BE REVIEWED AS DESIGN PROGRESSES.

0 5 10 15 20 25 50
SCALE (m) 1:500 (A1) ; 1:1000 (A3)

DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHKD	APP
A	03.07.20	15% DESIGN ISSUE	TL	TL_PF	FM	
A1	07.05.20	REFERENCE DESIGN ISSUE	TL	TL_PF	FM	

ORIG SIZE A1 — 0 10 20 30 40 50 100mm — AT ORIGINAL PLOT SIZE

NEWest Alliance

TCY-DJV-TSC-LA-DRG-0104

REFERENCES

SCALE : 1:500 (@ A1)
DATUM :
HORIZONTAL: PCG20
VERTICAL: AHD71
PTA ACCEPTANCE STAMP

DESIGNED	TL
DRAWN	TL/PF
CHECKED	FM

APPROVED FOR ISSUE
EXECUTIVE DIRECTOR
PTA Division / External Company
DATE

Government of Western Australia Public Transport Authority

THORNLIE COCKBURN LINK
RANFORD ROAD STATION
LANDSCAPE MASTERPLAN
LA SURFACE FINISHES - SHEET 5
PTA Drawing No: REV : A

CAD DRAWING PATHNAME C:\Pedro Faustino Files\#Working Files\METRONET Project\TCL Rail\TSC - Ranford Road Station\Detailed Design\TCY-DJV-TSC-LA-DRG-0104.dwg

RANFORD ROAD STATION

Landscape Concept (MEETING PLACE)

FEATURE COLOUR FOR LANDSCAPE - NATURAL CLAY PAV-

Ground Covers

Atriplex cinerea
Coastal Saltbush
Type: Ground Cover
Full Sun / Part Shade
Flower: Spring
Soil Type: All soils including coastal
Size: 25cm (H) x 2m (W)
(Available Lullfitz Nursery)

Dampiera linearis
True Blue
Type: Ground cover
Full Sun / Full shade
Flower: Spring / Summer
Soil Type: All soils including coastal
Size: 30 cm (H) x 40/50m (W)
(Available Lullfitz Nursery)

Eremophila glabra
Carramar Carpet
Type: Ground Cover
Full Sun / Part Shade
Flower: All year
Soil Type: All soils including coastal
Size: 30cm (H) x 1m (W)
(Available Lullfitz Nursery)

Grevillea obtusifolia
Gin Gin Gem
Type: Ground cover
Part Shade / Full Sun
Flower: Winter / Summer
Soil Type: All soils including coastal
Size: 25cm (H) x2-3m (W)
(Available Benara Nursery)

Hemiandra pungens alba
Snakebush
Type: Ground cover
Full Sun to Full shade
Flower: Summer
Soil Type: All soils including coastal
Size: 30 cm (H) x 2m (W)
(Available Benara Nursery)

Grasses

Anigozanthos hybrid
Amber Velvet PBR Kangaroo Paw
Type: Strappy Leaf
Full Sun / Part Shade
Flower: Spring / Summer
Soil Type: All soils including coastal
Size: 70cm (H) x 1 m (W)
(Available Lullfitz Nursery)

Anigozanthos manglesii
Red & Green Kangaroo Paw
Type: Strappy Leaf
Full Sun / Part Shade
Flower: Spring / Winter
Soil Type: All soils including coastal
Size: 1.5 m (H) x 1 m (W)
(Available Lullfitz Nursery)

Dianella revoluta DRS000
Flax Lily - Little REV
Type: Strappy Leaf
Full Sun / Part Shade
Flower: Spring
Soil Type: All soils
Size: 40cm (H) x 30cm (W)
(Available Benara Nursery)

Lomandra longifolia LM400 Nyala
Spiny Headed Mat Rush
Type: Strappy Leaf
Full Sun
Flower: Spring
Soil Type: All soils
Size: 80cm (H) x 80cm (W)
(Available Benara Nursery)

Patersonia occidentalis
Native Iris
Type: Grass
Full Sun / Part Shade
Flower: Spring / Summer
Soil Type: All soils including coastal
Size: 80cm (H) x 80cm (W)
(Available Lullfitz Nursery)

Shrubs

Banksia attenuata
Candlestick Banksia
Type: Large Shrub
Full Sun / Part Shade
Flower: Spring to Autumn
Soil Type: All Soils (Well Drained)
Size: 2m (H) x 2 m (W)
(Available Benara Nursery)

Boronia Crenulata 'Pink'
Aniseed Boronia
Type: Medium Shrub
Full Sun / Part Shade
Flower: Spring / Winter
Soil Type: All soils including coastal
Size: 1m (H) x 1m (W)
(Available Benara Nursery)

Hypocalymma angustifolium
White Myrtle
Type: Large Shrub
Full Sun / Part Shade
Flower: Spring
Soil Type: All Soils
Size: 1 m (H) x 1 m (W)
(Available Benara Nursery)

Olearia axilliaris
Coastal Daisy Bush
Type: Medium Shrub
Full Sun
Flower: Winter/Spring
Soil Type: All soils including coastal
Size: 1 m (H) x 1m (W)
(Available Lullfitz Nursery)

Westringia fruticosa WES04
Coastal Daisy Bush
Type: Small Shrub
Full Sun
Flower: Winter/Spring
Soil Type: All soils including coastal
Size: 40cm (H) x 45cm (W)
(Available Lullfitz Nursery)

Feature / Hedges / Swale

Nuytsia floribunda
Christmas Tree
Type: Feature Tree
Full Sun
Flower: Summer
Soil Type: All soils
Size: 9m (H) x 3m (W)
(Availability to be checked)

Melaleuca nesophila 'Little Nessie'
Honey Myrtle
Type: Medium Shrub (Hedge)
Full Sun / Light Shade
Flower: Summer
Soil Type: All soils
Size: 2 m (H) x 1-2 m (W)
(Available Lullfitz Nursery)

Ficinia nodosa
Knotted Club Rush
Type: Rush / Sedge
Light Shade / Full Sun
Flower: Summer to Winter
Soil Type: All soils including Coastal
Size: 1m (H) x 1m (W)
(Available Lullfitz Nursery)

Juncus krausii
Sea Rush
Type: Rush / Sedge
Light Shade / Full Sun
Flower: Spring / Summer
Soil Type: All soils including Coastal
Size: 1m (H) x 50cm (W)
(Available Lullfitz Nursery)

Baumea Juncea
Rush Rush
Type: Rush / Sedge
Light Shade / Full Sun
Flower: Spring / Summer
Soil Type: All soils including Coastal
Size: 1m (H) x 1m (W)
(Available Lullfitz Nursery)

Trees

Agonis flexuosa
WA Weeping Peppermint
Type:Medium Tree
Full Sun
Flower: Winter/ Spring
All soils (well drained)
Size: 8 m (H) x 5 m (W)
(Available Benara Nursery)

Allocasuarina fraseriana
Western Sheoak
Type: Large Tree
Full Sun / Part Shade
Flower: Autumn / Winter
All soils
Size: 10m (H) x 6m (W)
(Available Benara Nursery)

Banksia littoralis
Swamp Banksia
Type: Medium Tree
Full Sun
Flower: Autumn / Winter
All soils and wetlands
Size: 15 m (H) x 8 m (W)
(Available Lullfitz Nursery)

Eucalyptus marginata
Jarrah
Type: Large Tree
Full Sun
Flower: Winter / Spring
All soils and wetlands
Size: 40m (H) x 25 m (W)
(Available Benara Nursery)

Eucalyptus todtiana
Coastal Blackbutt
Type: Medium Tree
Full Sun
Flower: Summer / Autumn
All soils
Size: 6 m (H) x 5 -10 m (W)
(Available Ellenby Tree Farm)

Melaleuca rhaphiophylla
Freshwater Paperbark
Type: Small Tree
Full Sun
Flower: Spring
Wetlands
Size: 6 m (H) x 4m (W)
(Available Benara Nursery)

Feature Natives for Ranford Road Station Landscape

CLAY PAVER MIX

NICHOLSON ROAD STATION LANDSCAPE PAVING MIX TO BE COMPOSED OF A MIX OF CLAY PAVER INTERCEPTED BY ENGINEERED STONE PAVER BANDS.

PAVING PATTERNS TO DEFINE THE OVERALL SPACES AROUND THE STATION AND PROVIDE VISUAL CLUES THAT CONTRIBUTE TO WAYFINDING TOWARDS THE STATIONS MAIN ENTRANCES.

MEETING PLACE

CONCEPTUAL REFERENCE - MEETING PLACE

MEETING PLACE ICONOGRAPHY TO BE INTERPRETED WITHIN THE FEATURE BANDING PAVING LAYOUT IN ORDER TO PROVIDE A PATTERN THAT GUIDES PEDESTRIANS TOWARDS THE MAIN ENTRANCES OF THE STATION.

RANFORD ROAD LANDSCAPE CONCEPTUAL LAYOUT

DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHKD	APP
A	03.07.2020	15% DESIGN ISSUE	TL	TL_PF	FM_PF	

ORIG SIZE A1

0 10 20 30 40 50 100mm

AT ORIGINAL PLOT SIZE

NEWest Alliance

TCY-DJV-TSC-LA-DRG-0002

REFERENCES

SCALE : 1 : NTS (@ A1)

DATUM :
HORIZONTAL: PCG20
VERTICAL: AHD71

PTA ACCEPTANCE STAMP

DESIGNED TL
DRAWN TL_PF
CHECKED FM_PF

APPROVED FOR ISSUE

EXECUTIVE DIRECTOR
PTA Division / External Company

DATE

Government of Western Australia Public Transport Authority

THORNLIE COCKBURN LINK

RANFORD ROAD STATION
LANDSCAPE MASTERPLAN
PLANTING LIST / CONCEPT MATERIALS

PTA Drawing No:

REV: A

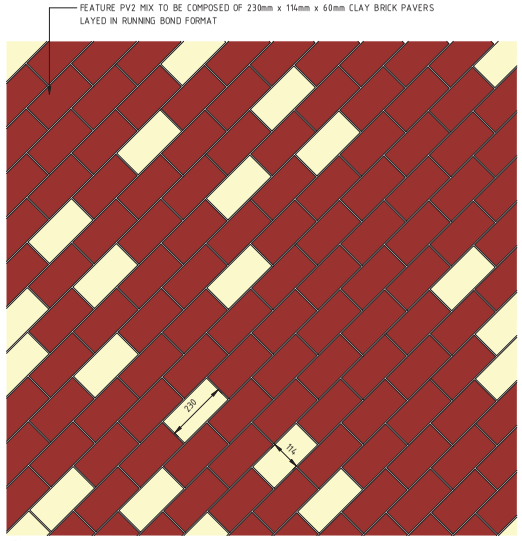
CAD DRAWING PATHNAME BIM 360://Metronet - TCY/TCY-DJV-TSC-LA-MOD-0001_RANFORD RD STATION.rvt

KEY:

	MIDLAND BRICK PAVESTONE CLASSIC CHARCOAL 230X114X60MM	20% MIX
	MIDLAND BRICK HEAVY DUTY RED 230X114X60MM	40% MIX
	MIDLAND BRICK HEAVY DUTY SENTOSA RED 230X114X60MM	20% MIX
	MIDLAND BRICK HEAVY DUTY GOLDEN DUNE 230X114X60MM	20% MIX

1 TCL PAVING DETAIL 1 - PV1 FEATURE MIX

SCALE 1 : 10

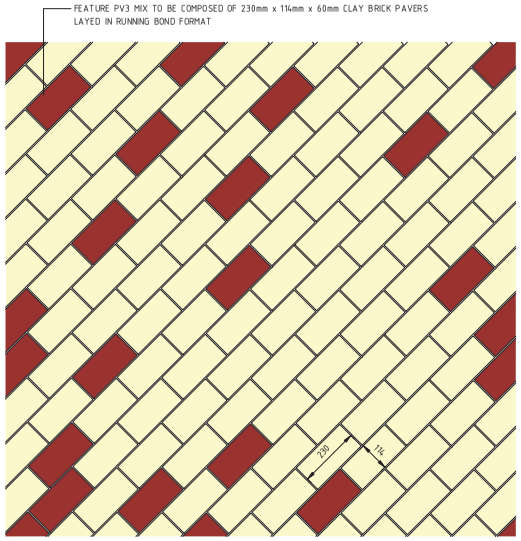


KEY:

	MIDLAND BRICK HEAVY DUTY RED 230X114X60MM	85% MIX
	MIDLAND BRICK HEAVY DUTY GOLDEN DUNE 230X114X60MM	15% MIX

2 TCL PAVING DETAIL 2 - PV2 FEATURE MIX

SCALE 1 : 10

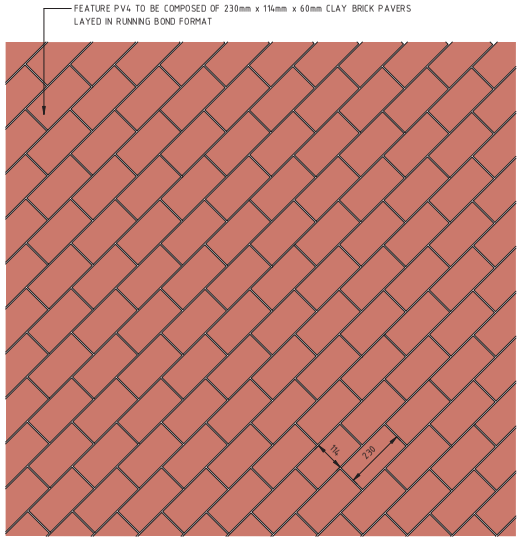


KEY:

	MIDLAND BRICK HEAVY DUTY RED 230X114X60MM	15% MIX
	MIDLAND BRICK HEAVY DUTY GOLDEN DUNE 230X114X60MM	85% MIX

3 TCL PAVING DETAIL 3 - PV3 FEATURE MIX

SCALE 1 : 10

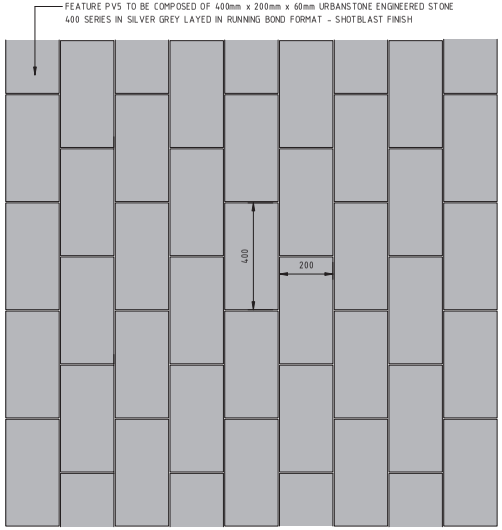


KEY:

	MIDLAND BRICK HEAVY DUTY SENTOSA RED 230X114X60MM	100% MIX

4 TCL PAVING DETAIL 4 - PV4 FEATURE MIX

SCALE 1 : 10

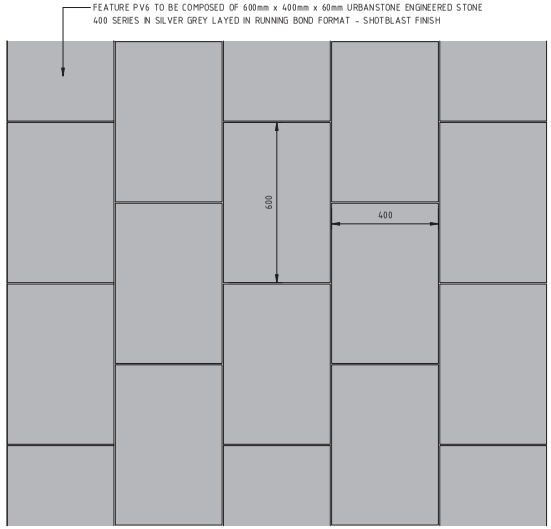


KEY:

	URBANSTONE SILVER GREY - SHOTBLAST FINISH 400X200X60MM	100% MIX

5 TCL PAVING DETAIL 5 - PV5 FEATURE MIX

SCALE 1 : 10



KEY:

	URBANSTONE SILVER GREY - SHOTBLAST FINISH 600X400X60MM	100% MIX

6 TCL PAVING DETAIL 6 - PV6 FEATURE MIX

SCALE 1 : 10

0 100 200 300 400 500 1000

SCALE (mm) 1:10 (A1) ; 1:20 (A3)

DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHKD	APP
A	030720	15% DESIGN ISSUE	TL	TL_PF	FM_PF	
A1	070520	REFERENCE DESIGN ISSUE	TL	TL_PF	FM_PF	

ORIG SIZE A1

0 10 20 30 40 50 100mm

AT ORIGINAL PLOT SIZE

NEWest Alliance

TCY-DJV-TSC-LA-DRG-0050

REFERENCES

SCALE : 1 : 10 (@ A1)

DATUM : HORIZONTAL: PCG20 VERTICAL: AHD71

PTA ACCEPTANCE STAMP

DESIGNED TL
DRAWN TL_PF
CHECKED FM_PF
APPROVED FOR ISSUE

EXECUTIVE DIRECTOR PTA Division / External Company
DATE

Government of Western Australia Public Transport Authority

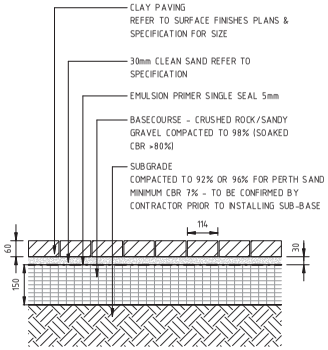
THORNLIE COCKBURN LINK

RANFORD ROAD STATION
LANDSCAPE MASTERPLAN
TYPICAL LANDSCAPE DETAILS - SHEET 1

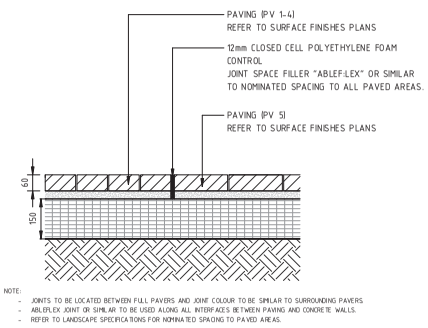
PTA Drawing No:

REV: A

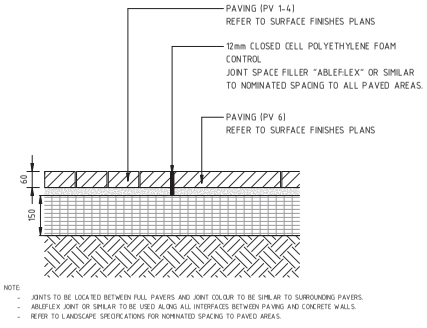
CAD DRAWING PATHNAME BIM 360://Metronet - TCY/TCY-DJV-TSC-LA-MOD-0001_RANFORD RD STATION.rvt



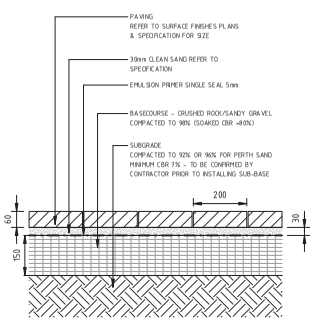
1 PV 1-4 (FOR TRAFFICABLE AREAS)
SCALE 1 : 10



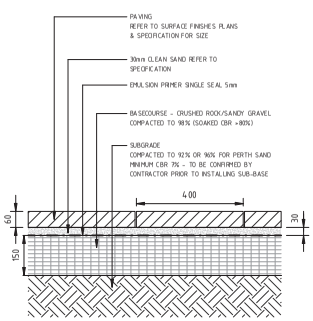
2 PV 1-4 TO PV 5 JOINTS
SCALE 1 : 10



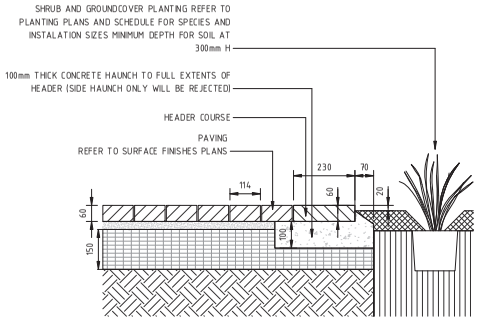
3 PV 1-4 TO PV 6 JOINTS
SCALE 1 : 10



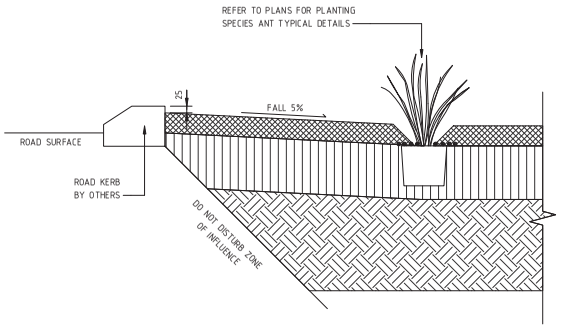
4 PV 5 (FOR TRAFFICABLE AREAS)
SCALE 1 : 10



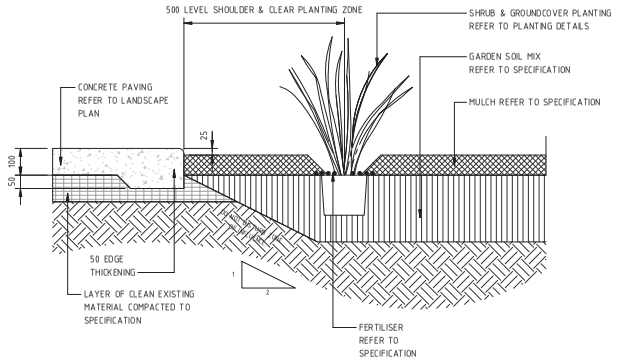
5 PV 6 (FOR TRAFFICABLE AREAS)
SCALE 1 : 10



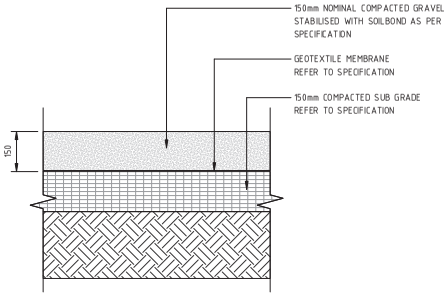
6 TYPICAL CONCRETE HAUNCH PAVING
SCALE 1 : 10



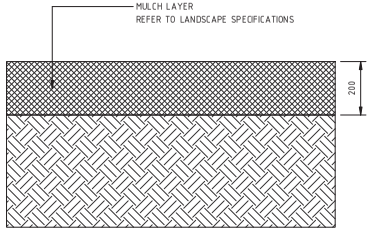
7 TYPICAL DETAIL SPADE CUT EDGE
SCALE 1 : 10



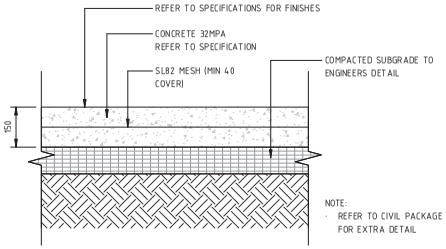
8 TYPICAL CONCRETE TO GARDEN BED
SCALE 1 : 10



9 TYPICAL GRAVEL SURFACE
SCALE 1 : 10



10 TYPICAL MULCH SURFACE
SCALE 1 : 10



11 TYPICAL TRAFFICABLE INSITU CONCRETE PATH
SCALE 1 : 10

0 100 200 300 400 500 1000
SCALE (mm) 1:10 (A1) ; 1:20 (A3)

DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHKD	APP
A	030720	15% DESIGN ISSUE	TL	TL_PF	FM_PF	
A1	070520	REFERENCE DESIGN ISSUE	TL	TL_PF	FM_PF	

ORIG SIZE A1
0 10 20 30 40 50 100mm
AT ORIGINAL PLOT SIZE

NEWest Alliance

TCY-DJV-TSC-LA-DRG-0051

REFERENCES

SCALE : 1 : 10 (@ A1)
DATUM :
HORIZONTAL: PCG20
VERTICAL: AHD71
PTA ACCEPTANCE STAMP

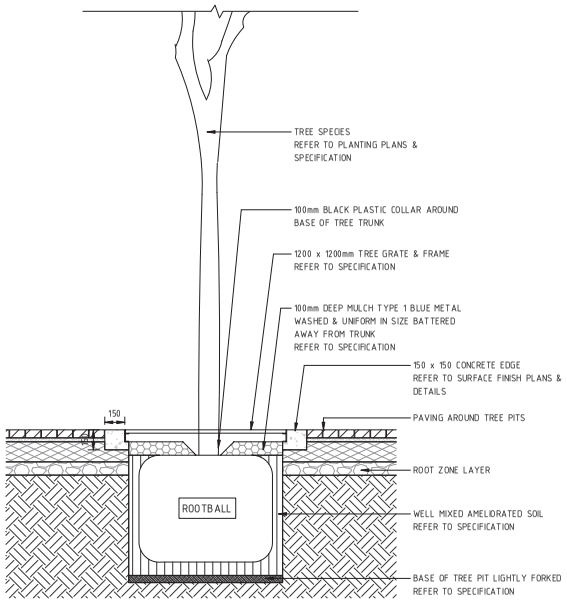
DESIGNED TL
DRAWN TL_PF
CHECKED FM_PF
APPROVED FOR ISSUE
EXECUTIVE DIRECTOR
PTA Division / External Company
DATE

Government of Western Australia Public Transport Authority

THORNLIE COCKBURN LINK
RANFORD ROAD STATION
LANDSCAPE MASTERPLAN
TYPICAL LANDSCAPE DETAILS - SHEET 2

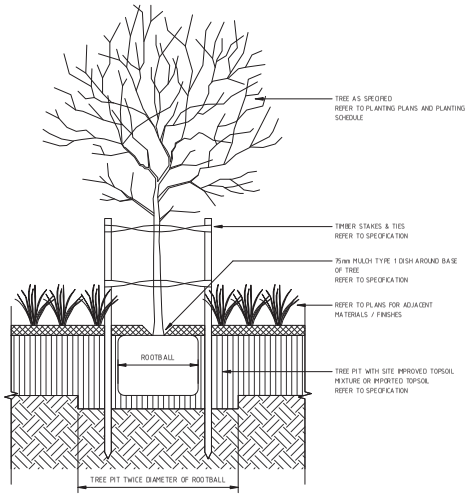
PTA Drawing No:
REV: A

CAD DRAWING PATHNAME BIM 360://Metronet - TCY/TCY-DJV-TSC-LA-MOD-0001_RANFORD RD STATION.rvt



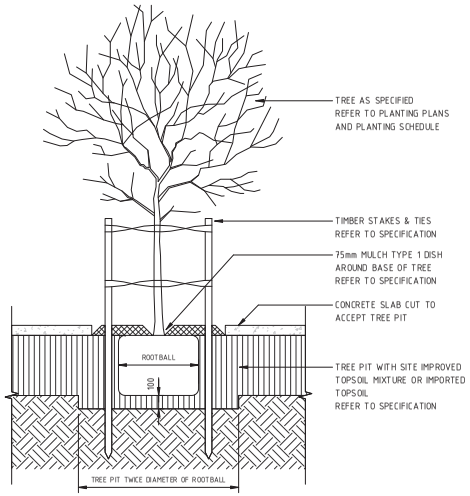
1 TYPICAL TREE IN PAVING - S UARE TREE PIT - SECTION

SCALE 1 : 20



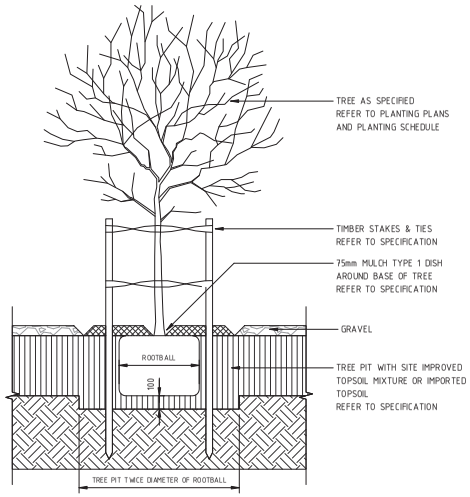
2 TYPICAL TREE IN PLANTING

SCALE 1 : 20



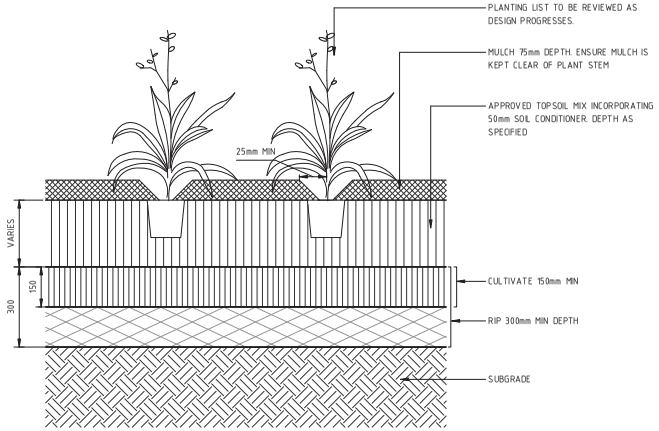
3 TYPICAL TREE IN CONCRETE

SCALE 1 : 20



4 TYPICAL TREE IN GRAVEL

SCALE 1 : 20



5 TYPICAL CONTAINER STOC PLANTING

SCALE 1 : 10

0 100 200 300 400 500 1000
SCALE (mm) 1:10 (A1) ; 1:20 (A3)

0 200 400 600 800 1000 2000
SCALE (mm) 1:20 (A1) ; 1:40 (A3)

DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHKD	APP
A	030720	15% DESIGN ISSUE	TL	TL_PF	FM_PF	

ORIG SIZE A1

0 10 20 30 40 50 100mm
AT ORIGINAL PLOT SIZE

NEWest Alliance

TCY-DJV-TSC-LA-DRG-0052

REFERENCES

SCALE : 1 : 10 / 1:20 (@ A1)

DATUM :
HORIZONTAL: PCG20
VERTICAL: AHD71

PTA ACCEPTANCE STAMP

DESIGNED TL
DRAWN TL_PF
CHECKED FM_PF
APPROVED FOR ISSUE

EXECUTIVE DIRECTOR
PTA Division / External Company
DATE

Government of Western Australia
Public Transport Authority

THORNLIE COCKBURN LINK

RANFORD ROAD STATION
LANDSCAPE MASTERPLAN
TYPICAL LANDSCAPE DETAILS - SHEET 3

PTA Drawing No:

REV: A

CAD DRAWING PATHNAME BIM 360://Metronet - TCY/TCY-DJV-TSC-LA-MOD-0001_RANFORD RD STATION.rvt

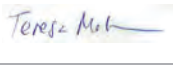
APPENDIX E TRAFFIC IMPACT ASSESSMENT

NEWest Alliance

Ranford Road Station: Transport Impact Assessment

METRONET Stage 1 Initiatives: Yanchep Railway Extension and Thornlie-Cockburn Link

Document Approval

Rev	Date	Prepared by	Reviewed By	Approved by
A	14-Jul-2020	Esta Jiang, Ryan Townsend	Teresa Matassa	Chris Deshon
Signature:				
Signature:				
Signature:				
Signature:				
Signature:				

Document Details

PTA Project:	180093 – METRONET Stage 1 Initiatives: Yanchep Railway Extension and Thornlie-Cockburn Link
PTA Document number:	
NEWest Document number:	TCY-DJV-TSC-TM-RPT-0002
Revision date:	14-Jul-2020
Revision:	A

DETAILS OF REVISION AMENDMENTS AND PLAN TERMINOLOGY

Document Control

The Principal Traffic Engineer is responsible for updating this plan to reflect changes as required.

Amendments

Any revisions or amendments must be approved by the Principal Traffic Engineer and/or NEWest Design Manager before being distributed or implemented.

Revision Details

Revision	Details
A	Issued for 15% Design

Terms and Definitions

Term	Meaning
DoS – Degree of Saturation	The DoS is a measure of available capacity at a road intersection, and is the ratio of the demand to capacity. The reported figure in this report reflects the maximum forecast DoS at the intersection: - A DoS less than 90 percent indicates that a vehicle movement / intersection is able to operate within the practical capacity, and is less likely to experience significant movement delays. - A DoS over 90 percent indicates a vehicle movement / intersection has exceeded practical capacity and is more likely to experience some delay or congestion, with mitigation measures likely to be required to ensure adequate capacity for priority movements at peak periods. A DoS of 100 percent or more indicates an intersection has exceeded practical capacity which would likely result in delay for vehicle movements, and be generally considered an undesirable outcome.
LoS – Level of Service	The LoS is a measure of the forecast delay for vehicle movements at a road intersection. The LoS measure ranges from A to F, and provides an indicator of the performance of the network or individual movement based on the average delay per passenger car unit (pcu).
SIDRA	Intersection analysis software used to analysis intersection performance

Abbreviations and Acronyms

Abbreviation/Acronym	Definition
DoS	Degree of Saturation
JELR	Jandakot East Link Road
LoS	Level of Service

PSP	Principal Shared Path
PTA	Public Transport Authority
ROM24	Regional Operations Model version 24– Main Roads strategic transport network model used for forecast road demand
TCL	Thornlie Cockburn Link
WAPC	Western Australian Planning Commission
WTS	Canning Waste Transfer Station

CONTENTS

Tables

Figures

THIS PAGE LEFT BLANK INTENTIONALLY

1. INTRODUCTION AND BACKGROUND

1.1 METRONET THORNLIE-COCKBURN LINK BACKGROUND

The proposed Ranford Road Station forms part of the wider METRONET Thornlie-Cockburn Link (TCL) project to deliver a new east-west rail connection in Perth's southern suburbs that links Thornlie Station (on the existing Armadale / Thornlie line) through to Cockburn Central Station (on the Mandurah line).

The project aims to deliver approximately 14.5km of new rail line between Thornlie Station and Cockburn to support the ongoing growth in the region and alleviate traffic congestion along key routes by providing a wider reaching public transport services in the southern suburbs Perth.

The TCL project is to be delivered by the NEWest Alliance, on behalf of the Public Transport Authority (PTA).

The primary components of the TCL project include the construction of two new train stations at the key locations of Nicholson Road and Ranford Road, as well as an upgraded station at Cockburn Central. Each of the proposed new train stations will also include a bus interchange for public transport connectivity, plus facilities for Park & Ride, Kiss & Ride and infrastructure for other active modes including walking and cycling.

Figure 1. TCL Project Overview

1.2 PROPOSED RANFORD ROAD STATION BACKGROUND

The proposed Ranford Road Station is located along the Thornlie-Cockburn line, approximately 21km south-east of Perth. The proposed station site is to be located south of the existing Ranford Road bridge crossing over the current freight rail line. The current Roe Highway / Ranford Road interchange is located approximately 1km north-west of the station site.

The Ranford Road Station is approximately 29 minutes from Perth by train, the design of this station maximises its location along a high-frequency bus route and will serve the Canning Vale industrial area. METRONET identifies the following long-term development opportunities around the Ranford Road Station:

- Future development of the Canning Vale industrial area to increase employment intensity and introduce new land uses.
- Removing land development constraints through zoning changes and site remediation.
- A faster rate of infill development in established surrounding suburban areas.

The precinct development plan for the METRONET Ranford Road Station is shown in Figure 2.

Figure 2. Ranford Road Station – Precinct Development (long term)

Source: METRONET

1.3 PURPOSE OF THIS DOCUMENT

This Transport Impact Assessment (TIA) has been prepared to support the ongoing development application of the proposed Ranford Road Station and seeks to outline the existing and proposed transport elements associated with the Station, due to be constructed as part of the wider METRONET TCL project.

As per the Western Australian Planning Commission (WAPC) Transport Impact Assessment Guidelines for Individual Developments (Volume 4), it is anticipated that the station will generate in excess of 100 vehicle trips within the development peak hour – resulting in what is considered to be a 'high' level of impact. Therefore, a transport impact assessment level of investigation is deemed to be appropriate for this development.

As such, this document has been prepared in accordance with the framework established within the WAPC guidelines.

2. EXISTING SITUATION

2.1 PROJECT SITE

The site of the proposed Ranford Road Station is located at the corner of the existing Ranford Road alignment and the current freight rail corridor, approximately 9.3km south-west of the existing Thornlie Station. As Ranford Road bounds the majority of the station land, this road will serve as one of the main access points to the external road network. The future Jandakot East Link Road (JELR) will also form a key part of the Station Access Strategy. The JELR features are outlined further in Section 3.2.

The proposed station is to be located on a largely unoccupied parcel of land adjacent to the current Ranford Road bridge over the freight rail line. The site boundary is shown in Figure 3.

Figure 3. Proposed Ranford Road Station Location

Source: Google Maps

The site was previously used as a landfill site. The site will be adjacent to the Canning Landfill and Recycling Facility (Waste Transfer Station) is which will continue to operate in the future, albeit with an amended access arrangement.

2.2 SURROUNDING ROAD NETWORK

2.2.1 LOCAL ROAD NETWORK

The existing road network in the area surrounding the proposed Ranford Road Station site is shown in Figure 4.

Figure 4. Ranford Road Station – Existing Surrounding Road Network

(

Source: Google Maps

All the station car parking access to and from the site shall be via the new Jandakot East Link Road that will connect to Ranford Road via a new intersection, to be located east of the site. However, southbound Transperth bus access shall be via a new connection just south of the current Ranford Road rail bridge. Northbound buses are able to access the station directly from Ranford Road.

Ranford Road is the primary roadway which bounds the site to the east. This road provides key regional connectivity from the south-eastern suburbs through to Roe Highway north of the site.

Ranford Road is currently a three-lane dual carriageway in the vicinity of the project area:

- South-east of Bannister Road to the Ranford Road bridge over the rail corridor:
  - In the north-west bound direction this includes two lanes for general traffic plus a short length of peak period bus lane which ends prior to Bannister Road signalised intersection.
  - In the south-east bound direction, this includes three traffic lanes for general traffic.
- Across the Ranford Road bridge over the rail corridor to Clifton Road (existing Waste Transfer Station access):
  - Due to the existing width of the bridge structure across the freight rail line, only two general traffic lanes per direction are provided across the bridge.
- South-east of Clifton Road to Nicholson Road:
  - Two lanes for general traffic and a peak period bus lane are provided in each direction.

The roadway includes a 2-5 metre wide median which runs along much of its length. Currently, the speed limit along Ranford Road in the vicinity of the station is limited to 70km/h.

Bannister Road is another key road connection in the vicinity of the site which services numerous retail and light industrial sites within the Canning Vale industrial area. Although the intersection of Bannister Road with Ranford Road is not directly modified as part of the proposed station works, the operation of this intersection is important for commercial movements in this area. Therefore, the interaction of the station infrastructure with Bannister Road is a key consideration throughout this assessment.

Bannister Road itself is a two-lane divided carriageway with a median up to 6 metres wide in some segments of the route. Currently, the speed limit along Bannister Road is 70km/h.

2.2.2 EXISTING TRAFFIC DATA

Existing traffic data was obtained from the WSP report *Thornlie-Cockburn Link Transport Assessment* (May 2019) prepared for METRONET / PTA. A traffic survey was undertaken for that study on Tuesday 9th April 2019 at the following locations:

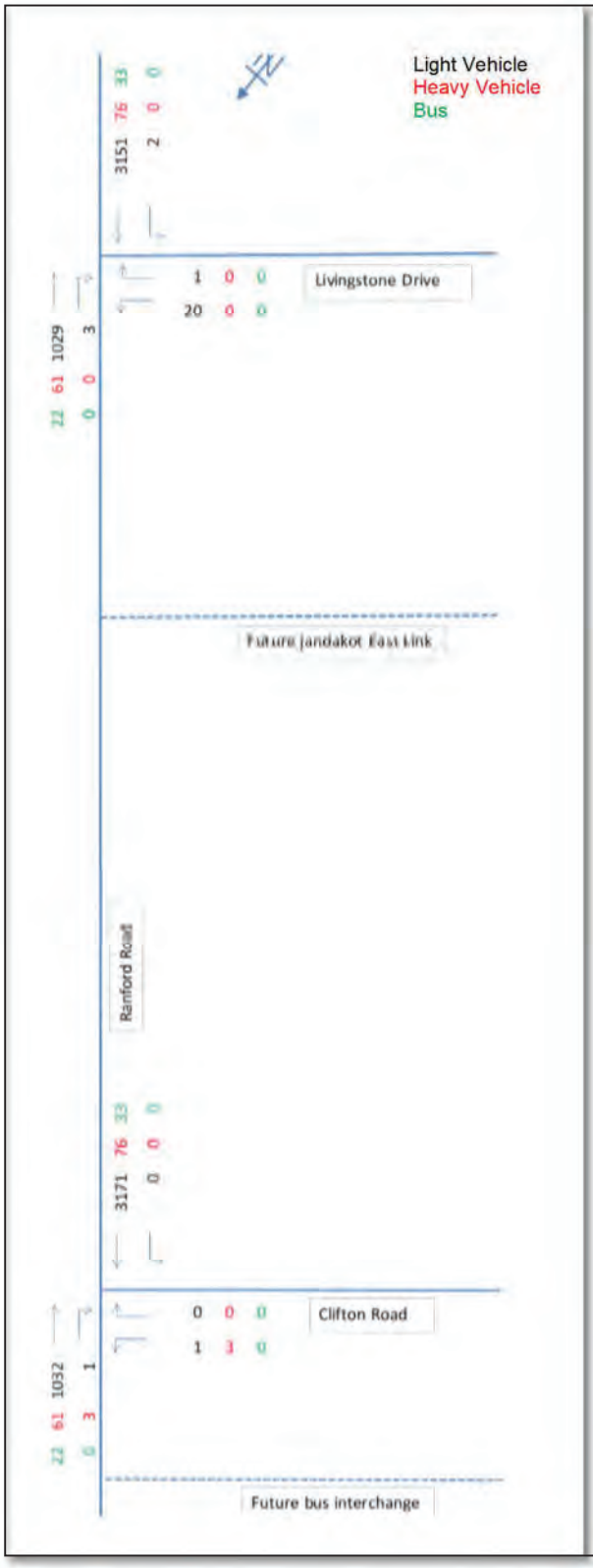
- Ranford Road / Livingstone Drive priority intersection
- Ranford Road / Clifton Road priority intersection.

The survey was undertaken 06:45 to 08:45 hours during the AM peak period and 16:00 to 18:00 hours during the PM peak period, with the AM peak hour being observed to be 07:15 to 08:15 hours and the PM peak hour observed to be 16:15 to 17:15 hours.

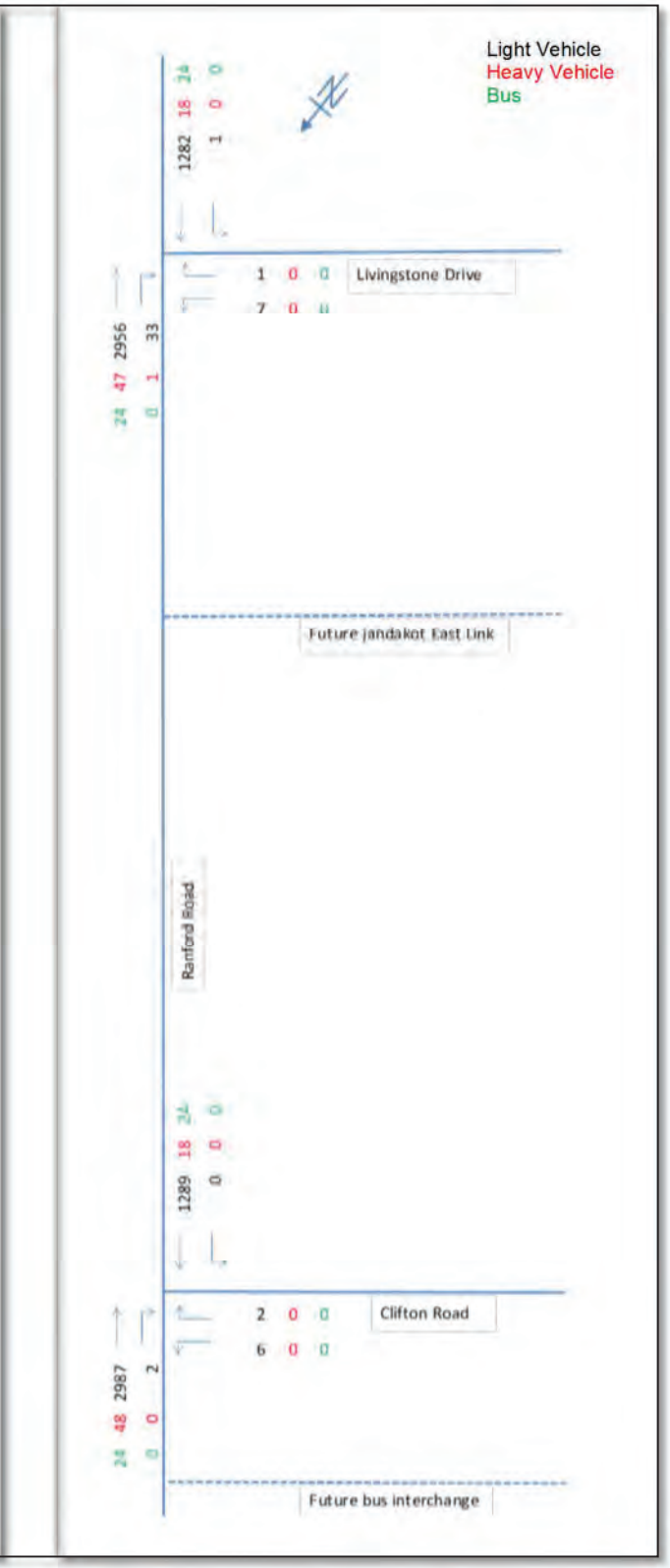
The above 2019 peak hour traffic flows are shown in Figure 5. Vehicle volumes have been categorised into ‘light vehicle’ and ‘heavy vehicle’ categories. Transperth bus services along Ranford Road has also been included.

Figure 5. Existing Peak Hour Traffic Counts (Tuesday 9th April 2019, source: WSP report)

AM Peak



PM Peak



Average weekday volume on Ranford Road next to the site was also obtained from Main Roads traffic map website. The 2015/2016 traffic data showed similar volumes, however being the hourly data (only whole hour data were reported) on average weekdays, some peak hour flows are slightly lower than the Tuesday peak hour counts obtained from the survey (WSP report). A summary of the Main Roads 2015/2016 average weekday data is shown in Table 1.

Table 1: 2015/16 Average Weekday Traffic Counts on Ranford Road (Source: Main Roads Traffic Map)

Peak Hour	Eastbound (Southbound)		Westbound (Northbound)	
	Total	Heavy	Total	Heavy
AM Peak 7:00-8:00	907	117 (13%)	2942	148 (5%)
PM Peak 16:00-17:00	2920	143 (5%)	1303	68 (5%)
All-day	25447	1763 (7%)	24819	1469 (6%)
AM Peak 7:00-8:00	907	117 (13%)	2942	148 (5%)

Clifton Road is currently used as an access road to the Canning Waste Transfer Station (WTS) and will be closed under the Ranford Road Station proposal. An alternative access to the WTS will be provided at the station access.

Ranford Road is currently operating at capacity with long queues observed in the peak direction (northbound in the AM peak and southbound in the PM peak) on the daily basis. The northbound queuing is largely due to the downstream congestion at Bannister Road intersection and South Street / Roe Highway interchange. The southbound queuing in the PM peak is due to inadequate capacity at Waratah Boulevard intersection (800 meters to the south), where only two general traffic lanes (plus a PM peak bus lane) are provided for the southbound traffic on Ranford Road.

2.3 EXISTING BUS ROUTES

Current Transperth bus route information for the area surrounding the Ranford Station site has been sourced from Transperth timetables and network mapping.

The bus routes which currently operate in the vicinity are shown in Figure 6.

Figure 6. Existing Transperth Bus Route Map

Source: Transperth Network Maps (https://www.transperth.wa.gov.au/journey-planner/network-maps)

From the Transperth network map, there are presently seven bus routes which travel past the project site along Ranford Road. Bus frequency information for this route is summarised in Table 2.

Table 2. Existing Transperth Bus Route Information

Route	Direction	Frequency (services per hour)		
		AM Peak	Off-Peak	PM Peak
204	Westbound	3	1	3
	Eastbound	3	1	3
205	Westbound	3	1	3
	Eastbound	3	1	3
206	Westbound	4	4	4
	Eastbound	4	4	4
207	Westbound	3	2	3
	Eastbound	3	2	3
517	Westbound	4	1	4
	Eastbound	4	1	4
518	Westbound	4	2	4
	Eastbound	4	2	4
519	Westbound	5	1	3
	Eastbound	3	1	4

Route	Direction	Frequency (services per hour)		
		AM Peak	Off-Peak	PM Peak
Total		50	24	49

2.4 EXISTING PEDESTRIAN AND CYCLING NETWORK

Ranford Road currently provides sealed shoulders on either side of the road, with a path along the northern (eastern) side in the subject area. A shared path is also provided along the southern (western) side of Ranford Road from south-east of Livingstone Drive. The City of Canning shared path map is shown in Figure 7.

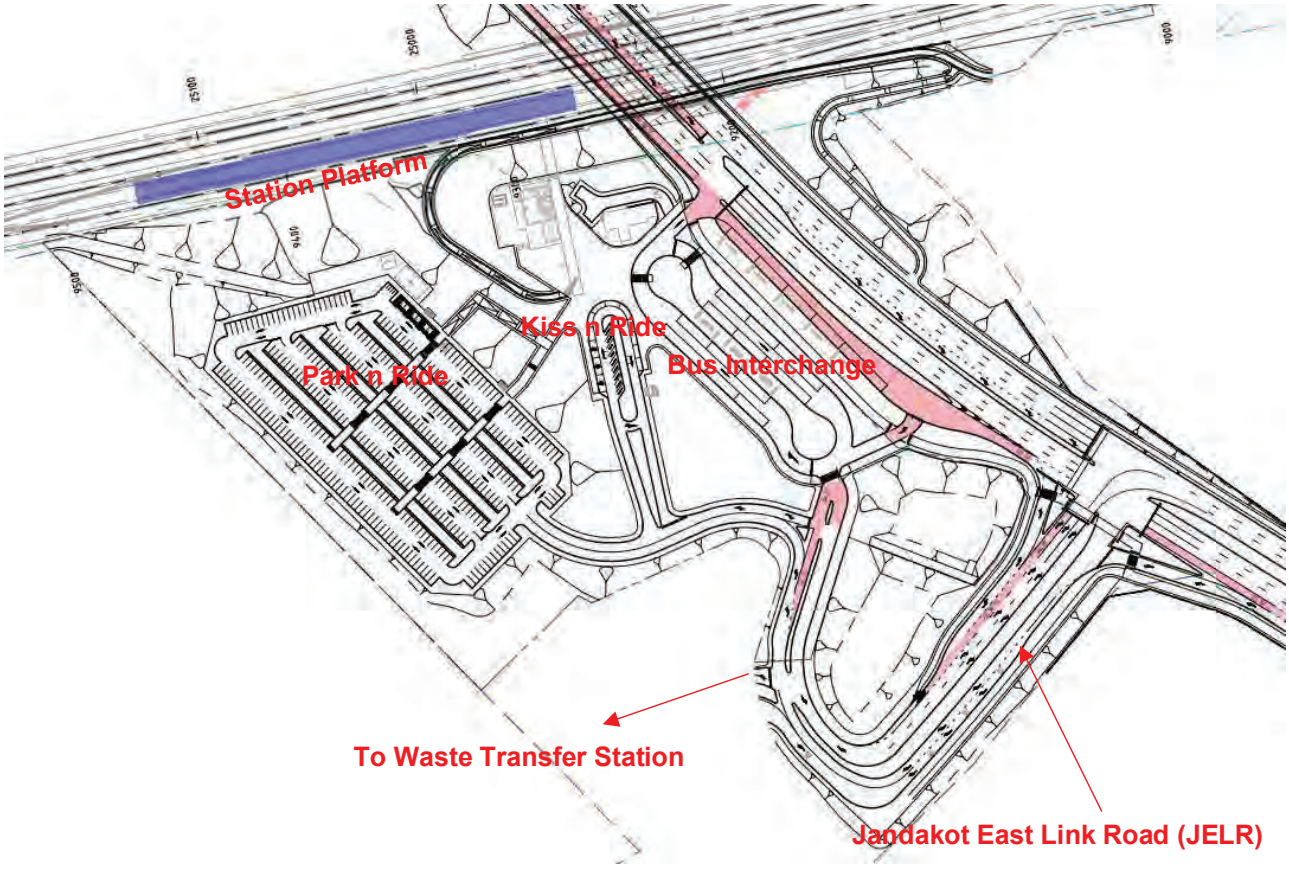
Figure 7. City of Canning Shared Path Network

3. DEVELOPMENT PROPOSAL

3.1 STATION LAYOUT

The proposed Ranford Station will provide a single platform train station along the new Cockburn Thornlie rail line, along with supporting infrastructure including a 400 bays parking area, drop-off parking zone, and a bus interchange. The general site layout is illustrated in Figure 8.

Figure 8. Proposed Station Layout



Ranford Station is identified as an SP6 Transit Node Station Precinct under the *METRONET Station Precinct Design Guide (2018)*, and the Station design is intended to support access to the station by bus and car (Park n Ride and drop off/pick up) followed by active modes which are more limited for this station due to the nature of the surrounding land uses. Further details on the Ranford Station forecast daily boardings, targeted station access mode share and catchment assessments are provided in **Section 4**. The Ranford Road Station design is consistent with the access priorities identified for this station, as is summarised below and in the following sections.

The proposed Ranford Road bus interchange is located to the south of the station platforms. The interchange provides a total of 11 active bus bays along with 6 layover bus bays in a space efficient dog-bone configuration, that also allows for full recirculation of buses within the bus interchange.

The long-term parking area (Park & Ride) is located south of the main station platforms and is connected to the station frontage via the station plaza. The car parking provides 400 bays, which includes both long term bays and a number of specific use bays such as accessible (i.e. ACROD permits) bays and taxi parking.

Located adjacent to the long-term parking area is the station drop-off area (Kiss & Ride), which provides for station pick-ups and drop-offs in a clockwise circulation to allow for safe access to vehicles for passengers.

3.2 CHANGES TO SURROUNDING TRANSPORT NETWORKS

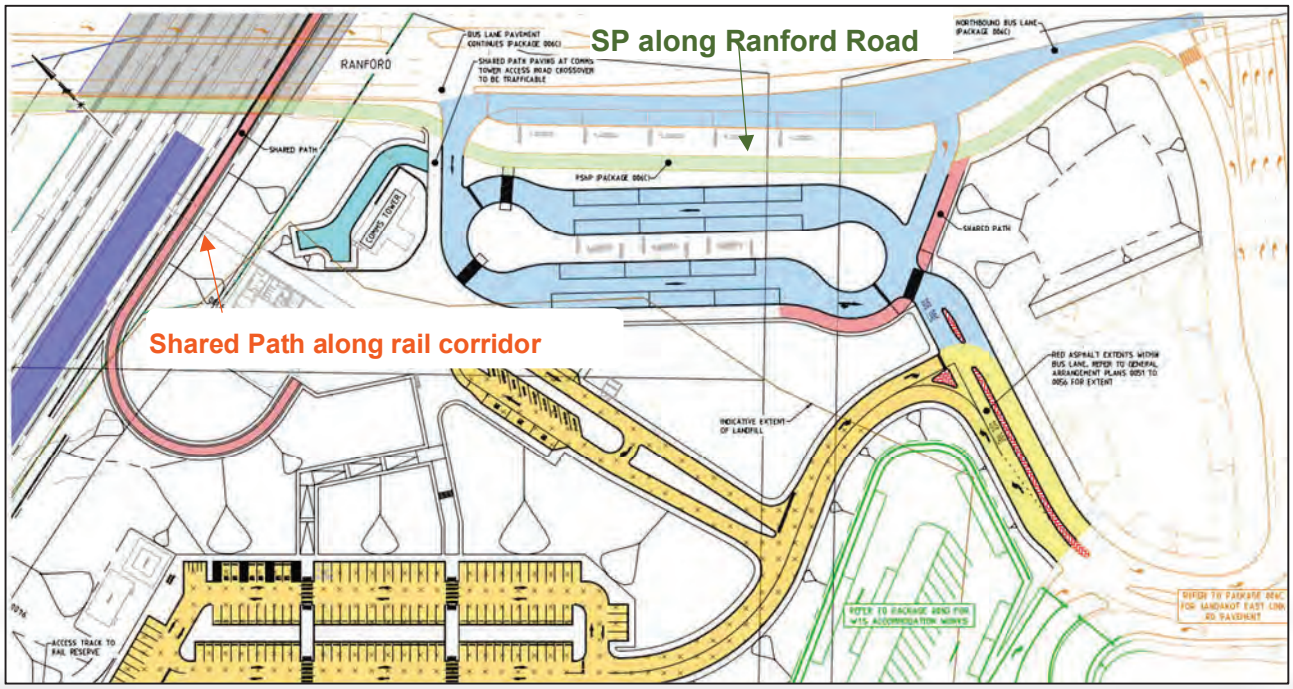
Vehicle access to the site shall be via a new priority-controlled intersection with the proposed Jandakot East Link Road (JELR) located on the southern side of the site. This access will provide for all inbound and outbound general traffic, as well as outbound for the southbound bus movement. The access strategy for the inbound movement for southbound buses is via a bus only right turn on Ranford Road, just south of the rail bridge. The northbound buses will access the bus interchange via the bus lane provided on Ranford Road.

To provide access to the station, the northern section of JELR between the station access and Ranford Road (including the Ranford Road / JELR intersection) is to be constructed as part of the METRONET / NEWest Ranford Road Station works. The extension of JELR further south of the station access is to be delivered by the City of Canning, and it is understood this is likely to be constructed within next five years.

An access to the City of Canning (South Metro) Waste Transfer Station (WTS) to the south of the site will be provided via the station access road, to replace the existing access via Clifton Road. According to the 2019 traffic survey, the WTS is currently generating less than 10 vehicle trips per hour during weekday network peak periods.

As part of the station construction, a new shared path is proposed along the southern side of Ranford Road (illustrated in green in Figure 9) that will provide access to the station plaza via accessible ramps at the southern end of the station site. The Ranford Road works also include a new shared path extending from the Station Plaza north-east along the TCL rail corridor which provides direct and safe connectivity under the Ranford Road bridge to the existing paths along the northern side of Ranford Road, and ties into the existing shared path along the TCL corridor. Along with the shared path connectivity, end of trip facilities are to be provided including sheltered bicycle parking, a number of bicycle U-rails, drinking fountain and public toilets.

Figure 9. Ranford Road Station works



4. ANALYSIS OF TRANSPORT NETWORKS

4.1 BACKGROUND AND APPROACH

The traffic assessment of the network surrounding the proposed Ranford Road Station is detailed within this section of the report. The goal of this assessment is to demonstrate that the transport infrastructure provided as part of the project is suitable for use and is capable of adequately accommodating the forecast transport demands associated with the future station.

4.1.1 ASSESSMENT YEARS / TIME PERIODS

For the transport infrastructure assessment of the Ranford Road Station, the assessment focuses on the proposed opening year of 2021, and a post-opening year of 2031 to account for the medium-term development in the area and nearby major infrastructure changes.

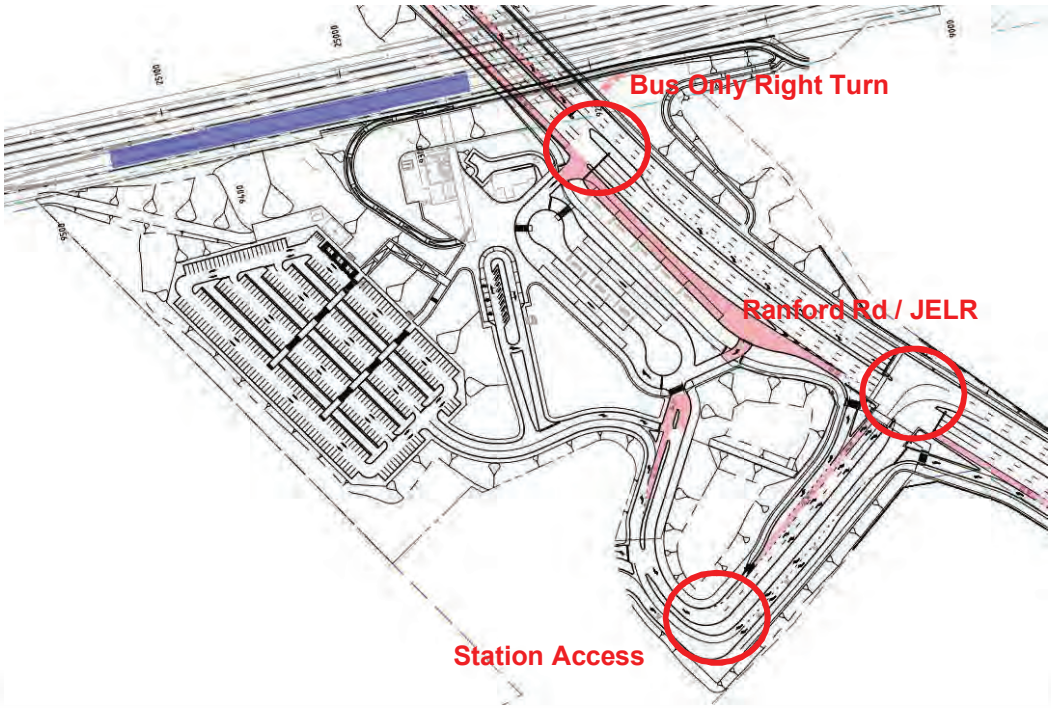
As the station is largely expected to accommodate work related trips to / from the Perth CBD, the assessment will focus primarily on the AM and PM peak periods. While weekend traffic is anticipated, both the station patronage and background traffic flows during the weekend are expected to be significantly lower than the respective weekday peaks.

The peak period intervals are primarily based on the existing traffic flow data for vehicle traffic along Ranford Road which demonstrates that the AM peak hour occurs from 07:15 to 08:15 and the PM peak hour from 16:15 to 17:15.

4.1.2 INTERSECTIONS TO BE ASSESSED

The access arrangement for the Ranford Road Station proposes that all vehicular traffic enter and exit the site via JELR, with the exception of the southbound inbound bus movement, which access (right turn) directly from Ranford Road. Therefore, the main access to the station site with JELR, and the intersection of Ranford Road and JELR will be a key focus of the traffic analysis study to be undertaken in this assessment. The key sites (intersections) are shown in Figure 10.

Figure 10. Key Intersections Assessed



4.2 BACKGROUND TRAFFIC FORECAST

Baseline traffic demands on Ranford Road have been sourced from existing counts and Main Roads ROM24 forecast (to understand the change in background traffic volumes on Ranford Road and JELR). Due to the Kwinana Freeway widening and Armadale Road upgrade (duplication), the ROM24 forecast showed marginal reduction in traffic on Ranford Road, with 6.9% reduction in 2021 and 3.7% reduction in 2031 compared to the 2016 traffic flow. For the JELR, the ROM24 forecast showed it is expected to carry 10,700 vehicles per day in 2031 (no JELR extension beyond the Station in 2021). It was assumed that traffic generated by the WTS will remain the same as the existing demand (2019 surveyed counts).

The 2021 and 2031 weekday peak hour background traffic forecast are illustrated in Figure 11 and Figure 12. The background turn volume at Ranford Road/JELR intersection (estimated based on Main Roads' advice) are shown in Figure 13 and Figure 14

Figure 11 Estimated 2021 Peak Hour Background Traffic Forecast on Ranford Road (no JELR extension beyond Ranford Station)

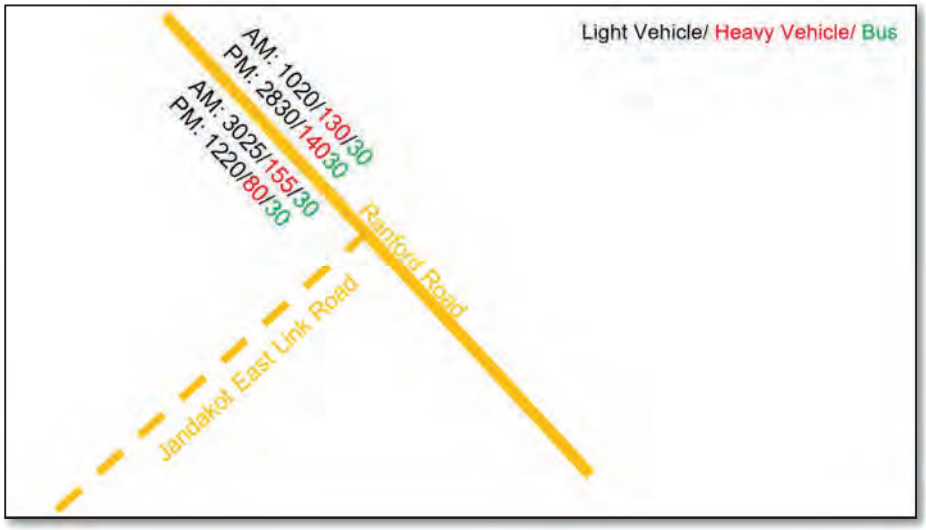


Figure 12 Estimated 2031 Peak Hour Background Traffic Forecast on Ranford Road and JELR

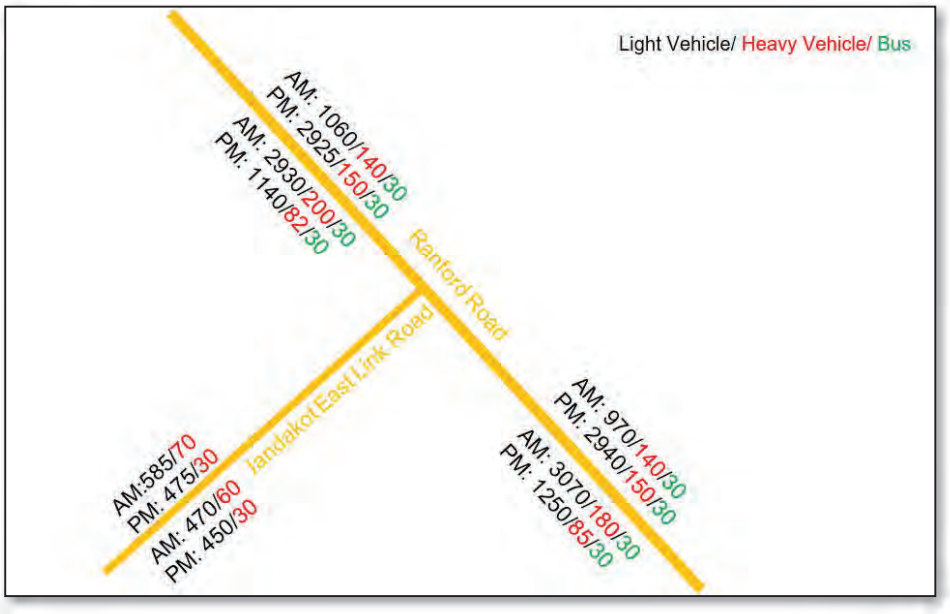


Figure 13 Estimated 2031 AM Peak Background Turning Volume at Ranford Road/ JELR Intersection

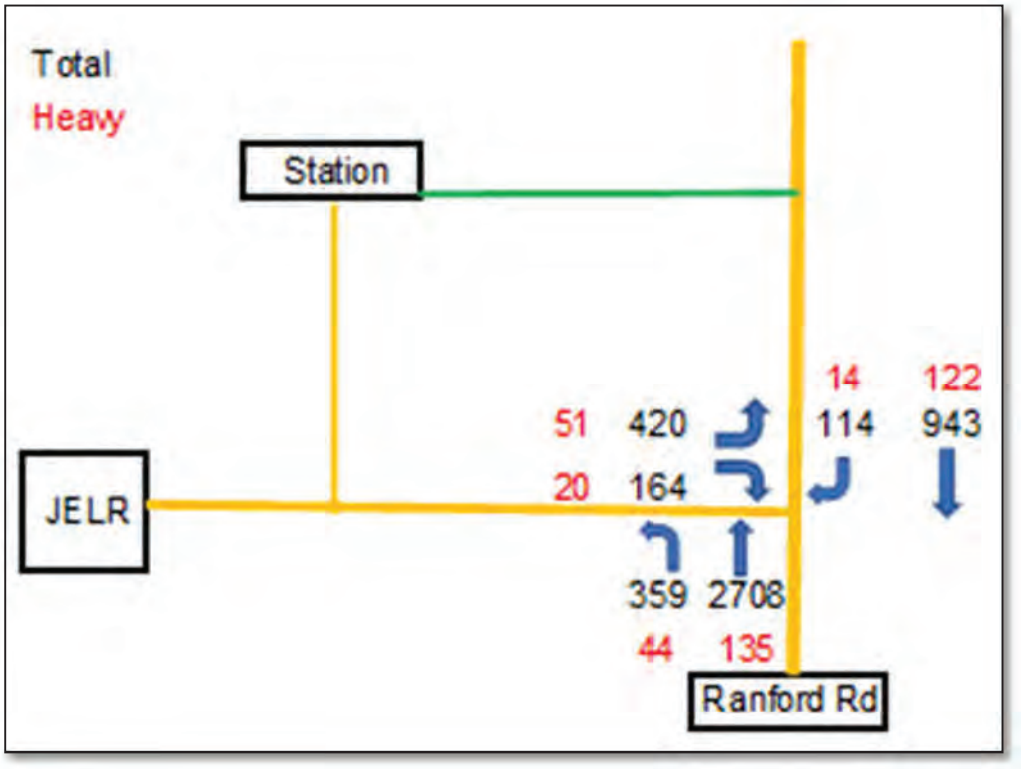
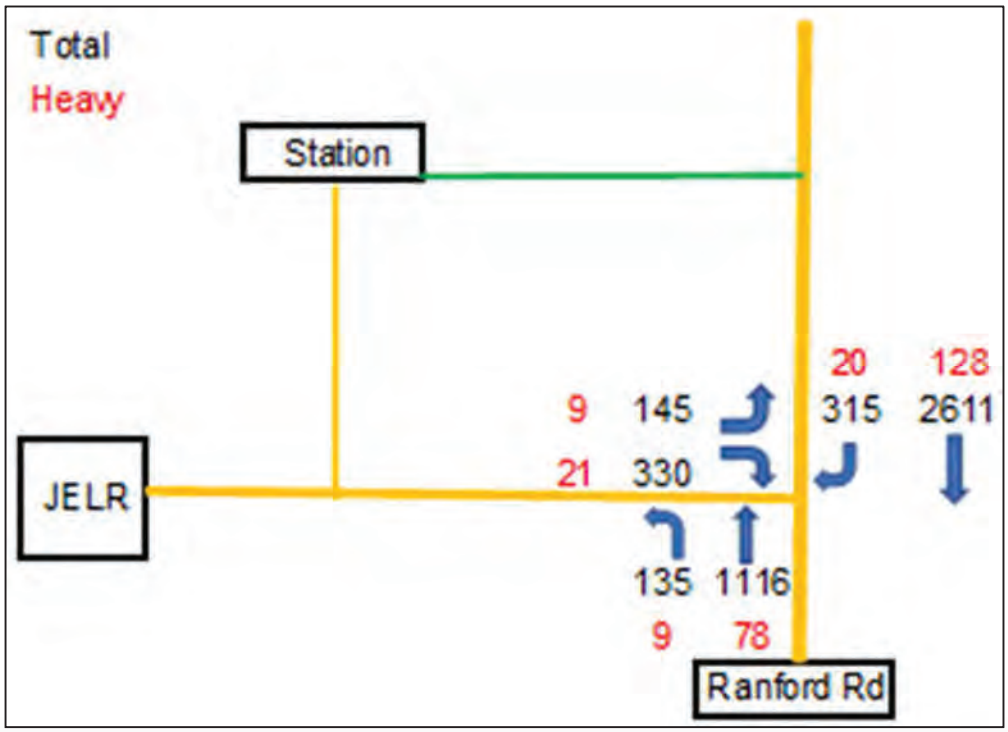


Figure 14 Estimated 2031 PM Peak Background Turning Volume at Ranford Road/ JELR Intersection



4.3 STATION TRIP GENERATION

This section outlines the key methodology and figures / assumptions utilised in order to determine the forecast trip generation and distribution profile associated with the proposed Ranford Road Station.

4.3.1 TRIP GENERATION

One of the major factors in calculating the trip generation associated with the site is the number of estimated daily station boardings. The daily boardings have been obtained from the *TCL Catchment Analysis Technical Note* (Arup, February 2018) and the forecast daily boardings for the Ranford Road Station are shown in Table 3.

Table 3. Ranford Road Station Daily Boardings Forecast

Year	2021	2031
Daily Boardings (Passengers /Day)	2,120	3,210

The Ranford Road Station access mode share has been sourced from the *Thornlie – Cockburn Link Transport Assessment* (WSP, May 2019), which in turn based the adopted mode share figures from the abovementioned *TCL Catchment Analysis Technical Note*. The assumed 2021 mode share at Ranford Road Station is shown in Table 4.

Table 4. Adopted 2021 Ranford Road Station Mode Share

Access Mode	Mode Share (2021)
Walking	3%
Cycling	5%
Bus	53%
Kiss & Ride	14%
Park & Ride	25%
Total	100%

The daily trip profile for the Park n Ride and Kiss n Ride was sourced from the *Thornlie-Cockburn Link Transport Assessment* (WSP, May 2019), as shown in Table 5.

Table 5. Adopted daily passenger Boarding / Alighting trip generation profile

Time (Hour Beginning)	Vehicle Trips (Train Passenger Boardings)		Vehicle Trips (Train Passenger Alightings)	
	Park & Ride	Kiss & Ride	Park & Ride	Kiss & Ride
5:00	10%	6%	0%	0%
6:00	24%	14%	0%	0%
7:00	44%	31%	0%	1%
8:00	7%	11%	0%	1%

Time (Hour Beginning)	Vehicle Trips (Train Passenger Boardings)		Vehicle Trips (Train Passenger Alightings)	
	Park & Ride	Kiss & Ride	Park & Ride	Kiss & Ride
9:00	5%	6%	0%	2%
10:00	1%	5%	0%	1%
11:00	1%	3%	1%	2%
12:00	0%	3%	2%	2%
13:00	1%	2%	4%	2%
14:00	1%	2%	6%	5%
15:00	0%	3%	8%	8%
16:00	2%	2%	19%	16%
17:00	1%	5%	31%	13%
18:00	2%	3%	19%	13%
19:00	1%	2%	5%	11%
20:00	0%	1%	2%	11%
21:00	0%	0%	1%	9%
Total	100%	99%	98%	97%

- *Note: Some figures do not add up to 100% as the data does not cover a full 24-hour period.*
- *Note: Kiss & Ride Inbound and outbound vehicle trips for each passenger boarding and alighting are accounted for and are equal (i.e. inbound vehicle trips and outbound vehicle trips are equal for a given time period).*

For the year 2031, it was assumed that the Park & Ride traffic demand will remain the same as 2021, as the car park is anticipated to be fully utilised by the opening year of 2021 (i.e. all 400 bays occupied). It is expected that the Kiss & Ride trip demand will increase by approximately 50%, in accordance with the forecast patronage growth between 2021 and 2031.

The estimated peak hour station traffic generation are shown in Table 6.

Table 6. Ranford Road Station Traffic Generation

Forecast Year	AM Peak		PM Peak	
	Inbound	Outbound	Inbound	Outbound
2021	289	95	58	190
PnR	194	0	4	137
KnR	95	95	54	54
2031	337	143	85	218
PnR	194	0	4	137
KnR	143	143	81	81

4.3.2 DIRECTIONAL DISTRIBUTION OF TRAFFIC FLOWS

All the traffic generated by the Ranford Road Station would access via Ranford Road in 2021. The aforementioned *TCL Catchment Analysis Technical Note* indicated 3% of the catchment would access the station from Ranford Road north and the remaining 97% would access from Ranford Road south.

For the 2031 case, with the JELR being operational, it has been assumed 10% of the traffic generated by the station would access the station via JELR, 87% would access from Ranford Road south, with the remaining 3% access from Ranford Road north. The assumed station traffic distribution during AM and PM peak periods are illustrated in Figure 15 and Figure 16.

Figure 15 2021 Ranford Station PnR and KnR Traffic Distribution

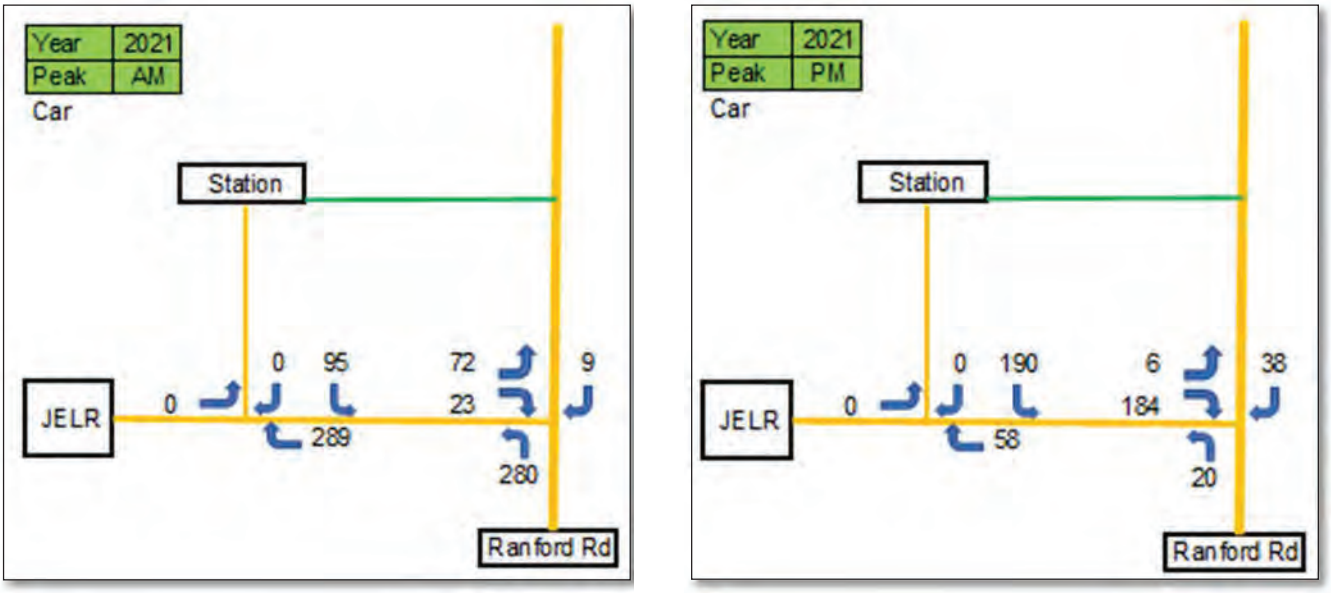
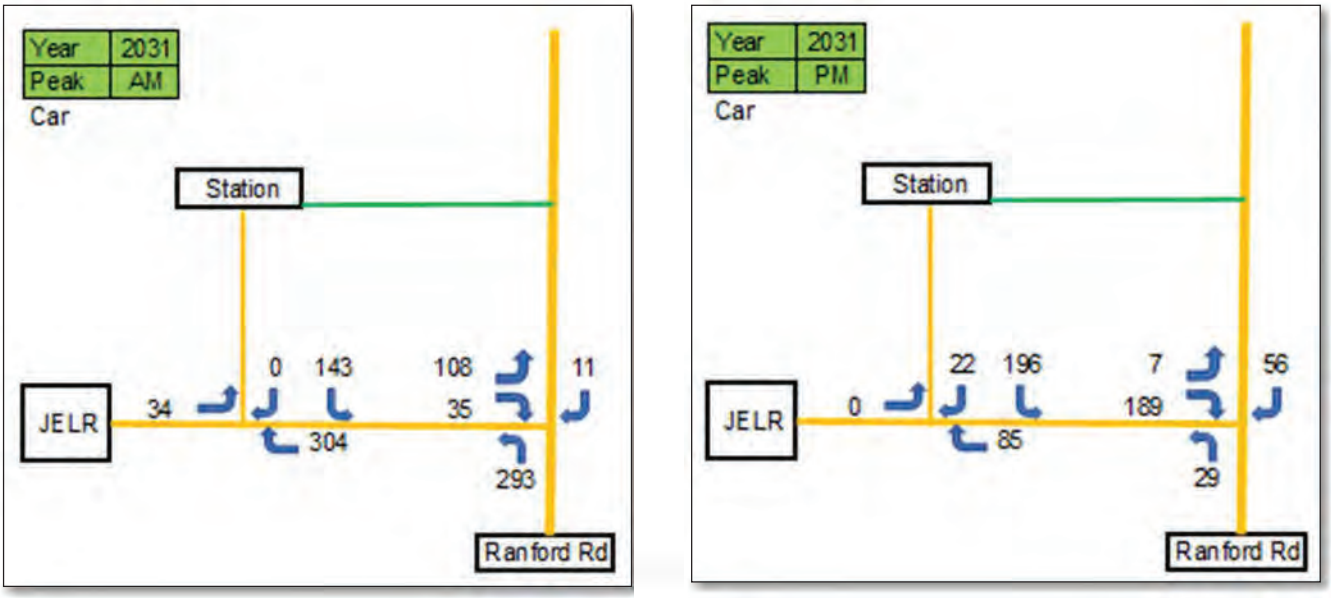


Figure 16 2031 Ranford Station PnR and KnR Traffic Distribution



The largest traffic impact of the new Station on Ranford Road is south of JELR, and on JELR it is between Ranford Road and Station Access. The traffic increases on these two sections of road due to the station traffic are shown in Table 7.

Table 7 Ranford Road Station Traffic Impacts

Year	Road	AM Peak		PM	
		NB/EB	SB/WB	NB/EB	SB/WB
2021	Ranford Road	9%	2%	2%	7%
	JELR	-	-	-	-
2031	Ranford Road	9%	3%	2%	6%
	JELR	22%	57%	39%	18%

It should be noted that, in reality, a large proportion of the traffic generated by the Ranford Road Station Park n Ride and Kiss n Ride would be using these surrounding roads anyway (traveling to their final destination rather than Ranford Road Station). Therefore, the real traffic impact of the station is likely to be much lower than those shown in the above calculation.

4.4 PERFORMANCE METRICS AND LEVEL OF SERVICE TARGETS

SIDRA Intersection analysis has been undertaken to determine the performance of adjacent intersections and road network.

The network results of the analysis summarised in this report are presented in terms of:

- Delay – The average delay experienced per passenger car unit (measured in seconds).
- Level of Service (LoS) – The LoS (ranging from A to F) provides an indicator of the performance of the network or individual movement based on the average delay per passenger car unit (pcu).
- Degree of Saturation (DoS) – The DoS is a ratio of the demand to capacity, with DoS over 90 percent indicating a congested intersection, and DoS of 100 percent indicating an intersection at capacity and DOS over 100 percent indicating oversaturated conditions. The DoS provided represents the maximum DoS at the intersection.
- Queue – The length of the average maximum back of queue (measured in meters) on the approach measured over a number of cycles.

As per the "*8803-000-005 Specification - Station Building and Civil Works*", the level of service requirements for intersection performance specified by the Scope of Work and Technical Criteria (SWTC) are as follows:

> *3.3 Level of Service for Intersections*
> *The overall level of service (LOS) for intersections during peak periods (as defined in Transportation Research Board's Highway Capacity Manual - Special Report 209) shall be Level D or higher, with no individual major movement having a LOS lower than Level D and no individual minor movement having a LOS lower than Level E.*

In addition, Book 4: Part A – PTA Technical Criteria stated:

> *22.2.1.10 With reference to PTA document 8803-000-005 Specification – Stations and Buildings Civil Works section 3.3 add the following at the end of the section: A LOS F will be acceptable for turning and minor movements where it is purely a results of a long cycle time with a Low Degree of Saturation and queue lengths and if approved by PTA.*

4.5 ROAD NETWORK IMPACT ANALYSIS

4.5.1 2021 TRAFFIC IMPACT ANALYSIS

In 2021, without the Ranford Road Station, there will also not be Ranford Road/ JELR intersection constructed by this time period. This intersection only exists in the "with station" scenario by 2021. SIDRA Intersection analysis has been undertaken for the "with station" scenario, including the two intersections (Ranford Road/ JELR and Ranford Road/ Bus Right Turn) forming a network.

Due to the potential requirement of traffic signal coordination on Ranford Road, it has been assumed that the signal cycle times will be compatible with the neighbouring Ranford Road/ Bannister Road intersection to the north of the site, and Ranford Road/ Waratah Boulevard intersection to the south. Therefore, the existing cycle times at these two intersections were obtained from 2019 SCATS signal data, and it was determined that the cycle time is 165 seconds in the AM peak and 190 seconds in the PM peak. Due to the long cycle time, Main Roads WA suggested that a double cycle should be used for the Bus Right Turn intersection.

Due to the close proximity of the two intersections, SIDRA "Network" analysis has been undertaken to account for the influence between intersections. The SIDRA "Network" analysis results are provided in Table 8 and Table 9.

Table 8 2021 AM Peak Network Intersection Level of Service Results – "with station"

Intersection	Approach	Turn	Degree of Saturation	Delay (sec)	Level of Service	95th Percentile Queue (m)
Ranford Rd/JELR	Ranford Rd northbound	Left	0.166	7	A	10
		Thru	0.920	25	C	499
	Ranford Rd southbound	Thru	0.243	4	A	52
		Right	0.223	97	F	9
	JELR	Left	0.092	23	C	21
		Right	0.326	82	F	36
	All		**0.920**	**20**	**B**	**499**
Bus Right Turn	Ranford Rd northbound	Thru	0.751	5	A	158
	Ranford Rd southbound	Thru	0.192	0	A	0
		Right	0.456	53	D	20
	All		**0.751**	**4**	**A**	**158**

Table 9 2021 PM Peak Network Intersection Level of Service Results – "with station"

Intersection	Approach	Turn	Degree of Saturation	Delay (sec)	Level of Service	95th Percentile Queue (m)
Ranford Rd/JELR	Ranford Rd northbound	Left	0.012	7	A	1
		Thru	0.317	11	B	108
	Ranford Rd southbound	Thru	0.725	9	A	326
		Right	0.329	101	F	26
	JELR	Left	0.008	7	A	1
		Right	0.438	92	F	60
	All		**0.725**	**15**	**B**	**326**
Bus Right Turn	Ranford Rd northbound	Thru	0.298	3	A	35
	Ranford Rd southbound	Thru	0.502	0	A	25
		Right	0.300	54	D	21
	All		**0.502**	**1.5**	**A**	**35**

The above SIDRA analysis results showed both intersections would performance satisfactorily under the forecast traffic, although the right turn movements (minor movements) on Ranford Road and JELR are likely to experience long delay due to the long cycle times adopted in the analysis. However, with short queuing reported on both movements, the SWTC criteria can be satisfied with the proposed intersection design. A high degree of saturation is reported on Ranford Road northbound in the AM peak, largely due to the upstream capacity constraints on Ranford Road (only 2 general traffic lanes leading up to the JELR intersection).

The detailed SIDRA analysis results are provided in Appendix A.

4.5.2 2031 TRAFFIC IMPACT ANALYSIS

In 2031, it was assumed that JELR will be constructed as part of the broader road network, and therefore the Ranford Road/JELR intersection is also included in the "without station" scenario, however the Bus Right Turn intersection on Ranford Road will not be present in this scenario.

SIDRA analysis results for the "without station" scenario are provided in Table 10 and Table 11. The results showed that the right turn movements are likely to experience long delay, again due to long cycle time adopted in the analysis.

Table 10 2031 AM Peak Ranford Rd/ JELR Intersection Level of Service Results – "without station"

Intersection	Approach	Turn	Degree of Saturation	Delay (sec)	Level of Service	95th Percentile Queue (m)
Ranford Rd/JELR	Ranford Rd northbound	Left	0.258	8	A	34
		Thru	0.894	23	C	441
	Ranford Rd southbound	Thru	0.239	4	A	52
		Right	0.880	101	F	85
	JELR	Left	0.499	26	C	161
		Right	0.464	82	F	53
	All		**0.894**	**22**	**C**	**441**

Table 11 2031 PM Peak Ranford Rd/ JELR Intersection Level of Service Results – "without station"

Intersection	Approach	Turn	Degree of Saturation	Delay (sec)	Level of Service	95th Percentile Queue (m)
Ranford Rd/JELR	Ranford Rd northbound	Left	0.110	11	B	20
		Thru	0.514	45	D	203
	Ranford Rd southbound	Thru	0.739	11	B	388
		Right	0.518	59	E	180
	JELR	Left	0.139	11	B	29
		Right	0.730	92	F	117
	All		**0.739**	**28**	**C**	**388**

For the 2031 "with station" scenario, two additional intersections will be created, one is the "Bus Right Turn" on Ranford Road, the other is the Station Access on JELR. Due to the close proximity of these three intersections, SIDRA "Network" analysis has been undertaken to account for the influences on one another. The SIDRA "Network" results are presented in Table 12 and Table 13.

Table 12 2031 AM Peak Network Intersection Level of Service Results – "with station"

Intersection	Approach	Turn	Degree of Saturation	Delay (sec)	Level of Service	95th Percentile Queue (m)
Ranford Rd/JELR	Ranford Rd northbound	Left	0.447	10	A	72
		Thru	0.957	49	D	561
	Ranford Rd southbound	Thru	0.228	4	A	51
		Right	0.926	108	F	101
	JELR	Left	0.652	30	C	232
		Right	0.522	82	F	63
	All		**0.957**	**37**	**D**	**561**
Bus Right Turn	Ranford Rd northbound	Thru	0.762	6	A	184
	Ranford Rd southbound	Thru	0.198	0	A	0
		Right	0.456	53	D	20
	All		**0.762**	**5**	**A**	**184**
JELR/ Station Access	JELR westbound	Thru	0.131	0	A	0
		Right	0.432	11	B	17
	Station Access	Left	0.327	7	A	9
		Right	0.013	48	D	0
	JELR eastbound	Left	0.021	6	A	1
		Thru	0.430	0	A	0
	All		**0.432**	**3**	**NA**	**17**

Table 13 2031 PM Peak Network Intersection Level of Service Results – "with station"

Intersection	Approach	Turn	Degree of Saturation	Delay (sec)	Level of Service	95th Percentile Queue (m)
Ranford Rd/JELR	Ranford Rd northbound	Left	0.137	12	B	30
		Thru	0.601	55	D	223
	Ranford Rd southbound	Thru	0.803	21	C	326
		Right	0.595	60	E	216
	JELR	Left	0.140	12	B	34
		Right	0.803	92	F	195
	All		**0.803**	**39**	**D**	**326**
Bus Right Turn	Ranford Rd northbound	Thru	0.312	1	A	15
	Ranford Rd southbound	Thru	0.615	0	A	174
		Right	0.300	53	D	22
	All		**0.615**	**1**	**A**	**174**
JELR/ Station Access	JELR westbound	Thru	0.120	0	A	0
		Right	0.101	8	A	2
	Station Access	Left	0.281	6	A	9
		Right	0.107	21	C	3
	JELR eastbound	Left	0.001	6	A	0
		Thru	0.201	0	A	0
	All		**0.281**	**2**	**NA**	**9**

The above 2031 SIDRA analysis indicates that with the proposed station, the overall Level of Service becomes LoS D, compared to the LoS C reported for the 2031 "without station" scenario. Again, it should be noted that the background traffic on Ranford Road in the "with station" scenario has not been reduced in this exercise, even though the opening of Ranford Road Station is likely to reduce the background traffic due to mode shift (car only trips shifting to rail trips). Therefore, the above impacts are likely to be overestimated, and an overall performance LoS D is considered acceptable for a peak period.

In the 2031 scenario, the SWTC criteria can be satisfied with the proposed design. The forecast LoS E and F reported for the Ranford Road / JELR two right turn movements are due to the long cycle time, but as 'minor' movements compared to the regional through movement function of Ranford Road, these are considered acceptable.

Long queuing and high degree of saturation were reported on Ranford Road, largely due to the high background traffic demand in the peak direction on Ranford Road. A high degree of saturation is reported on Ranford Road northbound in the AM peak, largely due to the upstream capacity constraints on Ranford Road (only 2 general traffic lanes leading up to the JELR intersection).

The 95th percentile eastbound queuing on JELR at Ranford Road intersection is also long, likely extending back to the station access intersection on JELR. A second left turn lane was considered but this requires the left turn movement be signalised. The SIDRA analysis showed that although this second lane reduces the AM peak eastbound queuing on JELR, the delay would increase significantly in both AM and PM peak. It should be noted that the high left turn flow in the AM peak is mainly due to the large demand forecast originated from JELR, with Ranford Road Station only anticipated to contribute 20% of the total left turn traffic demand. Therefore, this second left turn lane should not be considered until JERL is fully operational and all the future land development aspirations along this road are fully realised.

The detailed SIDRA analysis results are provided in Appendix A.

4.6 PUBLIC TRANSPORT ROUTES AND SERVICING

With the introduction of the new Thornlie-Cockburn Link (TCL) and the associated bus interchanges at each of the stations along the route, adjustments to existing bus routes and the introduction of new services are expected. The future Transperth bus network proposed to service the Ranford Station bus interchange is outlined in Table 14. This information has been supplied by PTA / Transperth and is subject to changes or adjustments pending future planning and community consultation.

Table 14. Ranford Station - Planned bus Services

Route	Headway (mins)	
	Peak	Inter-Peak / Off-Peak
Route 75	2-3	2
Route 200	15-20	60
Route 204	10	30
Route 205	10	15
Route 206	10	15
Route 207	15	30
Route 517	No Change	
Route 518	No Change	
Route 519	No Change	

- There are a number of new routes (Southern River, Armadale, Jandakot) which will not be operational for the Station opening.
- Routes 204, 205, 206, 207, 517, 518, 519 are bi-directional. In peak periods buses will be operating frequently in both directions, although peak frequency is generally biased to and from

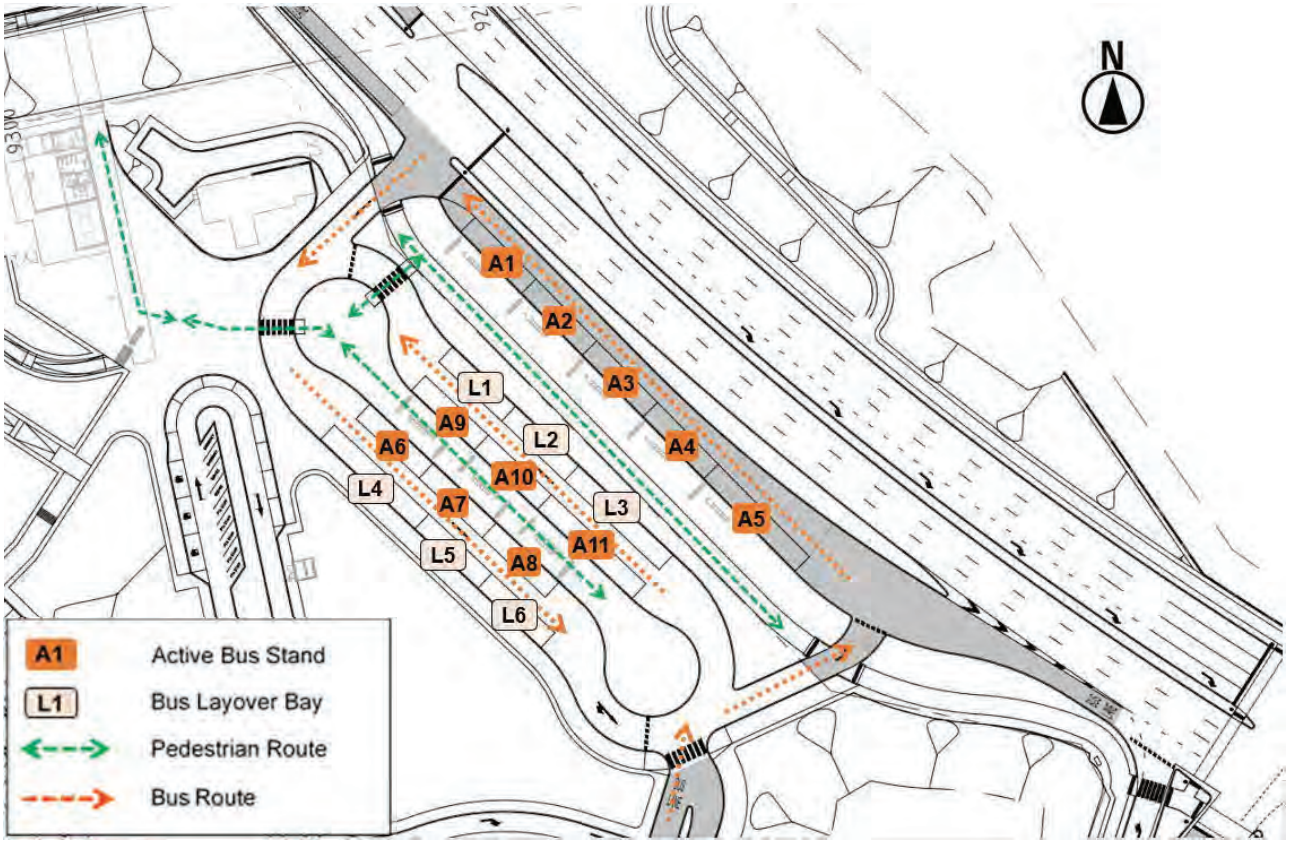
Murdoch (so may be 10 in peak flow, 15 min contraflow). The main exception is Route 518 which is more biased to Cockburn Central. A number of short working services will extend to and from Ranford Station.

4.6.1 BUS INTERCHANGE

The bus interchange at Ranford Station will be located to the south of the station platforms on the east of the rail corridor. The Schedule of Accommodation details that the bus interchange should include a minimum of 11 active bays (which includes 2 articulated bay) and at least 6 layover bays (including 2 articulated bay). The proposed design satisfies these requirements and provides an additional standard size active bay over and above the minimum requirements within the bus bay arrangement in a space efficient dog-bone configuration, that also allows for full recirculation of buses within the bus interchange.

Figure 17 illustrates how Transperth buses and pedestrians will integrate within the bus interchange and the potential location of the active and layover bays.

Figure 17. Proposed Bus Interchange Layout



4.7 PEDESTRIAN & CYCLE ACCESS

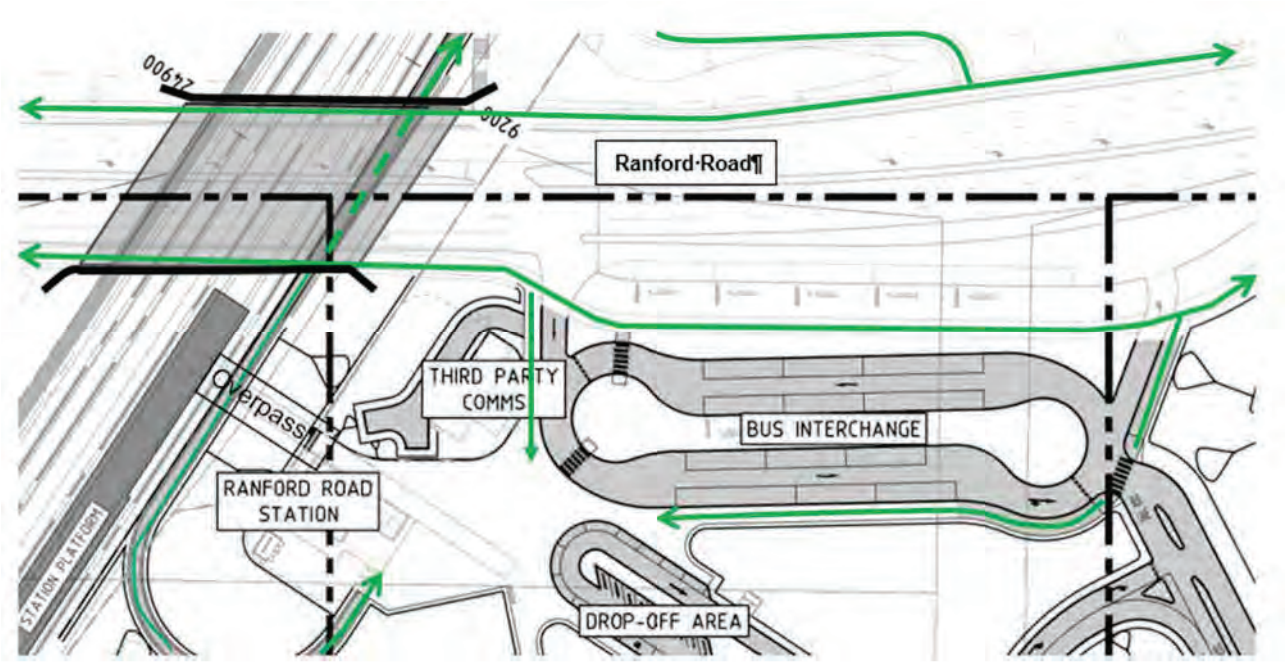
4.7.1 NORTH-SOUTH CONNECTIVITY

A major element of the METRONET TCL project is the provision of a new shared path along the station side of Ranford Road, and a new section of shared path heading north-east from the station plaza along the rail corridor, providing a grade-separated pedestrian and cycling connection under the Ranford Road bridge to connect to existing paths on the eastern side of Ranford Road. The proposed routes will provide direct and comfortable access between the Station and Canning Vale industrial areas to the north, and residential areas north of Roe Highway and south along either side of Ranford Road. A new signalised intersection at JELR and Ranford Road is also planned near the station, which will include safe crossing facilities for active modes across Ranford and JELR.

The proposed 4.0 metre wide shared path will tie in with the existing City of Canning RSP south of Livingstone Drive. The shared path below the bridge is proposed to be 3 metres wide to tie in with the existing path adjacent to the rail corridor.

The proposed station design reduces direct conflict between 'through' shared path users along the rail corridor and passenger movements at the station plaza, as a station overpass is provided between the station plaza and the platforms, which passes over the shared path along the rail alignment. The shared path along Ranford Road is located away from the Station plaza, with slow speed shared paths provided access to and from the Station for passengers.

Figure 18. Ranford Station – Shared Path Alignment and Station Connections



4.8 CYCLE PARKING AND END OF TRIP FACILITIES

As per the Schedule of Accommodation for Ranford Road Station referenced in the Thornlie Cockburn Link Scope of Work and Technical Criteria document (Book 3B Section 27.1.7 Table 2), the bicycle parking provision within the Ranford Station concept design is summarised below:

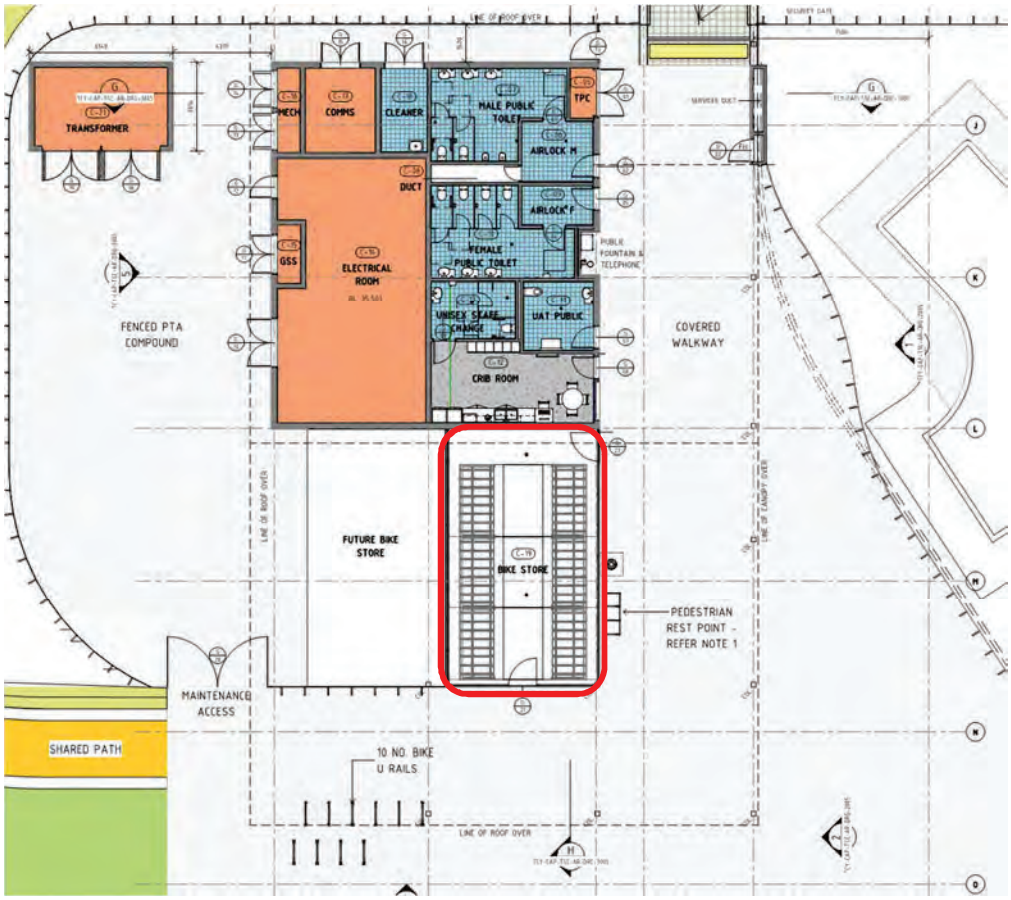
- 10 bicycle U-rails (distributed equally on both east and west sides of the station building entry).

- 1 x 96 bicycle capacity secure parking shelters (PTA standard 00-A-09-0159-TYPE B Module Arrangement).
- Allowance for future inclusion of 1x additional 96 bicycle capacity secure shelter.

Note that no showers or change rooms are required to be provided as part of the Schedule of Accommodation for Ranford Station. Similarly, secure locker facilities are not required to be provided.

The proposed bike shelter locations are highlighted in Figure 19.

Figure 19. Bicycle Storage Location



From Architectural 15% Design Drawing TCY-CAP-TSC-AR-DRG-1011

4.9 VEHICLE PARKING

As per the Schedule of Accommodation for Ranford Station referenced in the Thornlie Cockburn Link Scope of Work and Technical Criteria document, the vehicle parking provision within the Ranford Road Station design is summarised in Table 15.

Table 15. Ranford Station Parking Provision

Type		Provision
Total car parking bays (minimum)		400
Long Term Parking	Standard parking bays	392
	Accessible bays (ACROD)	6
	Motorcycle bays	5
	Electric car charging bays	2
Drop-off Parking	Drop-off bays (Kiss & Ride)	9
	Accessible bays (ACROD)	2
	Combined Accessible/ Accessible Taxi drop off bay (ACROD)	1

The following service bays are provided for use by PTA staff and other emergency services for the safe and ongoing operation of the station (in accordance with Schedule of Accommodation requirements).

- 2 emergency service bays (ambulance and state transit police).
- 1 fire response vehicle bay (in accordance with DFES requirements).
- 5 PTA Staff parking bays.
- 2 PTA Servicing bays.

4.10 SERVICE VEHICLE ACCESS

4.10.1 EMERGENCY VEHICLE ACCESS

The Ranford Road Station concept design will include allowance for one emergency fire response vehicle bay within close proximity to the main station building area. The location of the bay is also required to be within a suitable distance to the fire booster cabinet, to allow connection to the fire services infrastructure.

The proposed location of the Department of Fire and Emergency Services (DFES) hardstand area is currently being finalised through the development of the Ranford Station Fire Engineering documentation, which will enable NEWest to enter consultation with DFES to confirm the requirements. Access is proposed via the proposed Ranford Road Station Bus Interchange.

4.11 ROAD SAFETY

A pre-opening road safety audit will be required as a final check to ensure that the new roads have been adequately designed to meet relevant local design standards and to identify any safety issues which may require additional modification prior to 100% design. It is expected that all new roads will be assessed in detail, along with any new connections to the existing road network. At this stage it would be anticipated that any issues raised in the road safety audit can be rectified with minor modifications as part of the review process, however this will likely be dependent on the specifics of the audit process.

5. CONCLUSION

NEWest has prepared this Transport Impact Assessment in order to document the Station access elements and support the Development Application submission for the proposed Ranford Station development, as part of the wider METRONET Thornlie-Cockburn Link (TCL) project.

This study examines the function and operation of access to and from the new Ranford Station site, for all modes of transport. Ranford Station will provide a new Bus n Ride and Park n Ride Station which serves the wider residential and industrial employment area, compatible with a classification as a SP6 Transit Node Station Precinct Typology.

To support the station access and precinct typologies, Ranford Station includes a 400 bay Park & Ride facility, allowing for long term parking for passengers to access the Station, along with a bus interchange providing 11 active bus bays, and an efficient short term parking zone for drop off and pick up of passengers which will provide adequate facilities to service the anticipated patronage and access mode splits. The provision of shared path connections to the new Station will support active modes from residential and employment activities within the walking and cycling catchment.

The main access route to the station is Ranford Road. Ranford Road is currently operating at capacity with long queuing observed in the peak direction (northbound in the AM peak and southbound in the PM peak) on the daily basis, largely due to the northbound congestion at the Bannister Road intersection and South Street/ Roe Highway interchange, and inadequate southbound capacity at Waratah Boulevard intersection.

In 2021 for the Station opening, the proposed Ranford Road Station is forecast to generate 400-500 car trips in the AM peak and 250-300 car trips in the PM peak, all of which will originate via Ranford Road, and access the site via the short segment of JELR. By 2031 when it is anticipated the JELR will be constructed (south-west of the Station), an estimated 90% of the station traffic will approach the site via Ranford Road, with the remaining 10% approaching via the JELR (south-west of the Station).

The traffic analysis indicates that the intersection of Ranford Road/ JELR would operate acceptably in 2021, although the right turn movements on Ranford Road and JELR (essentially the traffic to and from the station) will experience long delays due to the long cycle time adopted in the analysis to enable signal coordination along Ranford Road. A high degree of saturation was reported on Ranford Road northbound in the AM peak due to the upstream capacity constraints, indicating this road is expected to be operating at its capacity. The Bus Right Turn intersection would perform satisfactorily in both AM and PM peak periods in 2021.

In the 2031 scenario, long queuing and high degree of saturation were reported on Ranford Road, largely due to the high background traffic demand in the peak direction. The 95th percentile eastbound queuing on JELR at Ranford Road intersection is forecast to extend back to the station access on JELR. A second left turn lane from JELR eastbound to Ranford Road has been considered, but this requires the left turn movement to be signalised. SIDRA analysis results showed that although the eastbound queuing on JELR can be reduced with this second lane in the AM peak, the delay would increase significantly in both AM and PM peak due to the signalisation. It should be noted that most of the left turn demand on JELR is forecast to originate from the future land development aspiration along JELR, and as the scale and timing of the development may change, this should be monitored and assessed again as the development plans are confirmed. The Bus Right Turn intersection and the Station Access intersection on JELR would perform satisfactorily in both AM and PM peak periods in 2031.

The SWTC criteria can be satisfied with the proposed design in both 2021 and 2031 scenarios.

5.1 APPENDICES

Table 16: Appendix List

Appendix Reference	Appendix Title
A	SIDRA Analysis

Appendix A: SIDRA Analysis

2021 AM Peak with Ranford Road Station

MOVEMENT SUMMARY

Site: 102 [2021 AM JELR]

Network: N101 [2021 AM]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 165 seconds (Network User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
1	L2	281	0.0	281	0.0	0.166	7.0	LOS A	1.4	10.1	0.11	0.62	0.11	55.3
2	T1	3056	6.0	3056	6.0	* 0.920	24.6	LOS C	64.3	499.3	0.65	0.66	0.71	36.6
Approach		3337	5.5	3337	5.5	0.920	23.2	LOS C	64.3	499.3	0.61	0.66	0.66	37.9
NorthWest: Ranford Rd SB														
8	T1	1021	12.9	1021	12.9	0.280	3.9	LOS A	7.5	62.8	0.26	0.23	0.26	63.5
9	R2	12	25.0	12	25.0	* 0.223	96.5	LOS F	1.0	9.3	1.00	0.69	1.00	11.4
Approach		1033	13.1	1033	13.1	0.280	5.0	LOS A	7.5	62.8	0.26	0.23	0.26	61.8
SouthWest: JELR EB														
10	L2	75	4.0	75	4.0	0.092	22.9	LOS C	2.7	20.7	0.52	0.68	0.52	18.7
12	R2	54	55.6	54	55.6	* 0.326	81.7	LOS F	2.4	35.6	0.95	0.72	0.95	20.4
Approach		129	25.6	129	25.6	0.326	47.5	LOS D	2.7	35.6	0.70	0.70	0.70	19.9
All Vehicles		4499	7.8	4499	7.8	0.920	19.7	LOS B	64.3	499.3	0.53	0.56	0.57	41.9

MOVEMENT SUMMARY

Site: 101 [2021 AM Bus Right Turn]

Network: N101 [2021 AM]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 165 seconds (Network User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
2	T1	3131	6.0	3131	6.0	* 0.751	5.0	LOS A	20.3	158.0	0.49	0.45	0.49	62.6
Approach		3131	6.0	3131	6.0	0.751	5.0	LOS A	20.3	158.0	0.49	0.45	0.49	62.6
NorthWest: Ranford Rd SB														
8	T1	1033	13.1	1033	13.1	0.192	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
9	R2	30	100.0	30	100.0	* 0.456	53.3	LOS D	1.3	20.0	0.99	0.74	0.99	33.0
Approach		1063	15.5	1063	15.5	0.456	1.6	LOS A	1.3	20.0	0.03	0.02	0.03	66.1
All Vehicles		4194	8.4	4194	8.4	0.751	4.1	LOS A	20.3	158.0	0.37	0.34	0.37	63.3

2021 PM Peak with Ranford Road Station

MOVEMENT SUMMARY

Site: 102 [2021 PM JELR] — Network: N101 [2021 PM]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 190 seconds (Network User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
1	L2	21	0.0	21	0.0	0.012	7.0	LOS A	0.1	0.8	0.09	0.60	0.09	59.2
2	T1	1252	8.9	1252	8.9	0.317	10.7	LOS B	13.7	108.0	0.40	0.36	0.40	55.9
Approach		1273	8.8	1273	8.8	0.317	10.6	LOS B	13.7	108.0	0.40	0.36	0.40	56.0
NorthWest: Ranford Rd SB														
8	T1	2827	4.9	2827	4.9	* 0.725	9.1	LOS A	42.1	326.4	0.45	0.43	0.45	61.0
9	R2	39	0.0	39	0.0	0.329	100.9	LOS F	3.6	26.2	0.99	0.74	0.99	11.1
Approach		2866	4.8	2866	4.8	0.725	10.4	LOS B	42.1	326.4	0.46	0.43	0.46	59.7
SouthWest: JELR EB														
10	L2	10	0.0	10	0.0	0.008	7.1	LOS A	0.1	0.8	0.16	0.58	0.16	35.7
12	R2	218	13.8	218	13.8	* 0.438	92.1	LOS F	8.2	60.3	0.97	0.78	0.97	24.4
Approach		228	13.2	228	13.2	0.438	88.4	LOS F	8.2	60.3	0.94	0.77	0.94	24.4
All Vehicles		4367	6.4	4367	6.4	0.725	14.5	LOS B	42.1	326.4	0.47	0.43	0.47	54.7

MOVEMENT SUMMARY

Site: 101 [2021 PM Bus Right Turn] — Network: N101 [2021 PM]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 190 seconds (Network User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
2	T1	1262	8.9	1262	8.9	* 0.298	3.3	LOS A	4.4	34.6	0.25	0.22	0.25	64.9
Approach		1262	8.9	1262	8.9	0.298	3.3	LOS A	4.4	34.6	0.25	0.22	0.25	64.9
NorthWest: Ranford Rd SB														
8	T1	2866	4.8	2866	4.8	0.502	0.2	LOS A	3.2	24.8	0.00	0.00	0.00	69.5
9	R2	30	100.0	30	100.0	* 0.300	53.8	LOS D	1.4	21.3	0.96	0.74	0.96	32.9
Approach		2896	5.8	2896	5.8	0.502	0.8	LOS A	3.2	24.8	0.01	0.01	0.01	68.1
All Vehicles		4158	6.7	4158	6.7	0.502	1.5	LOS A	4.4	34.6	0.08	0.07	0.08	66.9

2031 AM Peak without Ranford Road Station

MOVEMENT SUMMARY

Site: 102 [2031 AM JELR_WO Station]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 165 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
1	L2	359	44	359	12.3	0.258	8.3	LOS A	4.0	33.6	0.19	0.63	0.19	57.1
2	T1	2738	165	2738	6.0	* 0.894	22.8	LOS C	56.8	441.0	0.68	0.66	0.72	55.0
Approach		3097	209	3097	6.7	0.894	21.2	LOS C	56.8	441.0	0.62	0.66	0.65	55.1
NorthWest: Ranford Rd SB														
8	T1	973	152	973	15.6	0.275	4.2	LOS A	7.4	62.7	0.26	0.24	0.26	66.6
9	R2	114	14	114	12.3	* 0.880	101.1	LOS F	10.2	85.3	1.00	0.94	1.34	22.8
Approach		1087	166	1087	15.3	0.880	14.3	LOS B	10.2	85.3	0.34	0.31	0.38	59.1
SouthWest: JELR EB														
10	L2	420	51	420	12.1	0.499	25.9	LOS C	19.3	161.2	0.67	0.78	0.67	43.3
12	R2	164	20	164	12.2	* 0.464	81.9	LOS F	6.4	53.2	0.98	0.78	0.98	25.9
Approach		584	71	584	12.2	0.499	41.6	LOS D	19.3	161.2	0.76	0.78	0.76	36.4
All Vehicles		4768	446	4768	9.4	0.894	22.1	LOS C	56.8	441.0	0.58	0.59	0.60	53.7

2031 PM Peak without Ranford Road Station

MOVEMENT SUMMARY

Site: 102 [2031 PM JELR_WO Station]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 190 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
1	L2	135	9	135	6.7	0.110	10.5	LOS B	2.6	20.4	0.26	0.65	0.26	55.4
2	T1	1146	108	1146	9.4	0.514	45.2	LOS D	25.5	202.6	0.81	0.71	0.81	45.4
Approach		1281	117	1281	9.1	0.514	41.6	LOS D	25.5	202.6	0.75	0.70	0.75	45.9
NorthWest: Ranford Rd SB														
8	T1	2641	158	2641	6.0	* 0.739	10.7	LOS B	50.0	387.9	0.48	0.45	0.48	62.9
9	R2	315	20	315	6.3	0.518	59.0	LOS E	22.9	180.2	0.85	0.83	0.85	31.5
Approach		2956	178	2956	6.0	0.739	15.9	LOS B	50.0	387.9	0.52	0.49	0.52	59.0
SouthWest: JELR EB														
10	L2	145	9	145	6.2	0.139	11.1	LOS B	3.7	29.2	0.32	0.65	0.32	53.6
12	R2	330	21	330	6.4	* 0.730	91.9	LOS F	14.9	117.3	1.00	0.85	1.05	24.2
Approach		475	30	475	6.3	0.730	67.3	LOS E	14.9	117.3	0.79	0.79	0.83	29.1
All Vehicles		4712	325	4712	6.9	0.739	28.0	LOS C	50.0	387.9	0.61	0.58	0.61	51.4

2031 AM Peak with Ranford Road Station

MOVEMENT SUMMARY

Site: 102 [2031 AM JELR]

Network: N101 [2031 AM]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 165 seconds (Network User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
1	L2	653	6.7	653	6.7	0.447	9.5	LOS A	9.1	72.2	0.26	0.68	0.26	57.2
2	T1	2738	6.0	2738	6.0	* 0.957	49.0	LOS D	72.2	560.8	0.70	0.79	0.88	32.6
Approach		3391	6.2	3391	6.2	0.957	41.4	LOS D	72.2	560.8	0.62	0.77	0.76	35.4
NorthWest: Ranford Rd SB														
8	T1	943	12.9	943	12.9	0.263	4.3	LOS A	7.2	60.4	0.27	0.24	0.27	64.8
9	R2	127	13.4	127	13.4	* 0.926	107.9	LOS F	11.9	101.0	1.00	0.99	1.44	6.9
Approach		1070	13.0	1070	13.0	0.926	16.6	LOS B	11.9	101.0	0.35	0.33	0.41	52.0
SouthWest: JELR EB														
10	L2	531	10.2	531	10.2	0.652	29.9	LOS C	28.4	232.4	0.78	0.82	0.78	15.5
12	R2	229	21.8	229	21.8	* 0.522	81.6	LOS F	7.7	63.2	0.98	0.78	0.98	25.9
Approach		760	13.7	760	13.7	0.652	45.4	LOS D	28.4	232.4	0.84	0.81	0.84	21.7
All Vehicles		5221	8.7	5221	8.7	0.957	36.9	LOS D	72.2	560.8	0.59	0.69	0.70	36.5

MOVEMENT SUMMARY

Site: 101 [2031 AM Bus Right Turn]

Network: N101 [2031 AM]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 165 seconds (Network User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
2	T1	3270	6.7	3270	6.7	* 0.762	5.6	LOS A	23.4	183.6	0.57	0.54	0.57	61.8
Approach		3270	6.7	3270	6.7	0.762	5.6	LOS A	23.4	183.6	0.57	0.54	0.57	61.8
NorthWest: Ranford Rd SB														
8	T1	1070	13.0	1070	13.0	0.198	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
9	R2	30	100.0	30	100.0	* 0.456	53.3	LOS D	1.3	20.0	0.99	0.74	0.99	33.0
Approach		1100	15.4	1100	15.4	0.456	1.5	LOS A	1.3	20.0	0.03	0.02	0.03	66.3
All Vehicles		4370	8.9	4370	8.9	0.762	4.5	LOS A	23.4	183.6	0.44	0.41	0.44	62.6

MOVEMENT SUMMARY

Site: 103 [2031 AM Station Access]

Network: N101 [2031 AM]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: JELR WB														
11	T1	472	12.3	472	12.3	0.131	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
12	R2	308	1.0	308	1.0	0.432	11.0	LOS B	2.3	16.9	0.64	0.92	0.87	29.5
Approach		780	7.8	780	7.8	0.432	4.4	NA	2.3	16.9	0.25	0.37	0.34	50.8
NorthWest: Station Access SB														
1	L2	177	18.6	177	18.6	0.327	7.1	LOS A	1.0	8.9	0.55	0.77	0.61	20.0
3	R2	1	0.0	1	0.0	0.013	48.0	LOS E	0.0	0.3	0.92	0.96	0.92	24.2
Approach		178	18.5	178	18.5	0.327	7.3	LOS A	1.0	8.9	0.56	0.77	0.61	20.2
SouthWest: JELR EB														
4	L2	34	0.0	34	0.0	0.021	6.4	LOS A	0.1	0.7	0.36	0.54	0.36	47.2
5	T1	584	12.2	584	12.2	0.430	0.2	LOS A	0.0	0.0	0.00	0.00	0.00	59.6
Approach		618	11.5	618	11.5	0.430	0.6	LOS A	0.1	0.7	0.02	0.03	0.02	58.6
All Vehicles		1576	10.5	1576	10.5	0.432	3.2	NA	2.3	16.9	0.20	0.28	0.25	52.6

2031 PM Peak with Ranford Road Station

MOVEMENT SUMMARY

Site: 102 [2031 PM JELR]

Network: N101 [2031 PM]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 190 seconds (Network User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
1	L2	165	5.5	165	5.5	0.137	11.9	LOS B	3.8	29.5	0.30	0.66	0.30	54.6
2	T1	1146	9.4	1146	9.4	0.601	54.6	LOS D	28.1	223.1	0.88	0.77	0.88	30.6
Approach		1311	8.9	1311	8.9	0.601	49.2	LOS D	28.1	223.1	0.81	0.76	0.81	32.4
NorthWest: Ranford Rd SB														
8	T1	2611	5.0	2611	5.0	* 0.803	20.5	LOS C	42.0	326.4	0.59	0.55	0.59	55.0
9	R2	371	5.4	371	5.4	0.595	59.8	LOS E	27.7	215.6	0.88	0.84	0.88	11.5
Approach		2982	5.1	2982	5.1	0.803	25.4	LOS C	42.0	326.4	0.63	0.59	0.63	49.3
SouthWest: JELR EB														
10	L2	156	5.8	156	5.8	0.140	12.1	LOS B	4.4	34.2	0.34	0.65	0.34	27.7
12	R2	553	9.2	553	9.2	* 0.803	91.9	LOS F	25.4	194.9	0.99	0.88	1.06	25.1
Approach		709	8.5	709	8.5	0.803	74.3	LOS E	25.4	194.9	0.85	0.83	0.90	25.2
All Vehicles		5002	6.6	5002	6.6	0.803	38.6	LOS D	42.0	326.4	0.71	0.67	0.71	39.4

MOVEMENT SUMMARY

Site: 101 [2031 PM Bus Right Turn]

Network: N101 [2031 PM]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 190 seconds (Network User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Ranford Rd NB														
2	T1	1302	9.0	1302	9.0	* 0.312	1.3	LOS A	1.9	15.2	0.10	0.09	0.10	67.9
Approach		1302	9.0	1302	9.0	0.312	1.3	LOS A	1.9	15.2	0.10	0.09	0.10	67.8
NorthWest: Ranford Rd SB														
8	T1	2982	5.0	2982	5.0	0.615	0.4	LOS A	22.4	173.5	0.00	0.00	0.00	69.1
9	R2	30	100.0	30	100.0	* 0.300	53.4	LOS D	1.4	21.7	0.96	0.74	0.96	33.0
Approach		3012	5.9	3012	5.9	0.615	0.9	LOS A	22.4	173.5	0.01	0.01	0.01	67.8
All Vehicles		4314	6.8	4314	6.8	0.615	1.0	LOS A	22.4	173.5	0.04	0.03	0.04	67.8

MOVEMENT SUMMARY

Site: 103 [2031 PM Station Access]

Network: N101 [2031 PM]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: JELR WB														
11	T1	449	6.5	449	6.5	0.120	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
12	R2	87	0.0	87	0.0	0.101	8.0	LOS A	0.3	2.4	0.43	0.69	0.43	33.4
Approach		536	5.4	536	5.4	0.120	1.3	NA	0.3	2.4	0.07	0.11	0.07	57.2
NorthWest: Station Access SB														
1	L2	234	12.8	234	12.8	0.281	5.6	LOS A	1.0	8.5	0.47	0.64	0.47	22.9
3	R2	22	0.0	22	0.0	0.107	20.6	LOS C	0.4	2.6	0.80	0.90	0.80	35.9
Approach		256	11.7	256	11.7	0.281	6.9	LOS A	1.0	8.5	0.50	0.66	0.50	27.3
SouthWest: JELR EB														
4	L2	1	0.0	1	0.0	0.001	5.8	LOS A	0.0	0.0	0.17	0.49	0.17	48.1
5	T1	475	6.3	475	6.3	0.201	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		476	6.3	476	6.3	0.201	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		1268	7.0	1268	7.0	0.281	2.0	NA	1.0	8.5	0.13	0.18	0.13	55.4

APPENDIX F STATION CATCHMENT & MODE SHARE REVIEW

NEWest Alliance

Memorandum

Date	06-11-2020
To	Dusko Petrovich
From	Hugo Nilsson
CC	
Subject	Ranford Road Station Pedestrian Catchment Analysis Rev B

This memo outlines the methodology and findings for the pedestrian catchment analysis for Ranford Road Station on the planned Thornlie-Cockburn Link (TCL).

Ranford Road Station is proposed to be located adjacent to the current Ranford Road freight railway overpass as indicated in Figure 1. The surrounding land use is mostly industrial or open land with some residential land in Willetton and Leeming to the north and Canning Vale to the east.

Figure 1. Ranford Road Station Location

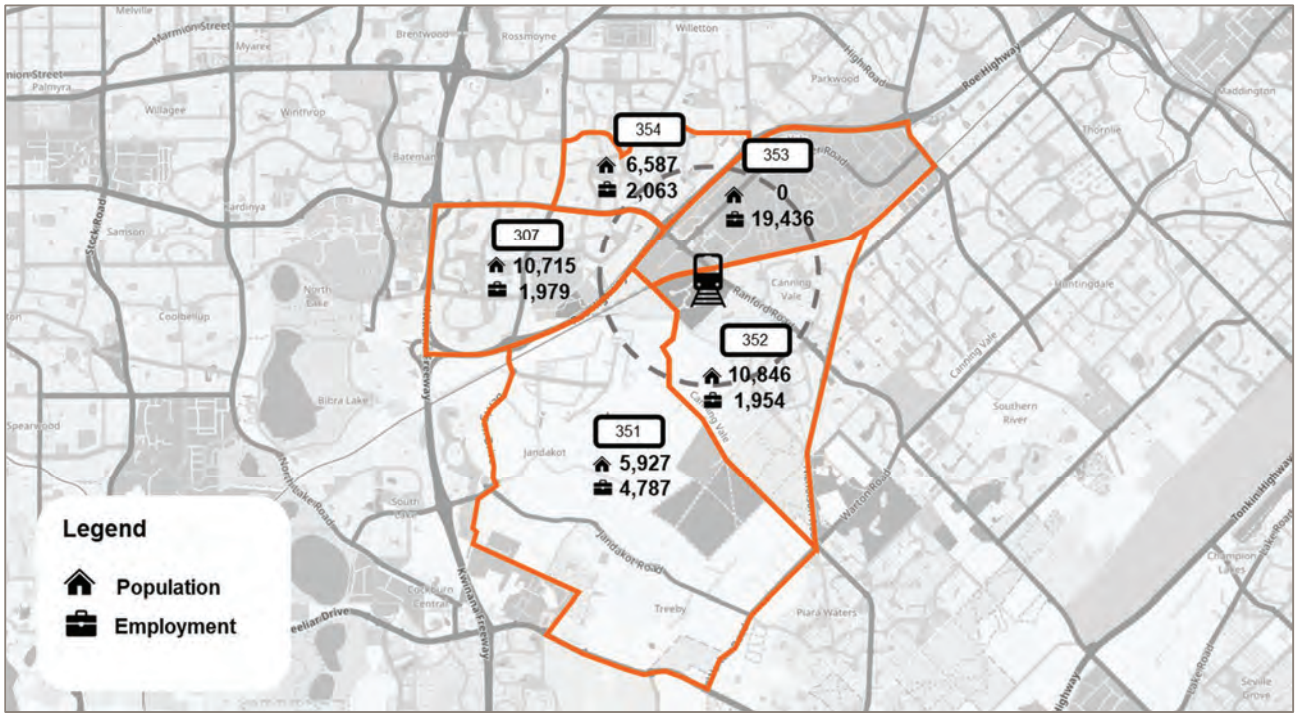
1. PEDESTRIAN CATCHMENT ANALYSIS

The pedestrian catchment analysis has aimed to identify the main potential sources of patronage demand accessing the station on foot and the likely resulting pedestrian desire lines. After identifying the extent of the potential pedestrian network catchment area, data related to the surrounding future population, employment and land use was used to determine the main pedestrian access 'approaches' to and from the station.

1.1 LAND USE AND PATRONAGE ORIGIN

Population and employment data were gathered from the 1.6.1 version of the Metropolitan Land Use Forecasting System (MLUFS). Data was gathered for zones within a 1.6-kilometre1 catchment from the station as shown in Figure 2.

Figure 2. MLUFS Zones and Population Data relevant to the Ranford Road Station Pedestrian Catchment



A desktop analysis was carried out to determine the proportion of area of each MLUFS zone falling within the potential 1.6-kilometre station catchment. The proportions were used to estimate the forecast residential population and employment numbers within the catchment, which subsequently served as an indication for the relative contribution of each MLUFS zone to the future station patronage. A summary of the analysis is provided in Table 1.

Table 1: MLUFS Zone Patronage Analysis – 2031 Data

MLUF-Zone	Residential Population	Employment	Total	Proportion of MLUFS Zone within Catchment	Total within Catchment	Relative Patronage Origin
307	10,715	1,979	12,694	10%	1,269	7%
351	5,927	4,787	10,714	5%	536	3%
352	10,846	1,954	12,800	40%	5,120	28%
353	-	19,436	19,436	45%	8,746	48%
354	6,587	2,063	8,650	30%	2,595	14%

[1] 1.6 kilometres represents the maximum extent of a 20-minute walking catchment (the actual 20-minute catchment will be less than this due to indirect walking routes or crossing barriers)

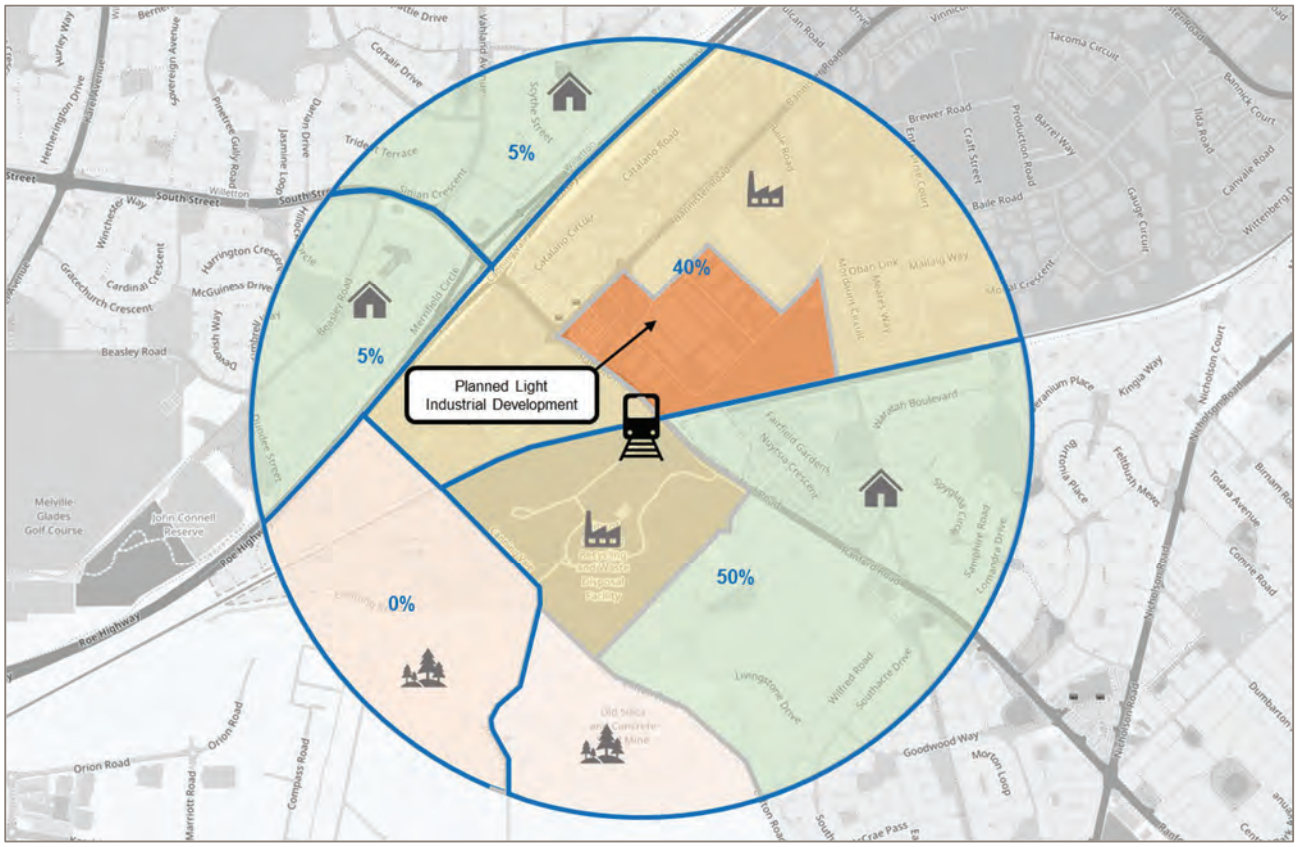
The patronage origin proportions were then revised to consider the existing land use and any proposed developments which would result in sections of a zone with higher density population or employment, or zones with non-urban areas with little or no population.

Patronage proportions were therefore reduced for the bush areas to the south-west of Ranford Road. Furthermore, the patronage percentage for residential areas on the north-west side of Roe Highway was reduced to reflect the likely perceived barrier effects of Roe Highway (despite the existing pedestrian route under the Roe Highway overpass) and the need for local residents to pass through industrial land alongside heavily trafficked Ranford Road to access the station. Assumed demand generated by the industrial area was also revised downwards (despite the plans to increase the amount of light industrial activity in this area) as it is assumed incoming workers to the industrial area are much less likely to use public transport than local residents, as staff parking is generally readily available at industrial sites and shift times often commence before the peak travel period.

Conversely, proportions were increased for the Canning Vale residential areas as this is assumed to be the major source of patronage.

The revised patronage origins, along with an overview of the surrounding land use and proposed developments are shown in Figure 3. As these proportions are derived from a high-level desktop analysis, they are subject to a degree of uncertainty.

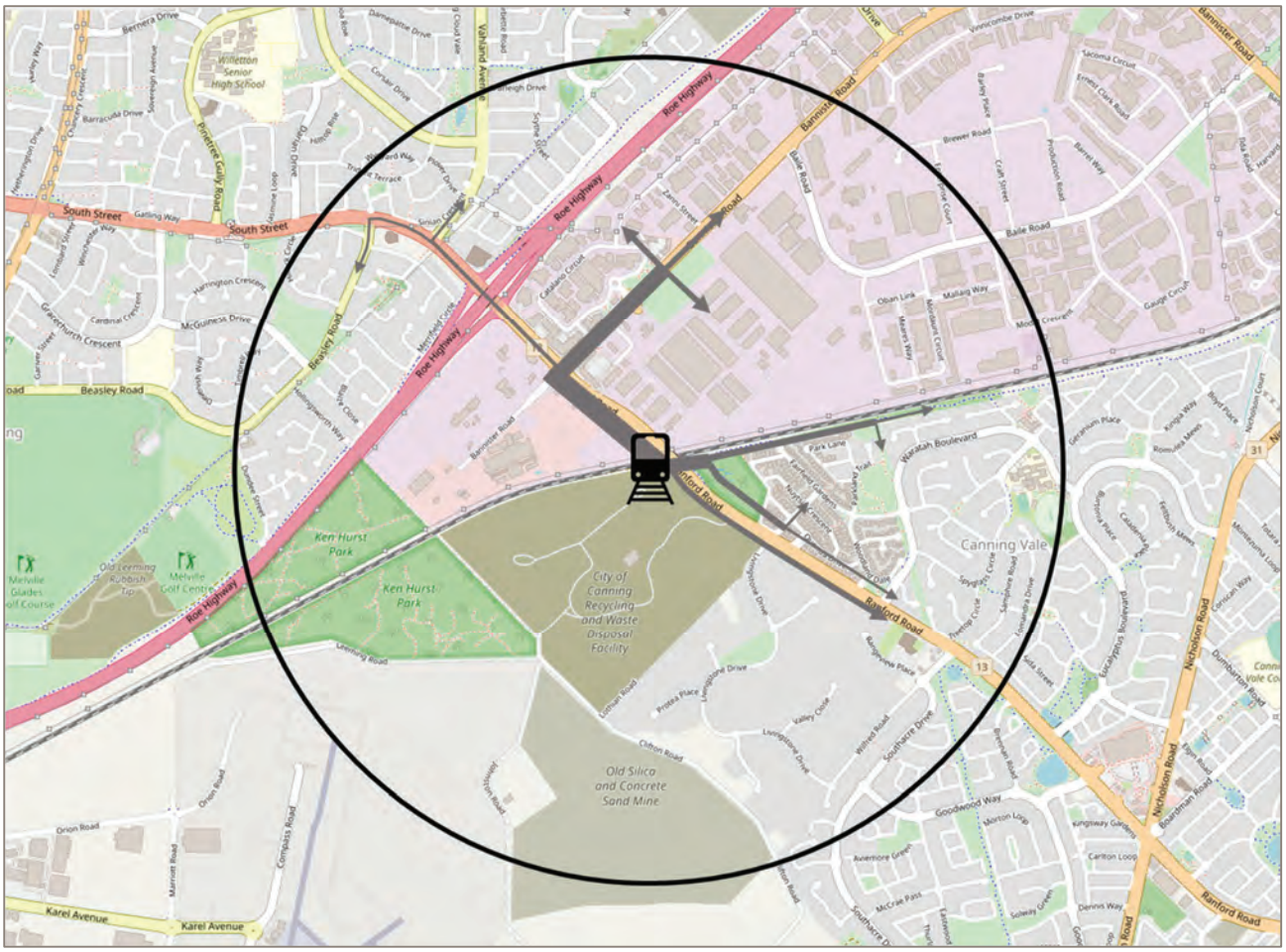
Figure 3. Surrounding Land Use and Proposed Patronage Origin Split



1.2 DESIRE LINES

The patronage origin proportions derived in Section 1.1 were used to estimate the main pedestrian desire lines to and from the station. As shown in Figure 4 the two main desire lines leads towards the industrial area to the north along Ranford Road and the Canning Vale residential areas via the proposed pedestrian underpass and along the southern side of Ranford Road (see Section 2.2).

Figure 4. Pedestrian Desire Lines



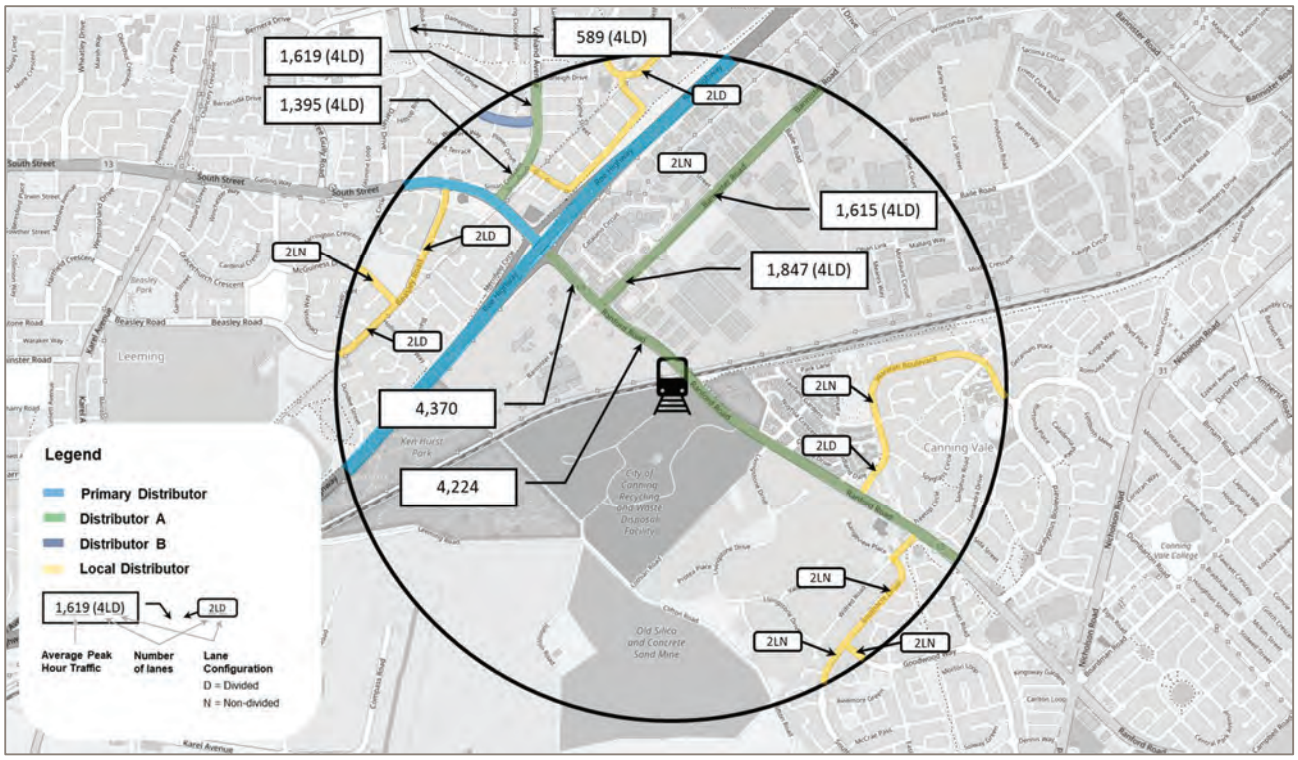
2. SURROUNDING TRANSPORT NETWORK

An analysis on the surrounding transport network has been carried out to assess the current and proposed pedestrian network along with any barrier effects caused by the road network in order to determine whether the network can provide sufficient opportunities for pedestrians to access the planned station.

2.1 ROAD NETWORK

An assessment was carried out to determine the barrier effects for pedestrians caused by the surrounding road network. The assessment is summarised in Figure 5 and highlights the road hierarchy and traffic volumes for the distributor network within the catchment.

Figure 5. Surrounding Road Network



Thresholds for traffic flows and lane configuration set out in the Public Transport Authority (PTA) Station Catchment Mapping Specifications were used to determine which sections of the road network that would likely cause barrier effects for pedestrian users and hinder easy crossing opportunities. A road was deemed to be a significant barrier and in need of formal crossing facilities if the traffic flow is more than:

- 1,100 vehicles per hour (VPH) with two lanes without division;
- 2,800 VPN with two lanes with division;
- 700 VPN with four lanes without division; and
- 1,600 VPN with four lanes with division.

The assessment further assumes that all primary distributor roads require formal crossing opportunities. In lack of traffic survey data, local distributors were classified as pedestrian road crossing barriers on an ad hoc basis through an assessment using Google Street view. The resulting road barriers are highlighted in Figure 6, with Ranford Road, Bannister Road and Roe Highway acting as the main road barriers to pedestrian movement.

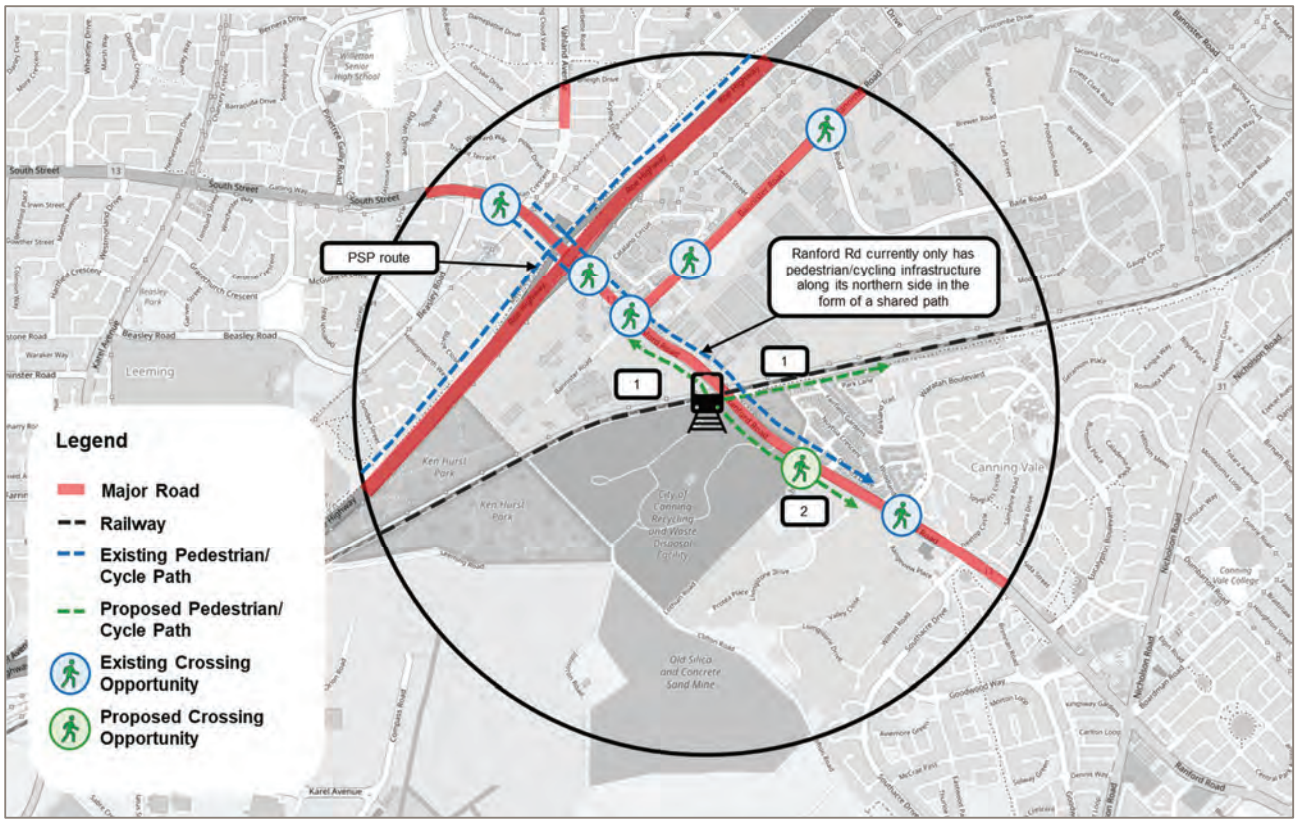
Figure 6. Pedestrian Road Barriers

2.2 PEDESTRIAN NETWORK

Figure 7 outlines the current and planned pedestrian provision within the catchment area. Currently, crossing opportunities are available across Ranford Road at intersections with Roe Highway and Bannister Road to the north of the station and at the intersection with Waratah Boulevard to the south of the station. A shared path is available along the northern side of Ranford Road. A Principal Shared Path (PSP) runs along the western side of Roe Highway and provides connections onto Ranford Road.

As a part of the overall station development a PSP is planned (highlighted as 1 in Figure 7), providing a north-south link, from which the industrial zone to the north can be accessed. This includes an underpass under Ranford Road, providing access to the Canning Vale residential areas and linking the new PSP and shared path along either side of Ranford Road. A new signalised intersection of the Jandakot East Link Road (JELR) and Ranford Road is also planned near the station (highlighted as 2 in Figure 7).

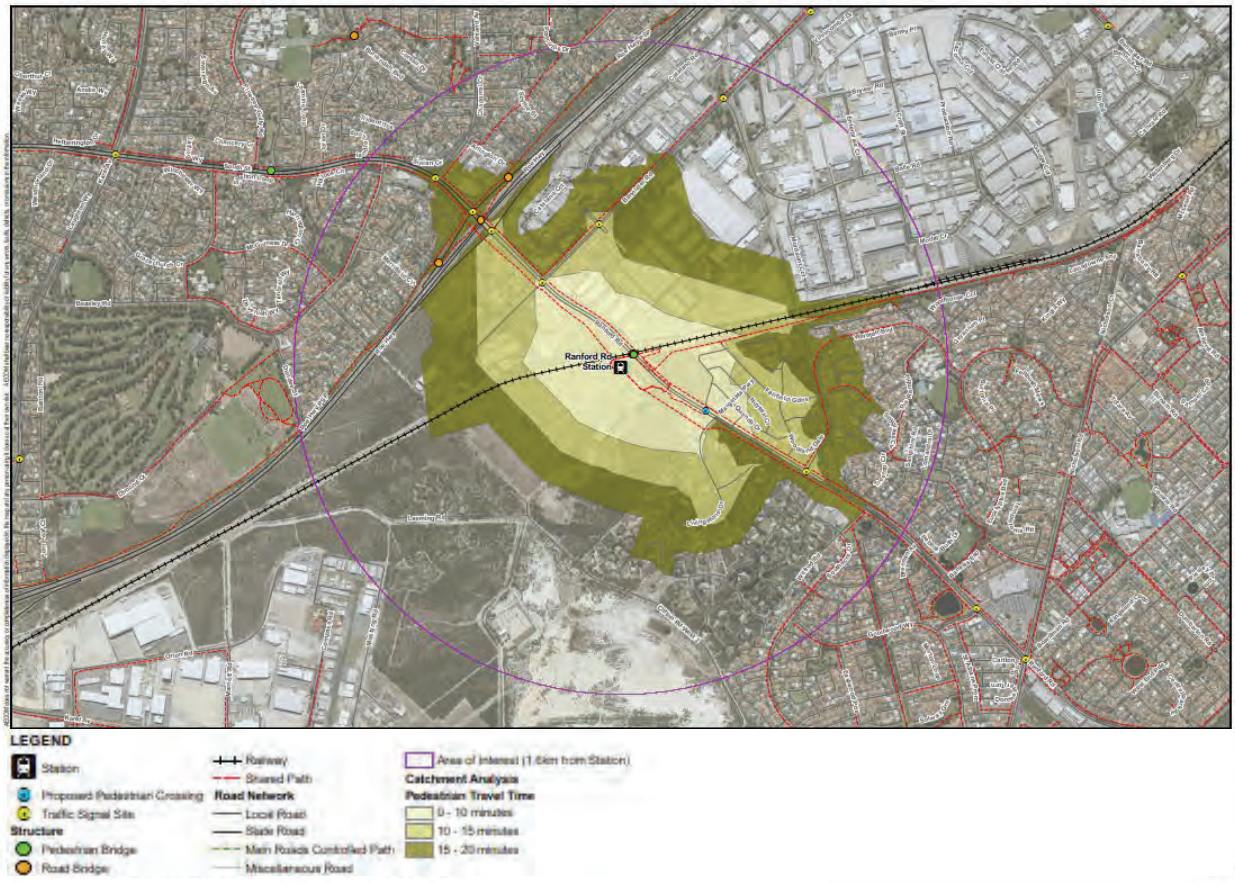
Figure 7. Current and Proposed Pedestrian Provision



2.3 STATION PEDESTRIAN CATCHMENT BASED ON ASSUMED PEDESTRIAN NETWORK

Figure 8 demonstrates the pedestrian network catchment area within a 10, 15 and 20 minutes-walk from the station assuming an average walk speed of 4.8 kilometres per hour. The catchments analysis includes the pedestrian network upgrades proposed as a part of the overall station development outlined in Section 2.2. As highlighted by Figure 3, most of the potential patronage demand is estimated to originate from the industrial zone to the north and the Canning Vale residential areas to the south and east. Large sections of these areas are included within the actual catchment, meaning that much of the potential demand will be able to access the station, provided that the proposed pedestrian infrastructure is put in place.

Figure 8. Pedestrian Network Catchment



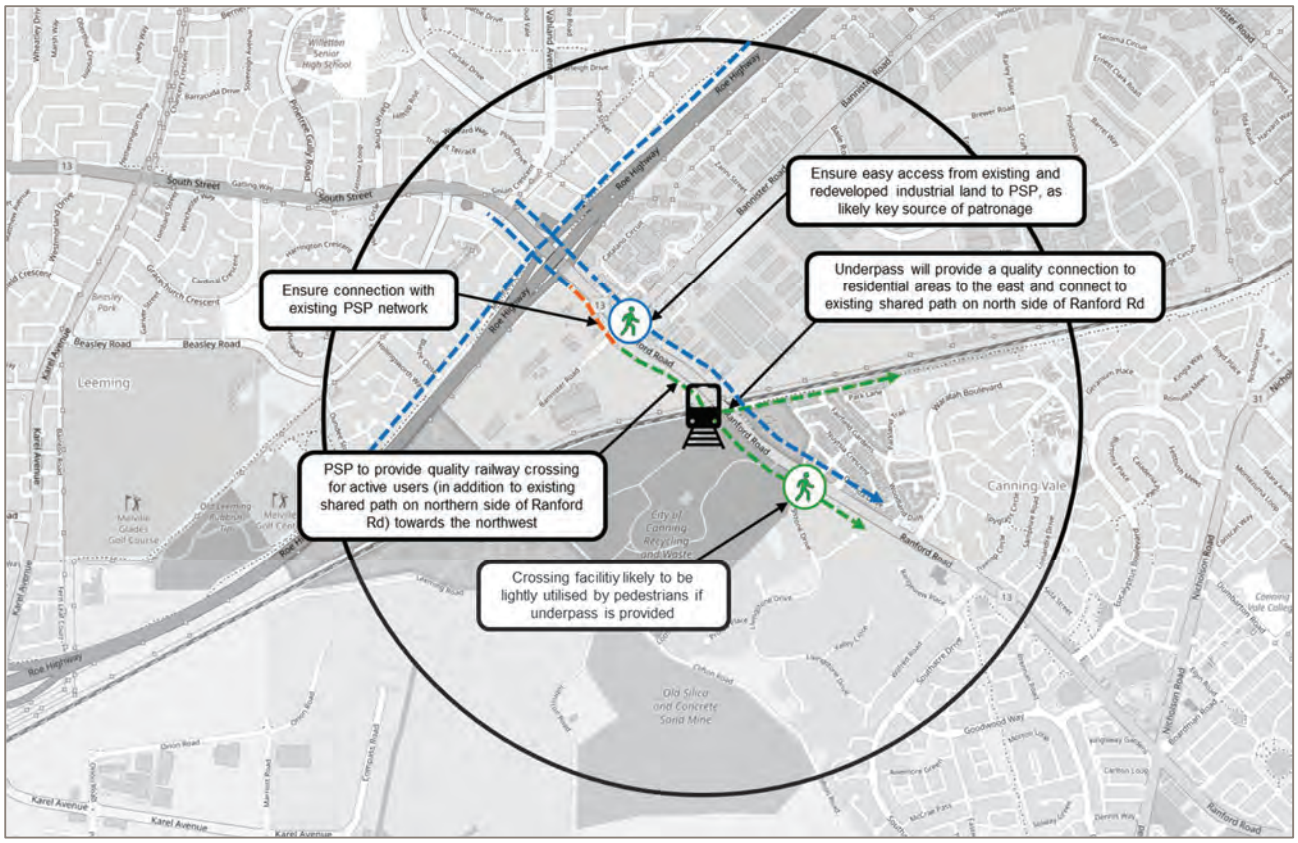
3. CONCLUSIONS

A summary of suggested pedestrian crossing measures is highlighted in Figure 9, to support the key pedestrian desire lines to the station and maximise the pedestrian catchment area. The planned pedestrian path/PSP along Ranford Road would provide a good quality link between the station and the industrial activities to the north via Bannister Road. Providing this link, together with enabling easier access via the Ranford Road underpass and the existing Ranford Road shared path, is essential as it is estimated that over a half of the demand will be generated from this area. The Ranford Road underpass would also create a direct link towards the residential areas in Canning Vale, which is estimated to contain another 35% of the patronage demand.

As a result of having the proposed grade separated underpass to cross Ranford Road near the station, the pedestrian crossing facilities across Ranford Road at the proposed JELR signalised intersection will be less utilised by pedestrians. However the pedestrian crossing facilities over the JELR lanes at this intersection are likely to have a higher demand, from pedestrian and cyclists travelling along the PSP and continuous shared path link along the south side of Ranford Road (connecting through to Nicholson Road) to the new station, and for cyclists travelling longer distances along the new PSP link past the station.

Further recommendations include ensuring a full integration of the station with the PSP link along Roe Highway and that the potential for increasing pedestrian priority at the intersection of Ranford Road and Bannister Road is investigated.

Figure 9. Suggested Measures



Memorandum

Date	06/11/2020
To	Willem du Toit,
From	Hugo Nilsson Teresa Matassa
CC	Thor Farnworth, John Caveill, Chris Deshon, Brad Sherlock, Param Lobana, Patrick Thompson, Gary Jones, Guy Smith, Martijn Van Het Kaar, Andy Godden Mason Bao, Thomas Beaver, Dusko Petrovich
Subject	**RANFORD ROAD STATION CATCHMENT AND MODE SHARE REVIEW**
Doc No.	**TCY-DJV-TSC-TM-MMO-0002**
Revision	**B**

1.0 Introduction

NEWest Alliance has been commissioned by METRONET to undertake a review of the catchment analysis for the Thornlie-Cockburn Link (TCL), based on the most recent land use, infrastructure and station design assumptions. This note summarises the data used and the methodology along with the findings in relation to mode specific patronage and associated parking requirements.

This note first considers the existing and forecast land use data and transport network to to assess the potential catchments and associated patronage for each mode (car, bus, cycle and walk). This is followed by a review of the likely effective mode shares, which, along with the forecast overall patronage volumes, will inform parking requirements.

The analysis in this note builds on previous work catchment analysis and transport assessment work out for the METRONET TCL project. This work is presented in the below documents, which will be referenced through this note:

- *Thornlie Rail Line Extension Strategic Access Planning* (Arup, 2018)
- *Thornlie – Cockburn Link Transport Assessment* (WSP, 2019)

Information relating to the assumed future infrastructure network and land use informing the catchment analysis has been gathered from online mapping as well as from the following the following sources:

- *City of Armadale Town Planning Scheme 4*
- *City of Canning Town Planning Scheme No. 42*
- *City of Cockburn Town Planning Scheme No. 3*
- *City of Gosnells Draft Local Planning Scheme 24*
- *City of Melville Local Planning Strategy (2021-2031)*

Overviews of the planning sources are provided in Figure 1 through to Figure 5

Memorandum

Figure 1: City of Armadale Town Planning Scheme 4

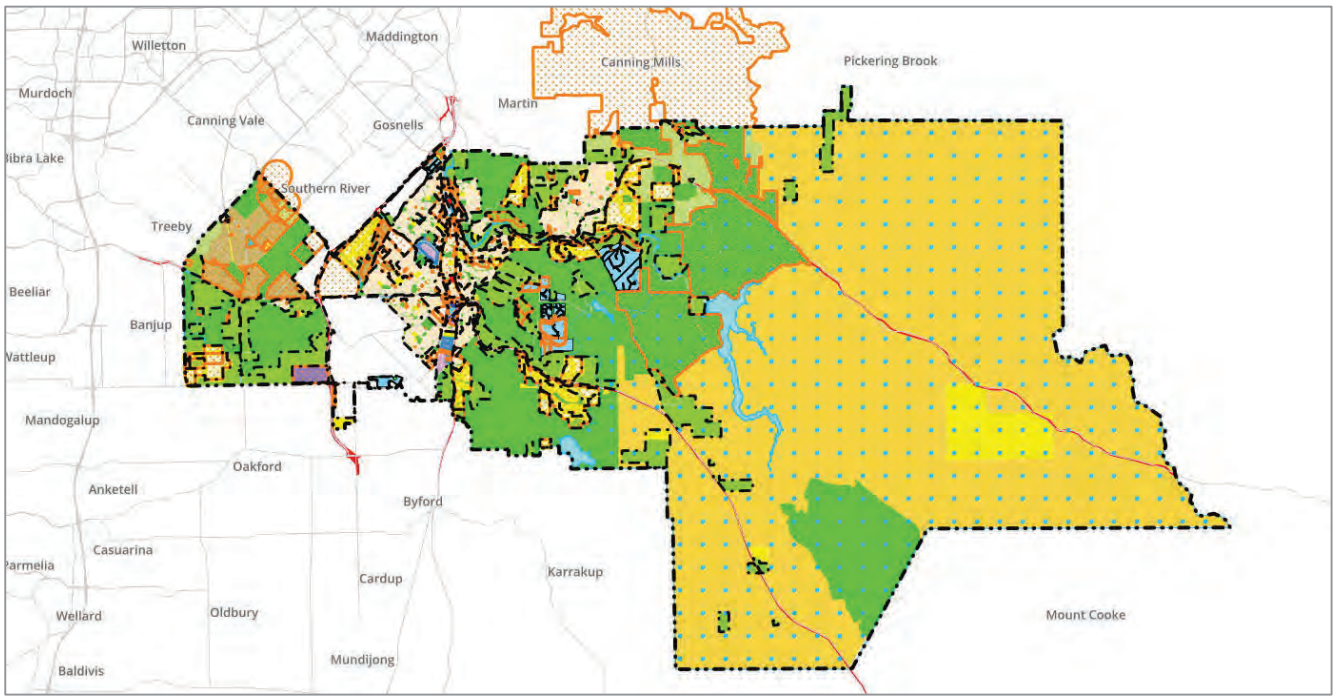
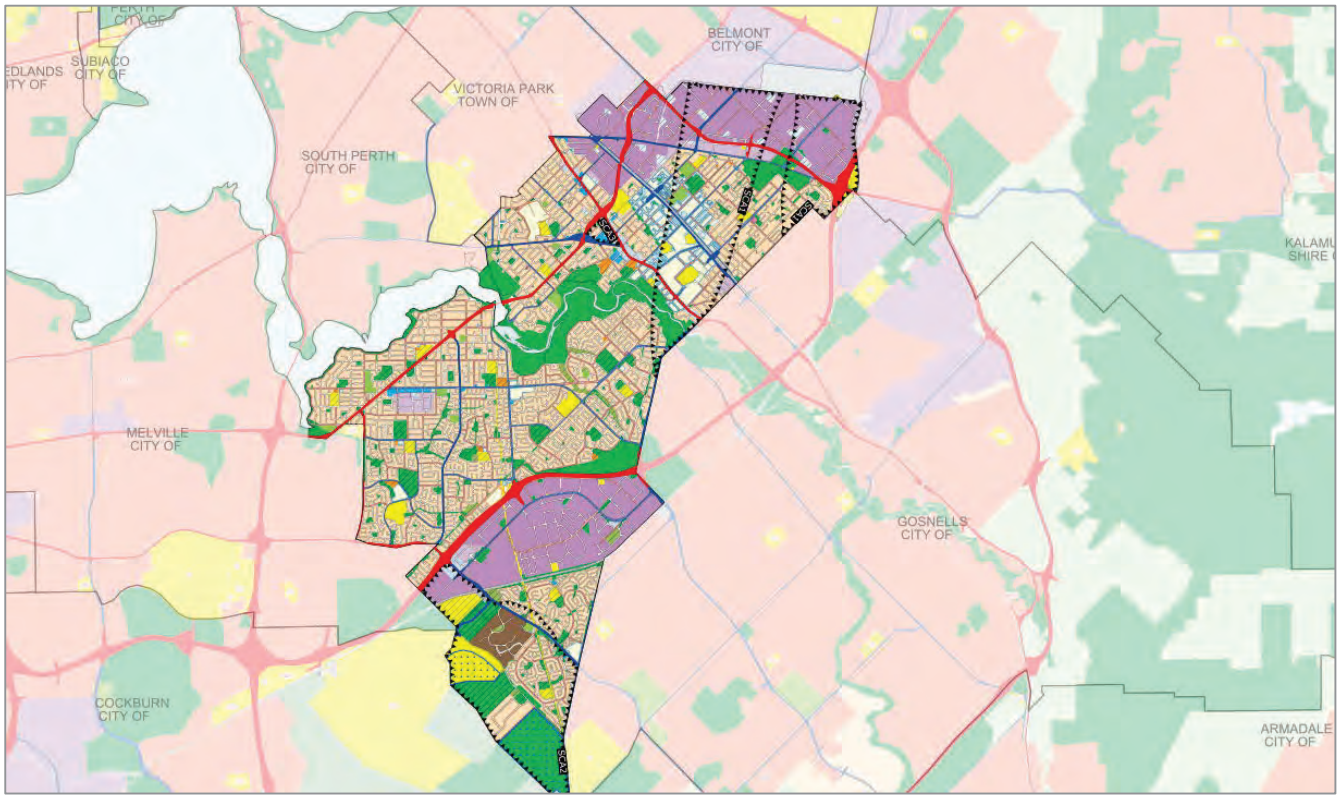
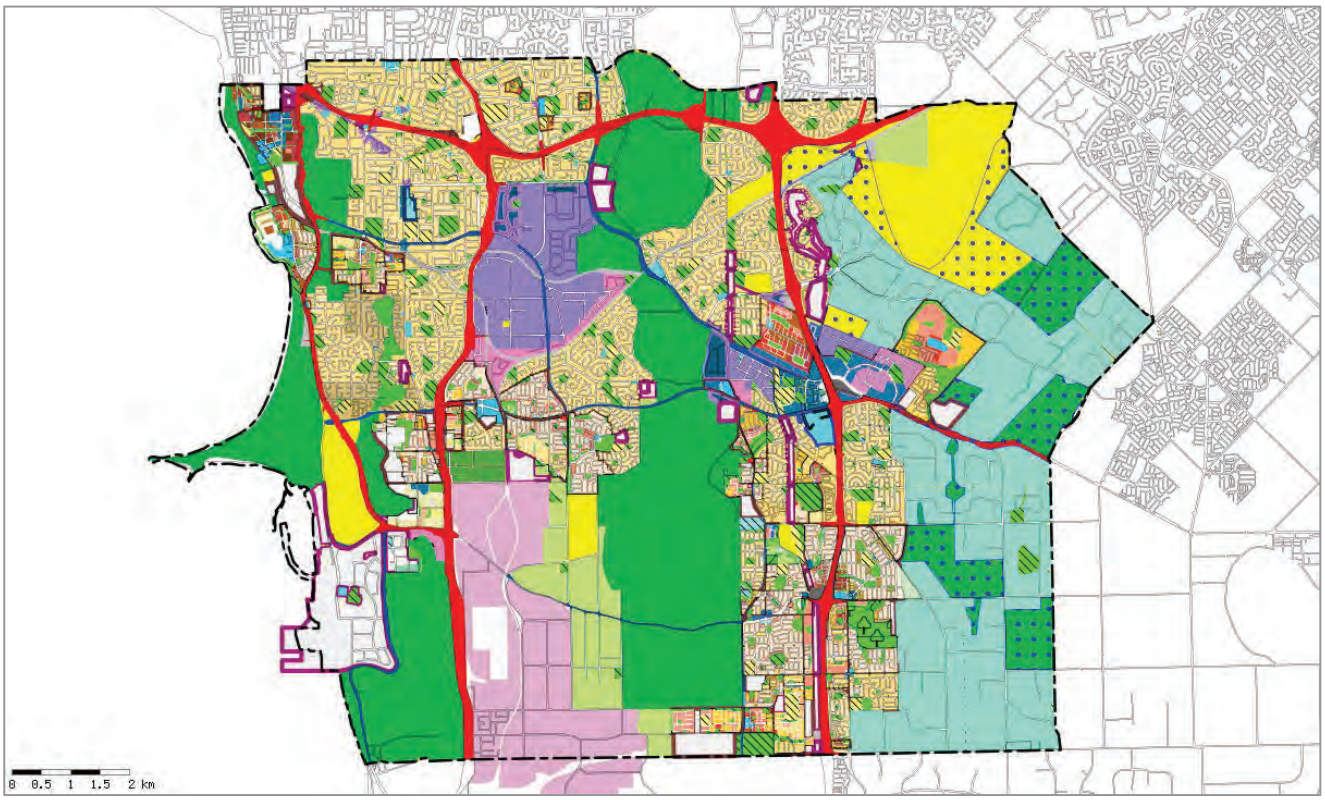


Figure 2: City of Canning Town Planning Scheme No. 42



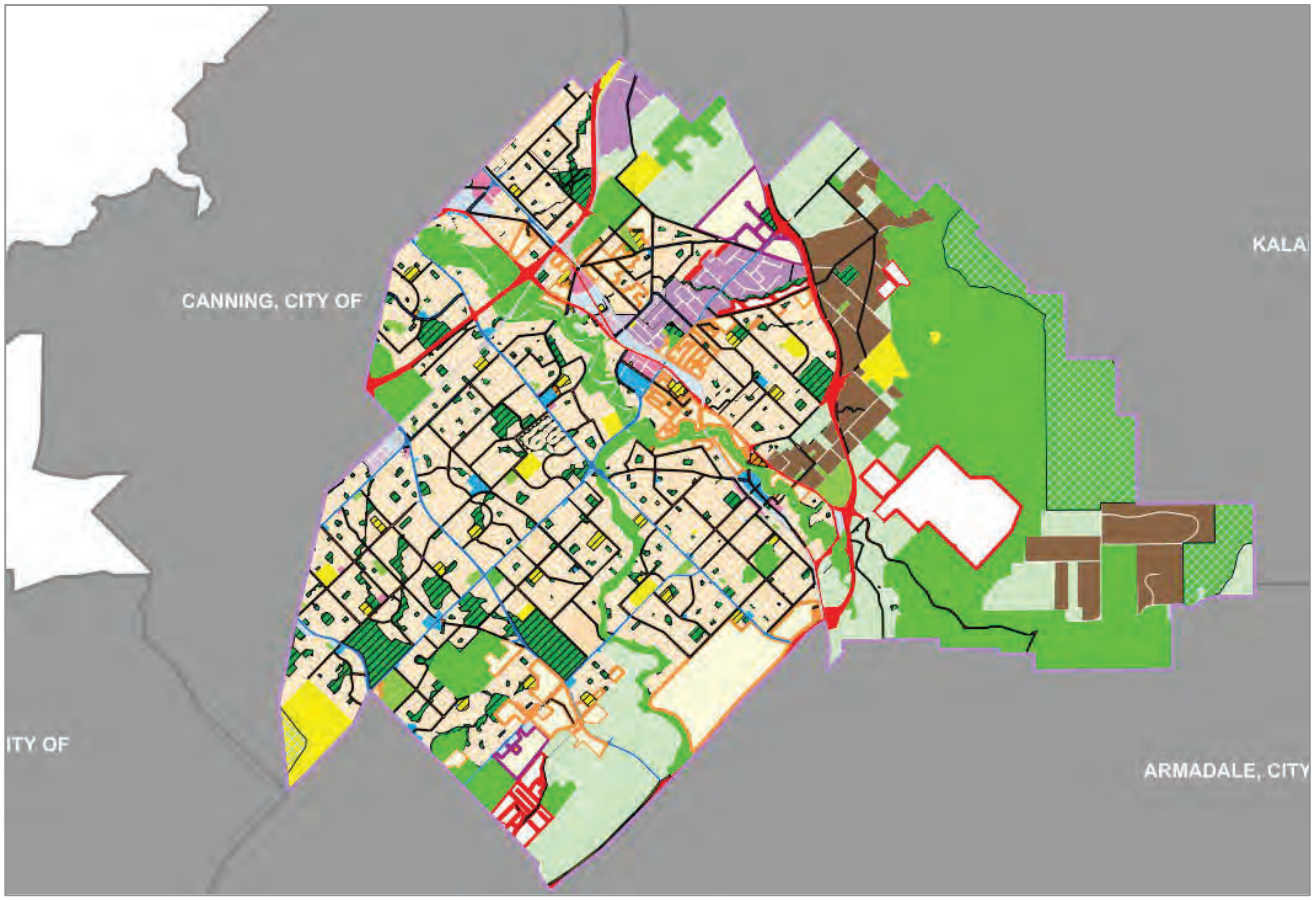
Memorandum

Figure 3: City of Cockburn Town Planning Scheme No. 3



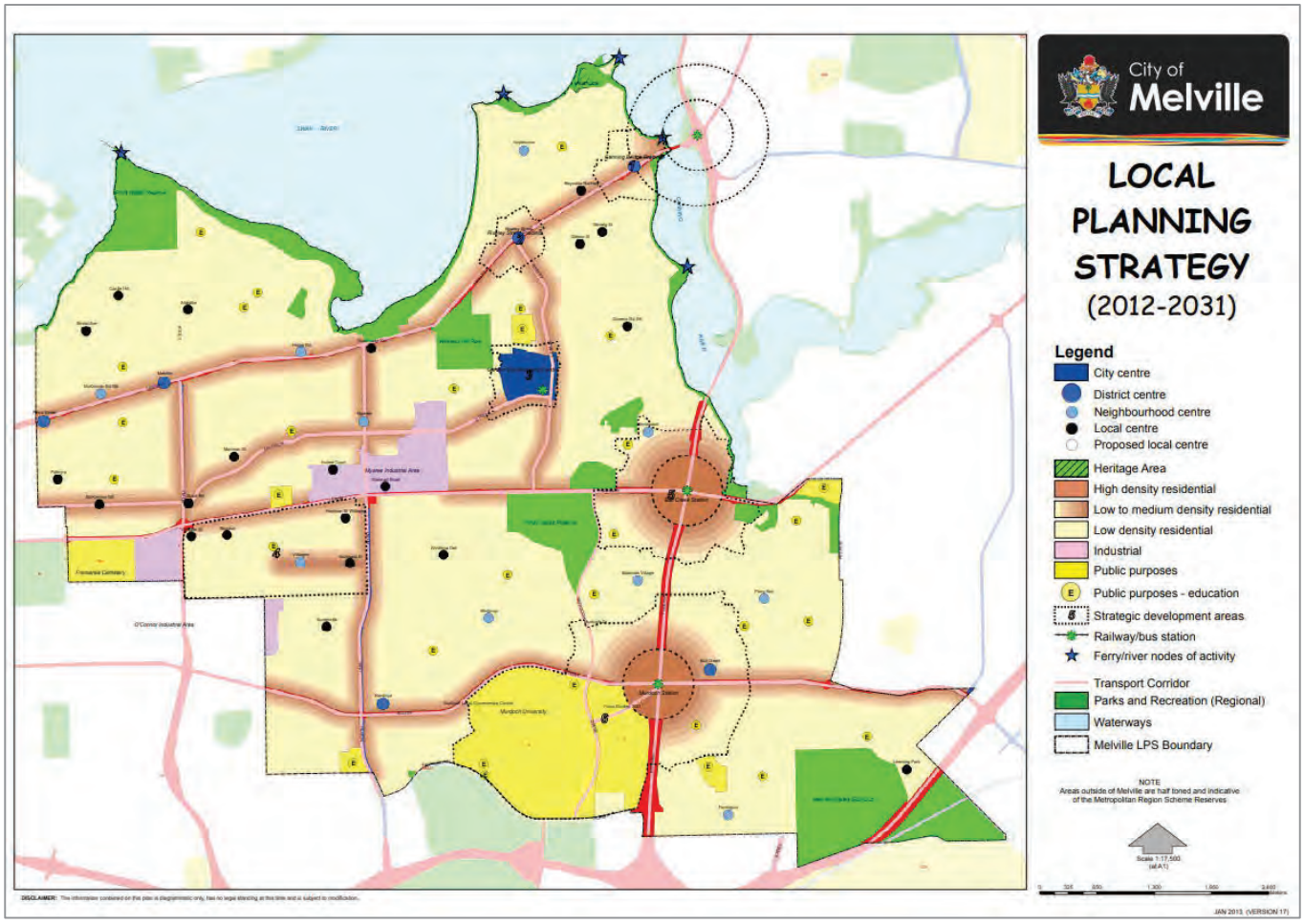
Memorandum

Figure 4: City of Gosnells Draft Local Planning Scheme 24



Memorandum

Figure 5: City of Melville Local Planning Strategy (2021-2031)



2.0 Geographical Catchment

This section describes the methodology of determining the geographical catchments for each mode. The extent of the geographical catchments will subsequently inform the potential patronage capture in Section 4.0.

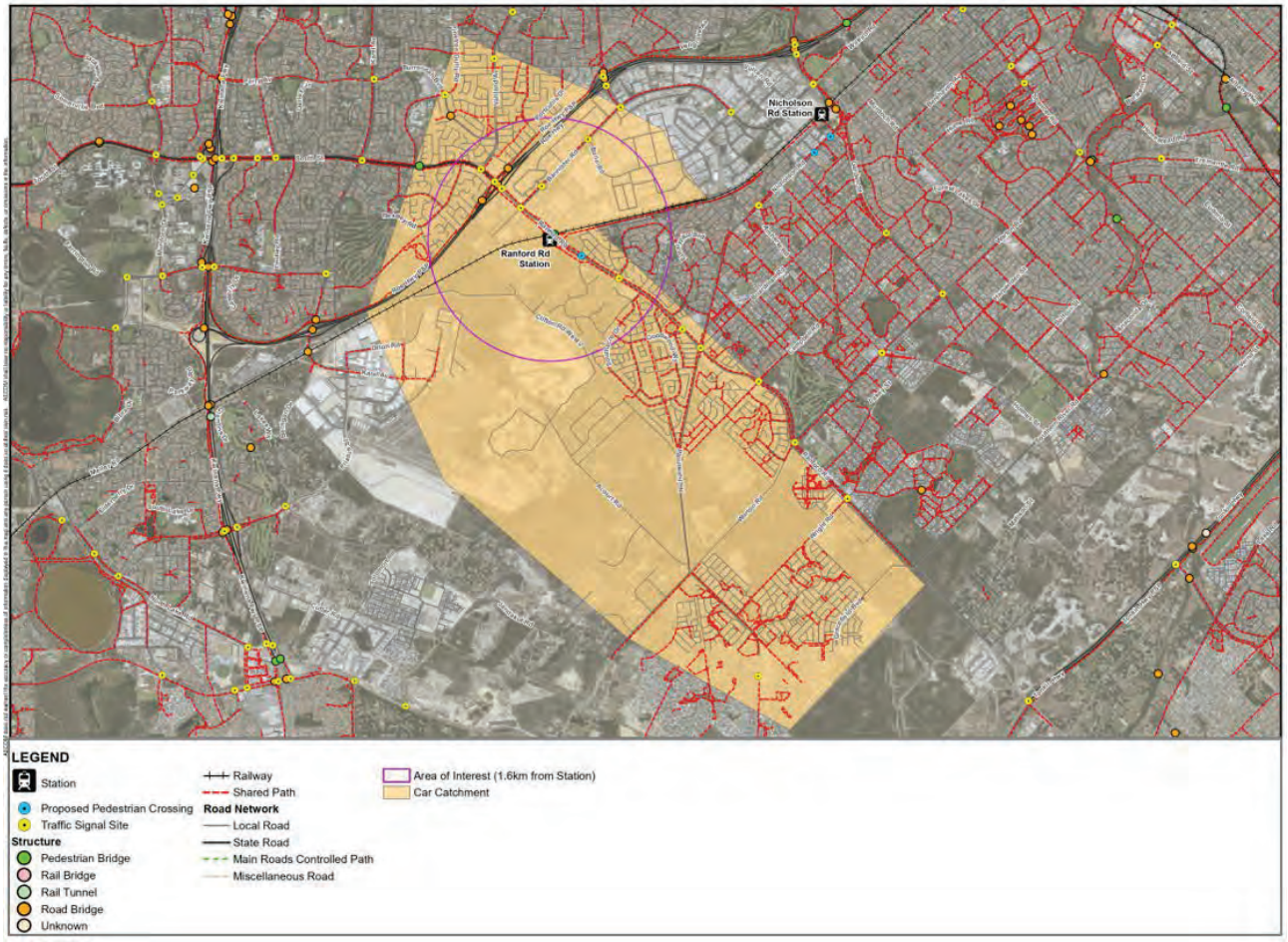
2.1 General Catchment

Land use data from the Metropolitan Land Use Forecasting System (MLUFS) (version 1.6) has been used to estimate the potential population within the future Ranford Road Station catchment.

The general (car) catchments for all new stations along the TCL was considered within the same analysis using the same assumptions adopted in the *TCL Strategic Access Planning* (Arup, 2018). This assumes a tendency that drivers will avoid 'back-tracking' and are likely to prefer driving downstream (towards Perth CBD) rather than upstream along the railway line.

The Ranford Road catchment identified in the previous Arup study has been adjusted to extend slightly east of Roe Highway, as travel time analysis completed for this analysis revealed that travel times within this area are likely to encourage Park n Ride passengers from a small catchment area east of Roe Highway to favour Ranford Road over the neighbouring Bull Creek and Murdoch stations. However, the catchment extent for Bull Creek and Murdoch stations still remained generous relative to the Ranford Road Station to reflect that the train journey time to Perth CBD will be less than from Ranford Road Station. The assumed general catchment for Ranford Road Station including this adjustment is presented in Figure 6.

Figure 6: General Catchment

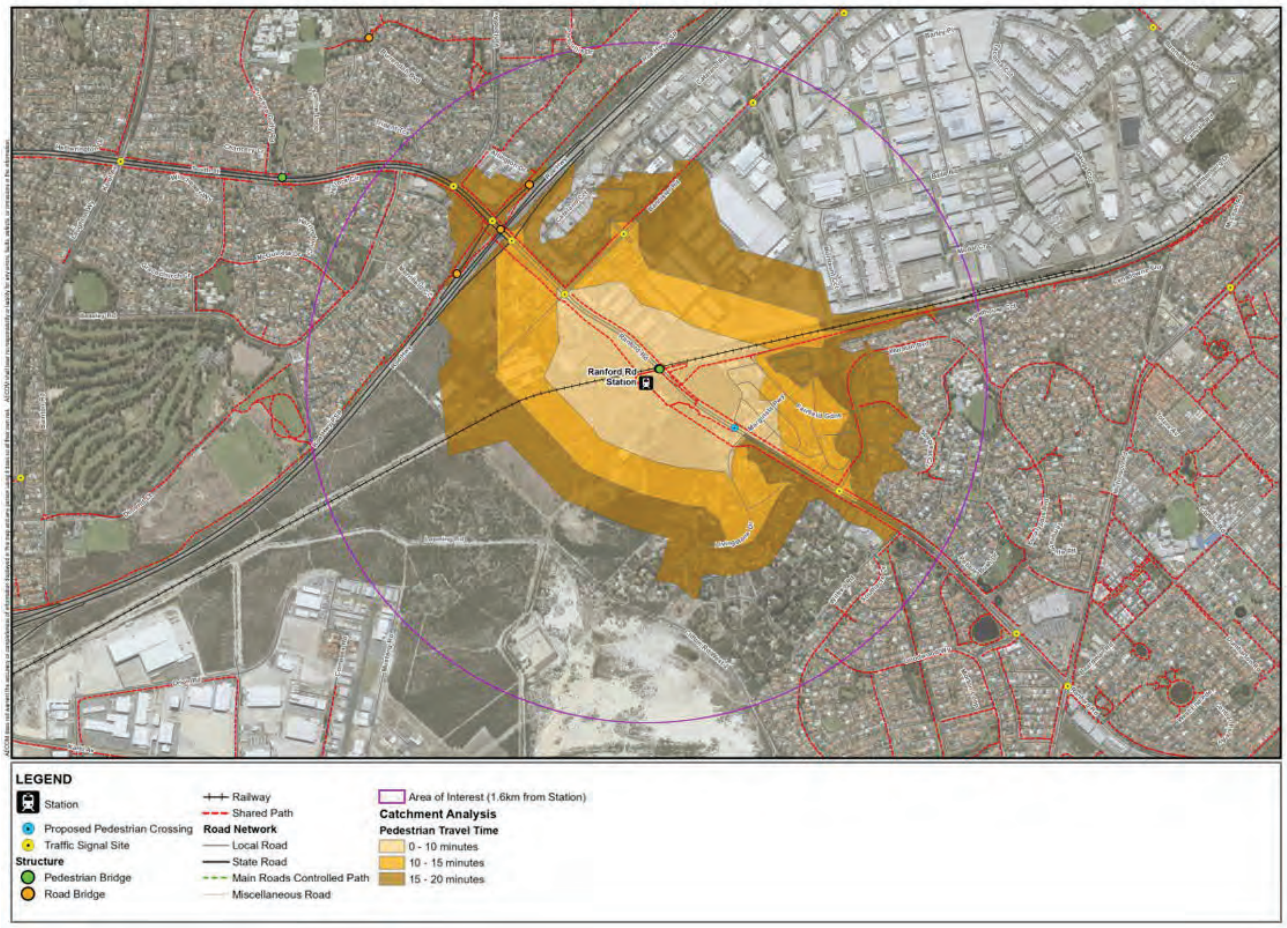


2.2 Future (2031) Walkable Catchment

Figure 7 presents the future (2031) walkable catchment around Ranford Road Station, segmented into 800m, 1200m and 1600m network distances. This is equivalent to a 10-, 15- and 20-minute walk at 4.8km/h, respectively. The potential walking catchment is set to fall within the 20-minute zone.

Memorandum

Figure 7: Future (2031) 10 /15/ 20 minute Walkable Catchment

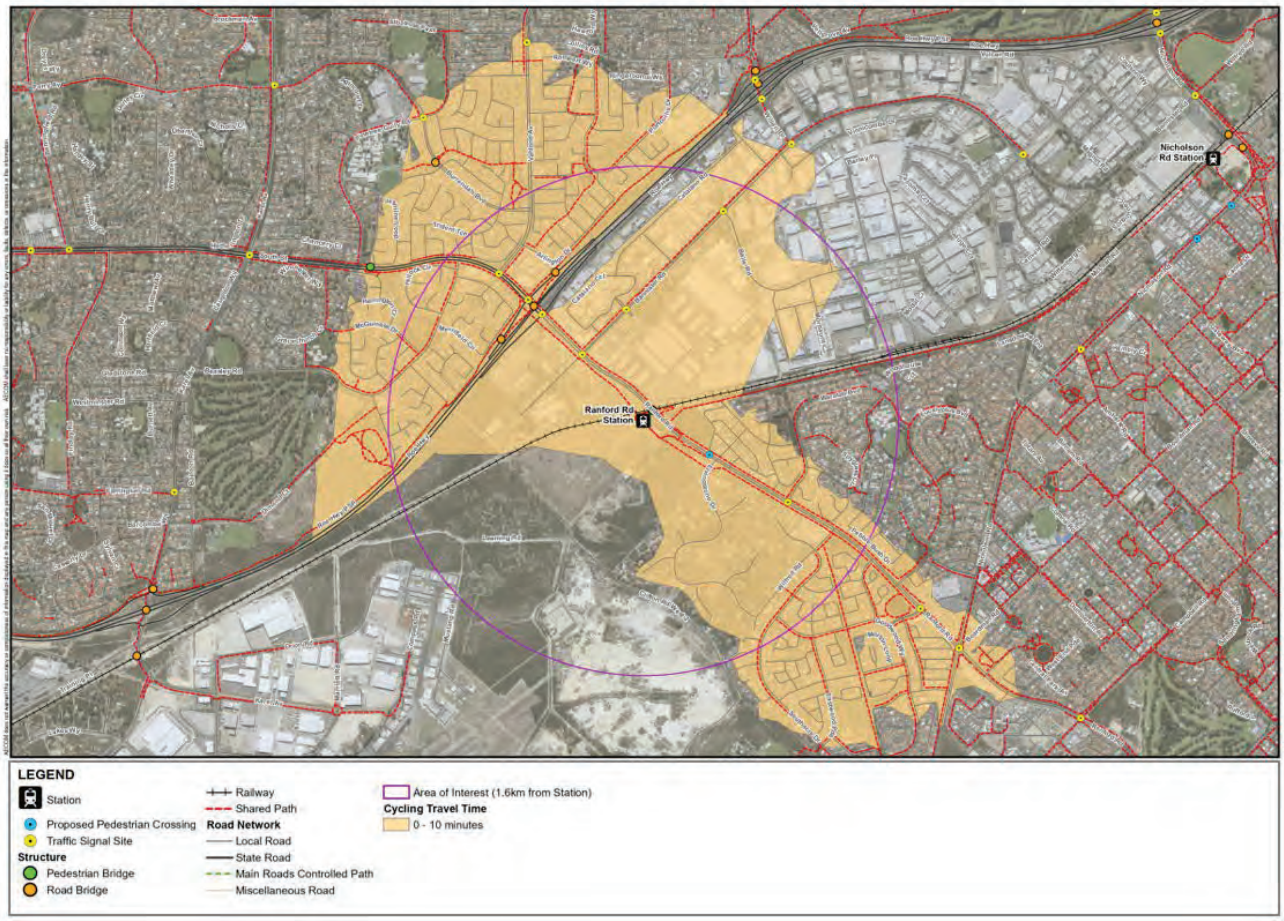


Memorandum

2.3 Future (2031) Cyclable Catchment

Figure 8 presents the future cyclable catchment around Ranford Road Station, within an 3km network distance. This is equivalent to a 10-minute cycle[1] and is the assumed potential cycling catchment. It further considers the assumed extent of the future cycling catchments of the neighbouring Bull Creek, Murdoch and Nicholson Road stations, using the same principle to avoid 'back-tracking' used to define the general catchment for each individual station.

Figure 8: Future (2031) 10 minute Cyclable Catchment



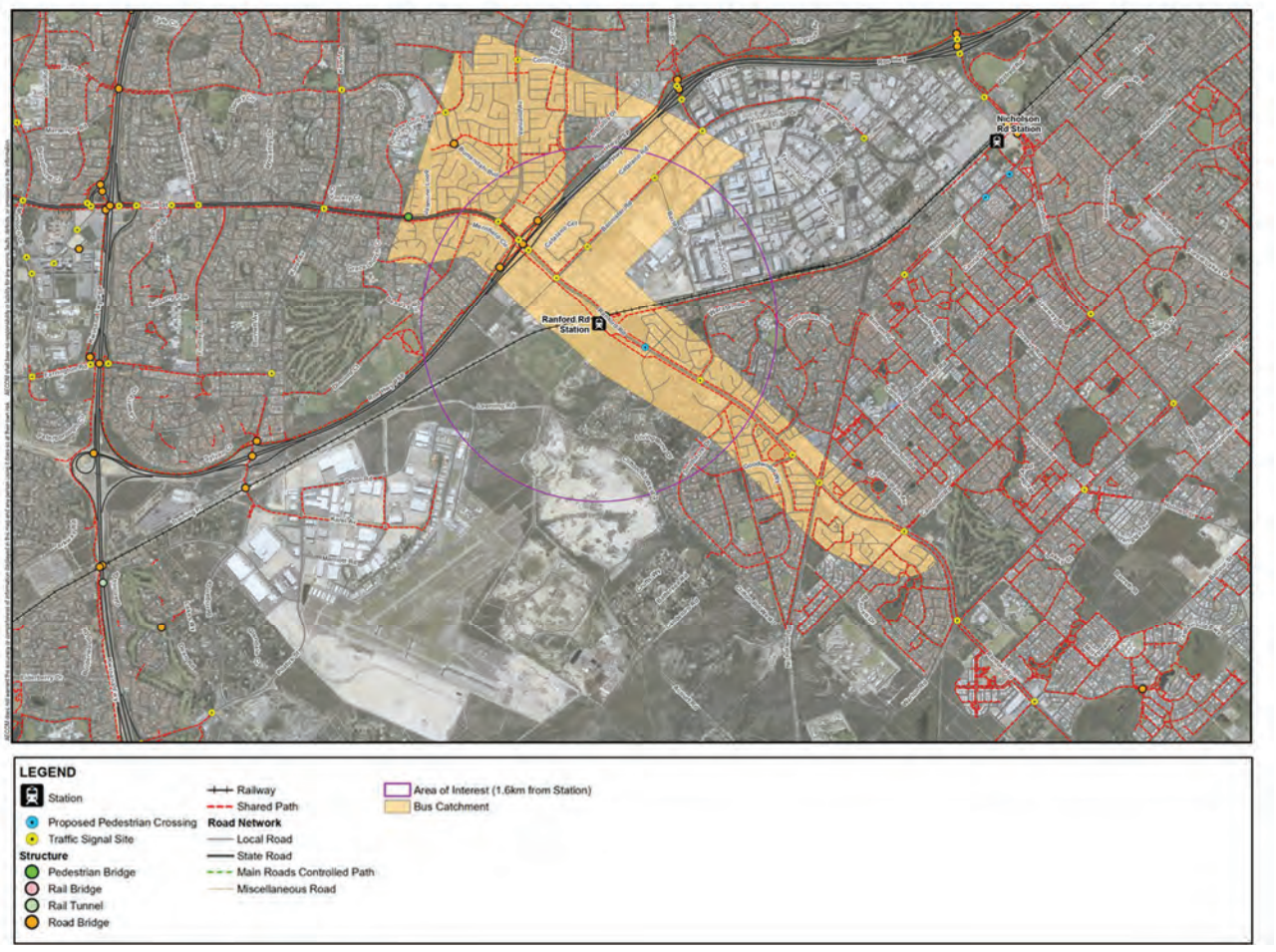
[1] Based on an average of 18/km cycle speed

2.4 Future (2031) Bus Catchment

A preferred future bus network option has been supplied to the NEWest team by the Public Transport Authority (PTA). Figure 9 highlights the resulting associated bus catchment. As route alignment and bus stop locations are yet to be confirmed the catchments are indicative only and formed by a 400m bus route buffer.

It further considers the assumed extent of the bus catchments of the neighbouring Bull Creek, Murdoch and Nicholson Road stations, using the same principle to avoid 'back-tracking' used to define the general catchments. There is a section of the Canning Vale residential area bounded by the rail corridor in the north, and extending further east than the identified bus catchment along Ranford Road, which could be captured within the Nicholson Road or Ranford Road station bus catchments. This area is not identified as part of the Ranford Road Station in Figure 9 as it is assumed the majority of passengers will travel northwards towards the Perth CBD via Nicholson Road Station. However it is likely that passengers will choose to travel to either station depending on their ultimate destination, time of day and future rail service travel times via the Armadale and Mandurah Lines. Therefore allowance for additional Bus n Ride demand for Ranford Road Station to reflect the shared bus catchment area has been considered in the future mode assessment (Section 5).

Figure 9: Bus Catchment



3.0 Station Typologies and Patronage

3.1 Ranford Road Station Typology

The future Ranford Road Station Access Typology and Precinct Typology are identified below in Table 1. The Station Access Typology reflects the anticipated catchment conditions and priority access modes, noting that a Bus n Ride Station suggests a large (typically more than 30 percent) mode share for bus transfers at the station but also allows for similar Park n Ride and walking/cycling mode shares depending on the Precinct typology and surrounding land uses. Ranford Road Station is identified as an SP6 'Transit Node' Precinct Typology, which indicates the station serves a wider catchment area through Park n Ride / transit transfers with limited TOD opportunity within the walking catchment, in this case due to the large area of non-developable land close to the Station (Bush Forever site and Canning Waste Transfer Facility), and less intensive industrial activities.

Table 1: Station Typologies

Access Typology	Precinct Typology	Comparable Stations
Bus n Ride	SP6 Transit Node	• Warnbro (Park n Ride, limited active modes) • Cockburn Station (Park n Ride, next closest existing station) • Thornlie Station (Bus n Ride, next closest existing station)

3.2 Forecast Patronage

The NEWest adopted patronage forecast for Ranford Road Station is presented in Table 2[2]. The forecasts are derived from the STEM multi-modal transport model and is compared below to previous patronage forecasts used in the previous METRONET studies by Arup (2018) and WSP (2019).

Table 2: Forecast Patronage

Patronage	Arup (2018)	WSP (2019)	TCL Adopted[2]
2021	**2,120**	**2,120**	**2,120**
2031	3,210	3,210	3,210

4.0 Potential Patronage Capture

MLUFS land use data has been used to estimate potential patronage that can access Ranford Road Station by each mode. The analysis for each mode has been carried out to determine the percentage of the MLUFS zones which are within the mode-specific geographical catchment. Detailed information on future land use development gathered from structure plans has been used to further adjust the percentage of the MLUFS zone within a catchment, to more realistically reflect the potential patronage. This adjusts for land uses areas which are likely to have low residential, employment or education activities such as conservation areas or large sections of public open space.

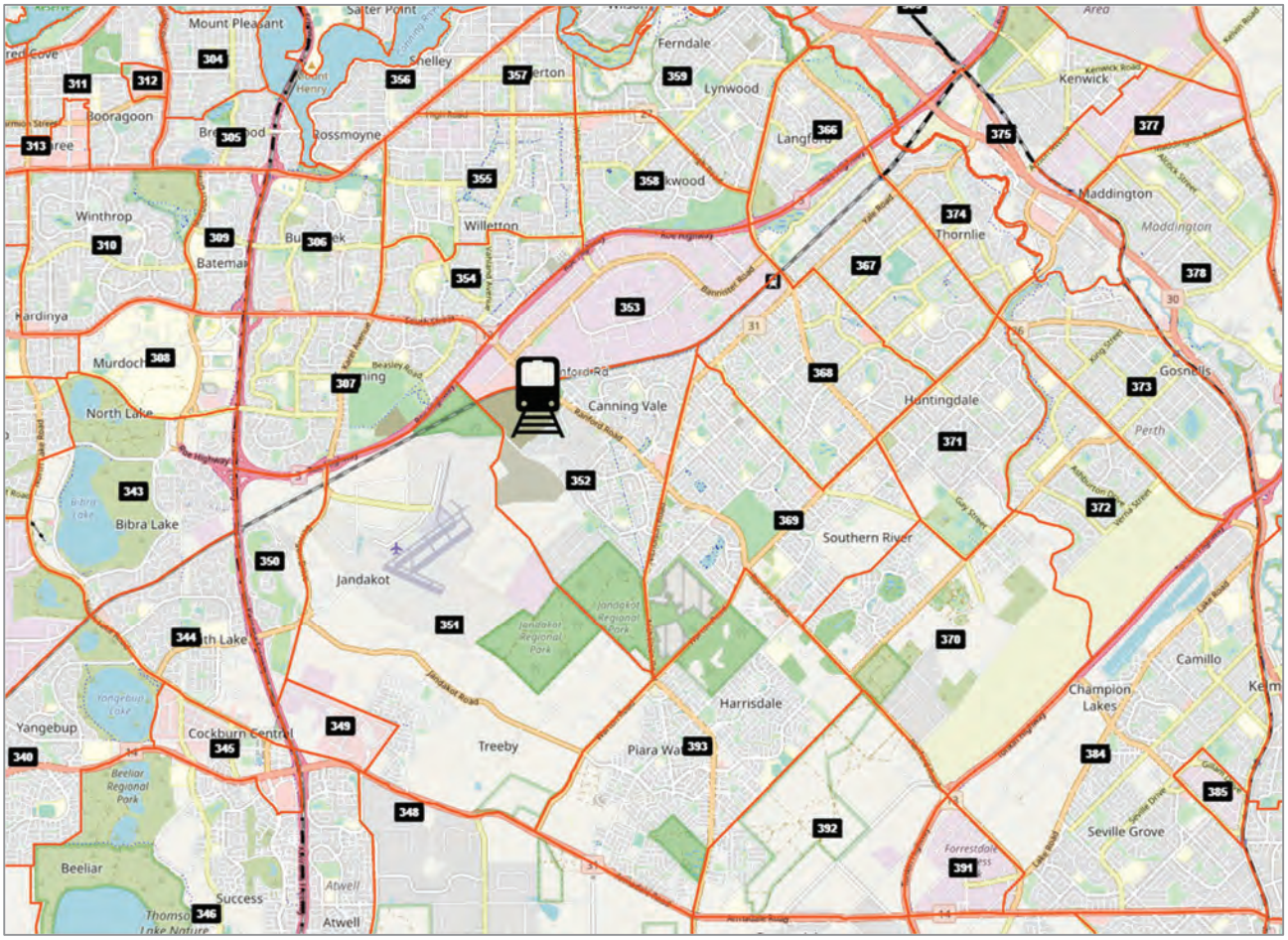
[2] Patronage forecasts specified in the TCL SWTC

Memorandum

4.1 MLUFS Data

MLUFS data describe forecasted population and employment figures for the Perth metropolitan region and forms the basis for the catchment analysis. The zones falling with the station catchments are highlighted in Figure 10.

Figure 10: MLUFS Zones



Memorandum

Table 3 provides a break-down of the residential and employment data for each zone for the year 2021 and 2031, along with the resulting growth between the two years. The zones with the higher proportion of existing or future population are highlighted in shades of green, illustrating the zones which have the potential to generate the most trips for Ranford Road Station in 2021 and 2031. These zones should therefore be a key focus for delivery of the interim (2021) and future transport routes to the station, particularly the residential areas to the south (Piara Waters, Harrisdale) and east (Canning Vale, Southern River).

Table 3: MLUFS Land Use Data

MLUFS Zone	2021			2031			2021 - 2031
	Residents	Employment	Total	Residents	Employment	Total	Growth
307	10,661	1,705	12,366	10,715	1,979	12,694	**3%**
351	3,551	4,328	7,879	5,927	4,787	10,714	**36%**
352	9,858	1,713	11,571	10,846	1,954	12,800	**11%**
353	0	15,198	15,198	0	19,436	19,436	**28%**
354	6,419	1,745	8,164	6,587	2,063	8,650	**6%**
355	11,441	2,341	13,782	11,739	2,838	14,577	**6%**
369	19,511	4,049	23,560	23,702	4,531	28,233	**20%**
393	23,850	4,215	28,065	25,461	4,120	29,581	**5%**

Memorandum

4.2 Overall Catchment Potential

Figure 11 provides an overview of the area overlap between the general catchment and the MLUFS zones, along with detailed land use data. The overlap serves as an indication of the proportion of population and employment within each MLUFS zone that will form part of the potential car patronage for Ranford Road Station.

Figure 11: Future (2031) Overall Catchment, Land Use and MLUFS Zone Overlap

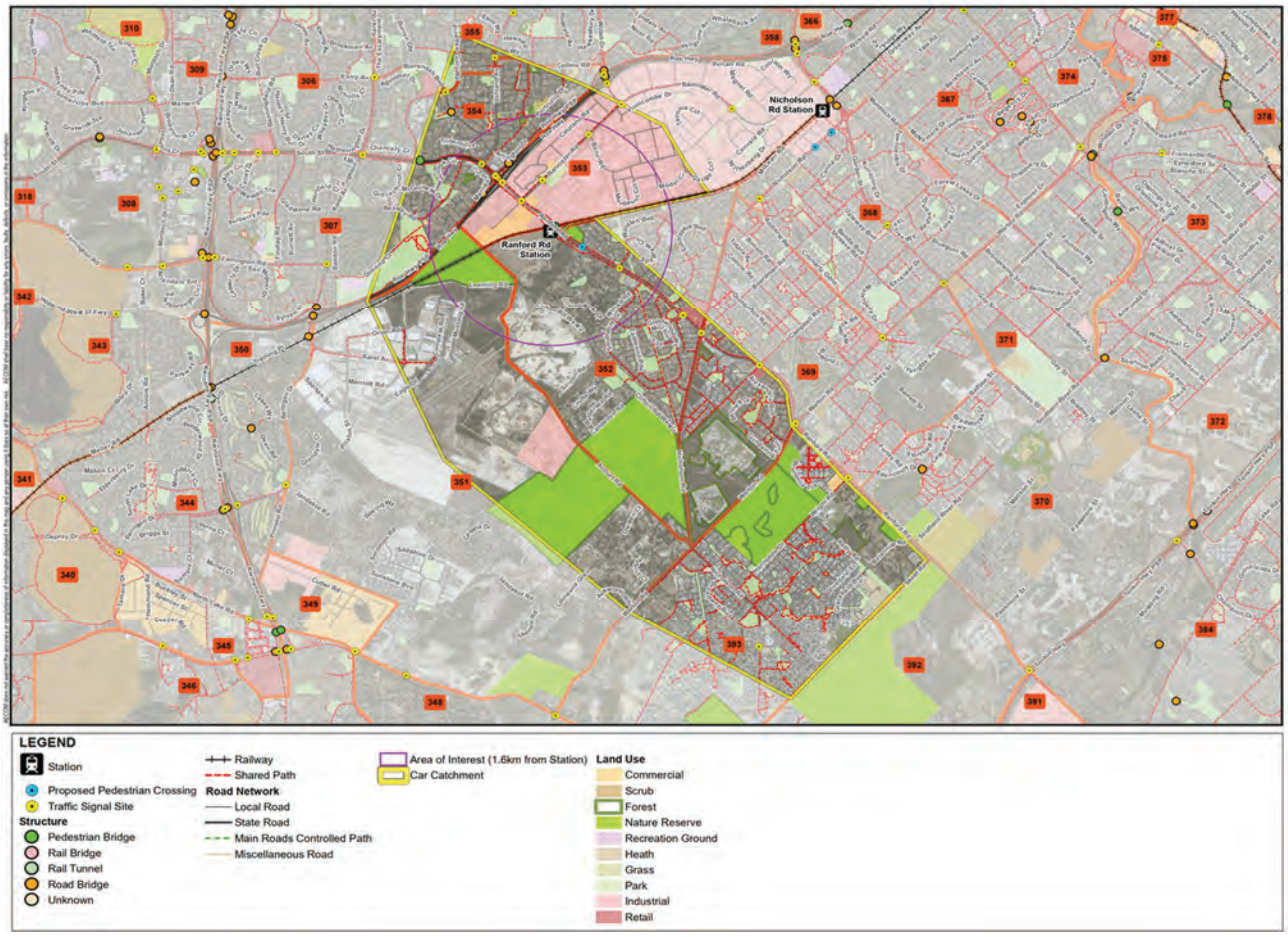


Table 4 highlights the proportion of each MLUFS zone captured within the overall station catchment, along with any adjustment made to the overlap percentage following consideration of the existing and planned detailed land use data sourced from structure plans.

Table 4: Future (2031) Overall Catchment and MLUFS Zone Adjusted Overlap

Car - 2031			
MLUFS Zone	**Overlap**	**Adjusted overlap**	**Reason for adjustment**
307	22%	22%	
351	39%	10%	Most patronage-generating land use falls outside catchment
352	81%	50%	All non-use land falls within catchment
353	51%	51%	
354	66%	66%	
355	6%	6%	
369	29%	20%	Large proportion of non-use land falls within catchment
393	62%	62%	

4.3 Future (2031) Bus Catchment Potential

Figure 12 provides an overview of the area overlap between the defined bus catchment and the MLUFS zones, along with detailed land use data. The overlap serves as an indication of the proportion of population and employment within each MLUFS zone that will form part of the potential bus patronage for Ranford Road Station.

Figure 12: Future (2031) Bus Catchment, Land Use and MLUFS Zone Overlap

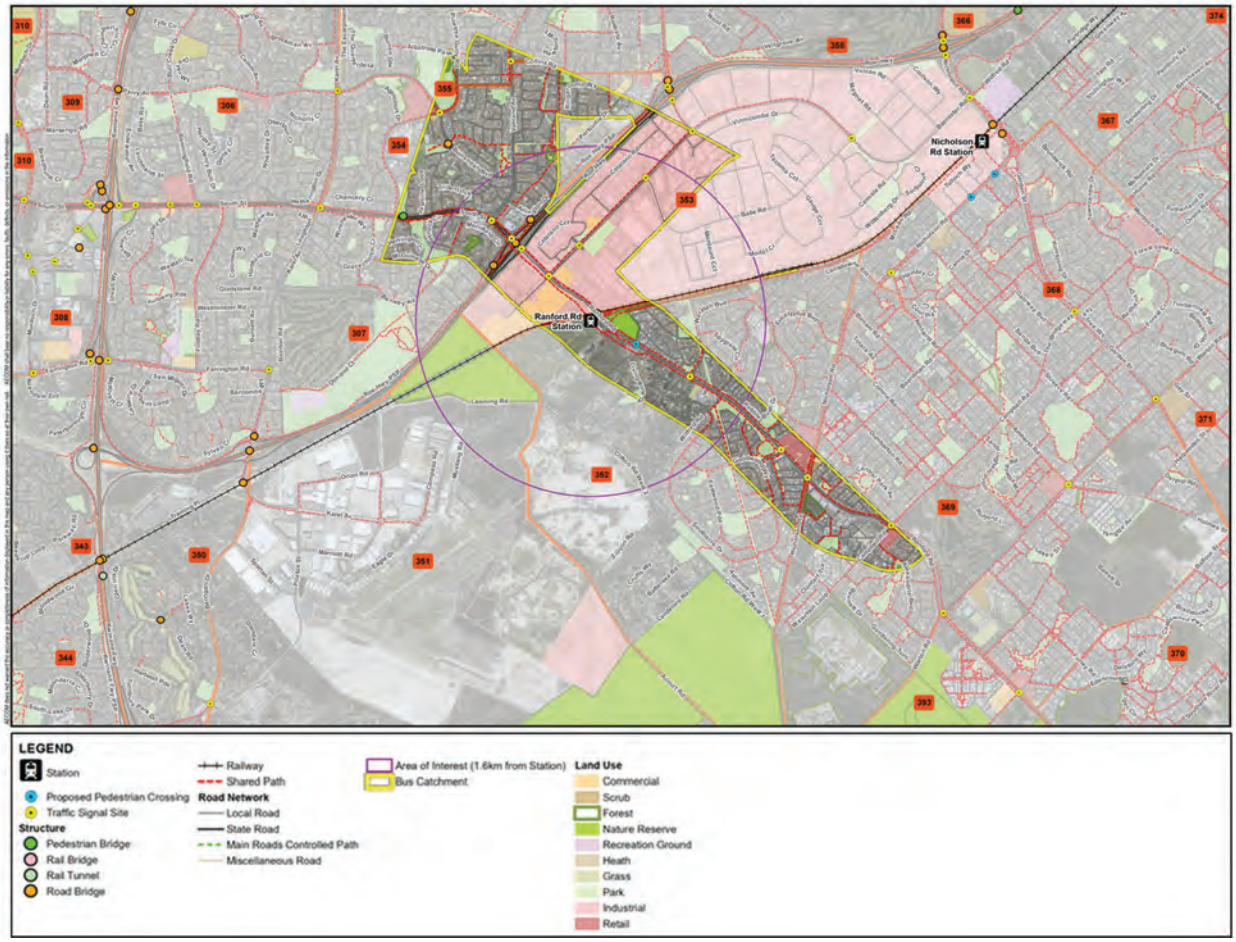


Table 5 highlights the area-based overlaps between the bus catchment and the MLUFS zones, along with any adjustment made to the overlap percentage being made following consideration of the existing and planned detailed land use data sourced from structure plans.

Table 5: Future (2031) Bus Catchment and MLUFS Zone Adjusted Overlap

MLUFS Zone	Overlap	Adjusted overlap	Reason for adjustment
307	7%	7%	
352	20%	23%	Most non-use land falls outside catchment
353	29%	29%	
354	57%	57%	
355	5%	5%	
369	6%	9%	No non-use land within catchment

4.4 Future (2031) Cycling Catchment Potential

Figure 13 provides an overview of the area overlap between the cyclable catchment and the MLUFS zones, along with detailed land use data. The overlap serves as an indication of the proportion of population and employment within each MLUFS zone that will form part of the potential cycle patronage for Ranford Road Station.

Figure 13: Future (2031) Cyclable Catchment, Land Use and MLUFS Zone Overlap

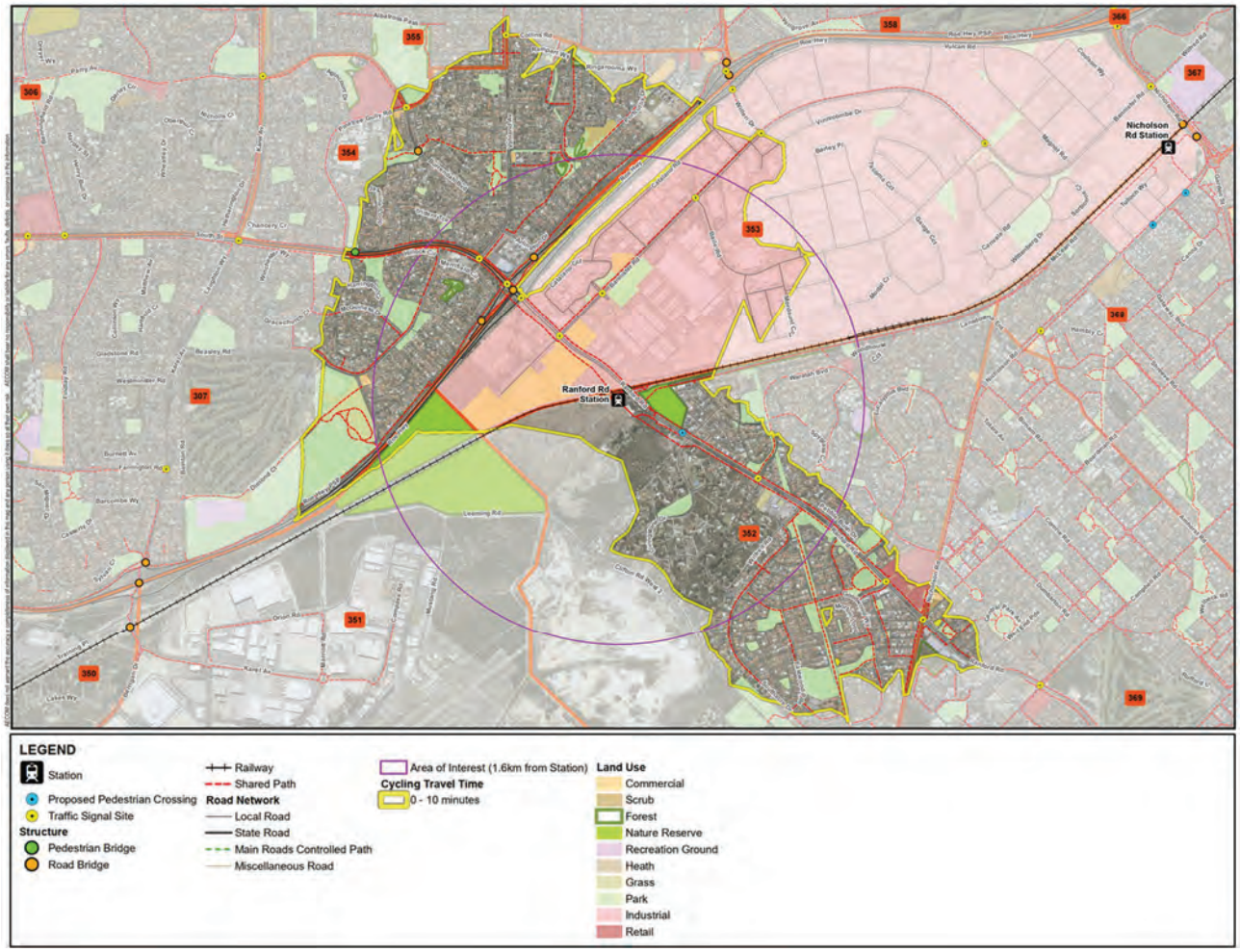


Table 6 highlights the area-based overlaps between the cyclable catchment and the MLUFS zones, along with any adjustment made to the overlap percentage being made following consideration of the existing and planned detailed land use data sourced from structure plans.

Table 6: Future (2031) Cyclable Catchment and MLUFS Zone Adjusted Overlap

MLUFS Zone	Overlap	Adjusted overlap	Reason for adjustment
307	18%	18%	
351	1%	0%	No patronage-generating land use captured
352	32%	55%	Most non-use land falls outside catchment
353	34%	34%	
354	61%	61%	
355	1%	1%	
369	1%	1%	

4.5 Future (2031) Walking Catchment Potential

Figure 14 provides an overview of the area overlap between the walkable catchment and the MLUFS zones, along with detailed land use data. The overlap serves as an indication of the proportion of population and employment within each MLUFS zone that will form part of the potential pedestrian patronage for Ranford Road Station.

Figure 14: Future (2031) Walkable Catchment, Land Use and MLUFS Zone Overlap

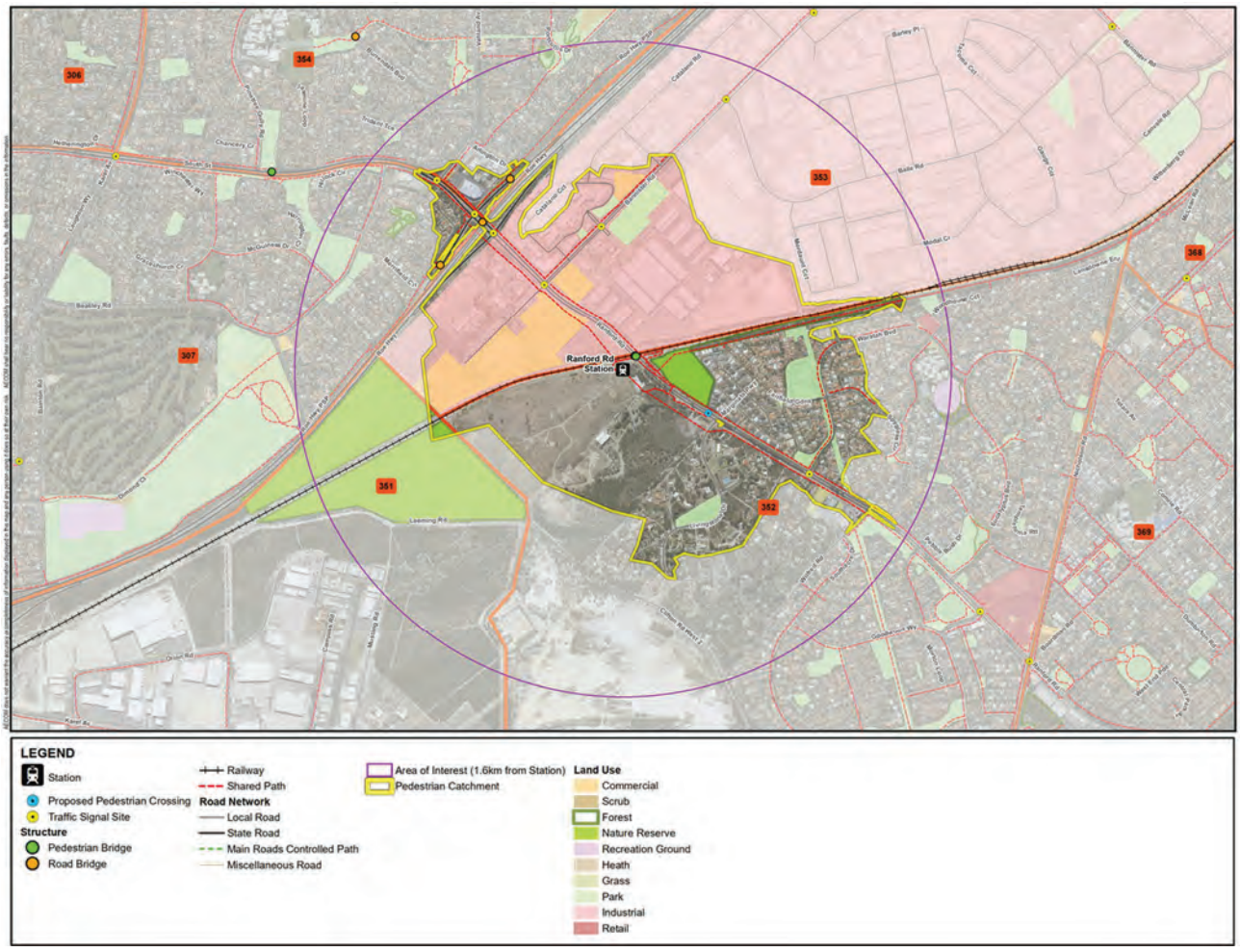


Table 7 highlights the area-based overlaps between the future walkable catchment and the MLUFS zones, along with any adjustment made to the overlap percentage being made following consideration of the existing and planned detailed land use data sourced from structure plans.

Table 7: Future (2031) Walkable Catchment and MLUFS Zone Adjusted Overlap

MLUFS Zone	Overlap	Adjusted overlap	Reason for adjustment
307	1%	1%	
351	0%	0%	
352	17%	12%	Large proportion of non-use land within catchment
353	19%	19%	
354	2%	2%	

4.6 Mode Share Potential

Table 8 summarises the adjusted overlaps between the mode-specific catchments and the MLUFS zones, along with the resulting potential patronage volumes using the patronage volumes presented in Section 3.0. It is important to note that these potential patronage volumes only denote the theoretical maximum patronage volumes for each mode.

Memorandum

Table 8: Potential Patronage by Mode

MLUFS Zone	Adjusted overlap - 2031				Potential patronage - 2031			
	Car	Bus	Cycling	Walking	Car	Bus	Cycling	Walking
307	22%	7%	18%	1%	2,357	889	2,285	127
351	10%	0%	0%	0%	593	0	0	0
352	50%	23%	55%	12%	5,423	2,944	7,040	1,536
353	51%	29%	34%	19%	0	5,636	6,608	3,693
354	66%	57%	61%	2%	4,347	4,931	5,277	173
354	6%	5%	1%	0%	704	729	146	0
369	20%	9%	1%	0%	4,740	2,541	282	0
393	62%	0%	0%	0%	15,786	0	0	0

The combined potential patronage volumes for all MLUFS zones and each mode serve as the basis for the upper limits of the mode shares. This is done by calculating the proportion of potential patronage for each mode relative to the potential car patronage, as summarised in Table 9.

Table 9: Potential Mode Shares

2031	Car	Bus	Cycling	Walking
Potential patronage	33,951	17,669	21,638	5,529
Potential mode share	100%	52%	64%	16%
Potential mode share (Arup, 2018)	100%		83%	5%

5.0 Access Mode Share

The effective mode shares for 2031, presented in Table 10, have been derived using bench-marking analysis against similar stations (considering the Station typologies and catchment conditions) and consideration of the potential mode shares derived in Section 4.0. These have subsequentially been compared to the mode shares suggested by previous TCL 2018[3] analysis (Arup) and TCL 2019[4] analysis (WSP). The car access modes, 'Kiss and Ride' (KnR) and 'Park and Ride' (PnR) has been estimated separately, in order to be able to assess the required parking supply in Section 6.0.

The WSP analysis, which builds on the Arup analysis, is based on 2021 mode shares with the adjustment that the PnR mode share is constrained to the assumed parking capacity and shifting the overflow PnR to bus. Therefore, the WSP mode shares could potentially overestimate the bus target mode share for the 2031 scenario.

Table 10: Effective Mode Shares 2031

Mode shares	TCL 2018[3]	TCL 2019[4]	STEM	TCL 2020 Catchment Analysis	Comments
Walking	2%	3%		4%	Based on increased potential pedestrian patronage compared to Arup analysis (although overall still small) and benchmarking against Warnbro (4%), Cockburn (10%) and Thornlie (13%) Station Access Strategy 2031 targets, noting that Cockburn and Thornlie Stations are likely to have more opportunity for TOD / more intensive land uses within the pedestrian catchment
Cycling	10%	5%		4%	Based on decreased potential cycling patronage compared to the Arup analysis, and benchmarking against Warnbro (4%), Cockburn (2%) and Thornlie (1%) Station Access Strategy 2031 targets, and reflecting the direct and quality PSP connections to be delivered as part of the Ranford Road Station.
Walking + Cycling	12%	8%	23%	8%	A low combined active mode share is reflecting of the SP6 Transit Node Precinct Typology, and surrounding land use with lower potential for active travel modes
Bus	40%	53%	36%	40%	A moderately high mode share is suggested to reflect the relatively large potential bus catchment, the attractiveness of bus priority measures along Ranford Road, and benchmarking against Warnbro (45%), Cockburn (35%) and Thornlie (33%) Station Access Strategy 2031 targets. The Ranford Road bus mode share also considers potential additional demand from a section of Canning Vale residential area which is likely to be shared between Ranford Road and Nicholson Road Station bus catchments (not included in the Ranford Road bus catchment population estimate).
KnR	12%	14%	13%	20%	This is comparable to existing Stations with similar typologies and conditions, such as the Warnbro (24%) and Cockburn (31%) existing Kiss n Ride mode shares.
PnR	36%	25%	28%	32%	Remaining mode share, and reflective of the Station Access and SP6 Station Precinct Typology.

[3] TCL 2018 - *Thornlie Rail Line Extension Strategic Access Planning* (Arup, 2018)
[4] TCL 2019 - *Thornlie – Cockburn Link Transport Assessment* (WSP, 2019)

As the land use within the station catchments are not expected to change significantly between the future forecast (2031) and opening day (2021) years, the mode shares are expected to be similar for both scenario years. In particular, since no Transit Oriented Development or significant intensification is able to be developed nearby the station due to the land use zoning and large area of non-developable land at this location, it is not expected that the active mode share will increase over time, with greater growth forecast for areas within the bus and car catchments, such as Canning Vale and Southern River.

Table 11 presents the resulting patronage volumes for each mode for the years 2021 and 2031.

Table 11: Patronage by Mode

Patronage by mode	2021	2031
Walking	85	125
Cycling	85	125
Bus	848	1248
KnR	424	624
PnR	678	998

6.0 Station Requirements

Based on the PnR patronage volumes estimated in Section 5.0, long-term parking supply requirements for Ranford Road Station has been assessed, using an assumed 1.1 parking space turnover rate and 1.2 vehicle occupancy rate (consistent with the previous Arup and WSP analysis). The resulting necessary parking supply is presented in Table 12, along with a comparison against previous Arup and WSP analysis, STEM modelling assumptions and current design provision. The analysis suggests that the current design provides insufficient parking provision for both the anticipated 2021 and 2031 demand, based on the patronage forecasts adopted for the TCL project.

As there is unlikely to be a large supply of unrestricted parking within close (400 metres) walk of the new Station, more passengers are expected to instead either be picked up / dropped off (including by on demand services), shift to cycle or the bus modes, use alternative stations with available parking capacity or not switch from a car-only journey. Promotion of the available bus services and cycling connectivity will be required to ensure the alternative mode options are maximised for areas which overlap with the car catchment.

Table 12: Future (2031) Parking Requirements

Parking	YRE 2018[5]	YRE 2019[6]	STEM	Current 15% Design	YRE 2020 Catchment Analysis
2021	684	400		400	514
2031	834	400	400	400	756

7.0 Conclusions

This note has reviewed the proposed station access mode shares for Ranford Road Station and it is estimated that the suggested parking provision will be unable to meet demand for the opening and forecast year, based on the forecast patronage adopted for the TCL project. For Ranford Road Station to meet it's potential as a SP6 Transit Node and achieve an increase in overall rail patronage and public transport mode share for trips generated by the Station catchment area, it is recommended for strong promotion of the available bus services and cycling connectivity to ensure the access trips via alternative mode options are maximised for areas which overlap with the car catchment. More investigation of opportunities to improve bus services (frequency, travel time, service areas) and cycling connectivity (missing gaps or safety / delay issues) should be undertaken prior to the Station opening and ongoing monitoring in the short and medium term.

APPENDIX G BUSHFIRE MANAGEMENT PLAN

NEWest Alliance

Bushfire Management Plan (Development Application)

Ranford Road Station

10 September 2020

59400/132,203 (Rev A)

JBS&G Australia Pty Ltd T/A Strategen-JBS&G

www.jbsg.com.au

Table of Contents

List of Tables

List of Figures

List of plates

Appendices

1. Proposal details

1.1 Background

NEWest Alliance is seeking to lodge a Development Application (DA) in relation to proposed development of a Train Station at Lots 60, 303, 302 and 500 (81) Ranford Road, Canning Vale (the project area), located in the City of Canning. The site plan (Figure 1) identifies that the proposed development will comprise the following elements:

- entry building (habitable building)
- staff office on platform (habitable building)
- canopy, platform and overpass (not habitable)
- various communications, electrical, cleaner, mechanical, toilet, services, transformer buildings (not habitable)
- communications compound
- bus link canopy
- bus interchange
- bus shelters
- landscaping
- roads
- rail track
- footpaths
- carparks.

A Bushfire Attack Level (BAL) contour assessment report has been prepared previously to determine the level of BAL impact applicable to the Ranford Road Station based on the current vegetation conditions and consideration of the proposed development and Thornlie to Cockburn Link (TCL) Development Envelope.

The initial BAL contour assessment report served to inform:

- the level of BAL exposure across the site
- whether any subsequent design modifications were required as part of proposed development to achieve compliant bushfire outcomes
- the level of bushfire reporting required to accompany the DA process.

The project area is designated as bushfire prone on the *Map of Bush Fire Prone Areas* (DFES 2020, see Plate 1). As such, bushfire risk considerations and BAL assessment at the planning (DA) stage are required to be formally addressed.

Assessment results are based on post-development site conditions, including establishment and ongoing maintenance of the entire project area and broader TCL Development Envelope to a non-vegetated/low threat state.

The project area contains proposed habitable development located within a designated bush fire prone area that is subject to a BAL rating above BAL-Low. On this basis, Strategen-JBS&G considers that the proposed development is required to comply with the relevant requirements under *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7; WAPC 2015) and the associated

Guidelines for Planning in Bushfire Prone Areas (the Guidelines; WAPC 2017). Therefore, this BMP is required to accompany the Ranford Road Station DA to demonstrate the necessary bushfire compliance measures in accordance with the abovementioned policy and guidelines.

1.2 Site description

The project area comprises approximately 96.5 ha within Lots 302, 303 and 500 and is surrounded by (see Figure 2):

- Thornlie train line, Ranford Road and industrial land uses to the north
- remnant bushland, Livingston Park Estate and Canning Club rifle range to the south
- Ranford Road, remnant bushland and Caledonia Grove Estate to the east
- remnant bushland within Ken Hurst Park and previously cleared land within the Canning Vale Rubbish Tip to the west.

1.3 Purpose

This Bushfire Management Plan (BMP) has been prepared to address requirements under Policy Measure 6.5 of SPP 3.7 and the Guidelines.

1.4 Other plans/reports

Aside from the initial Strategen-JBS&G (2020) BAL contour assessment, there are no known bushfire or environmental reports or assessments that have been prepared previously for the project area.

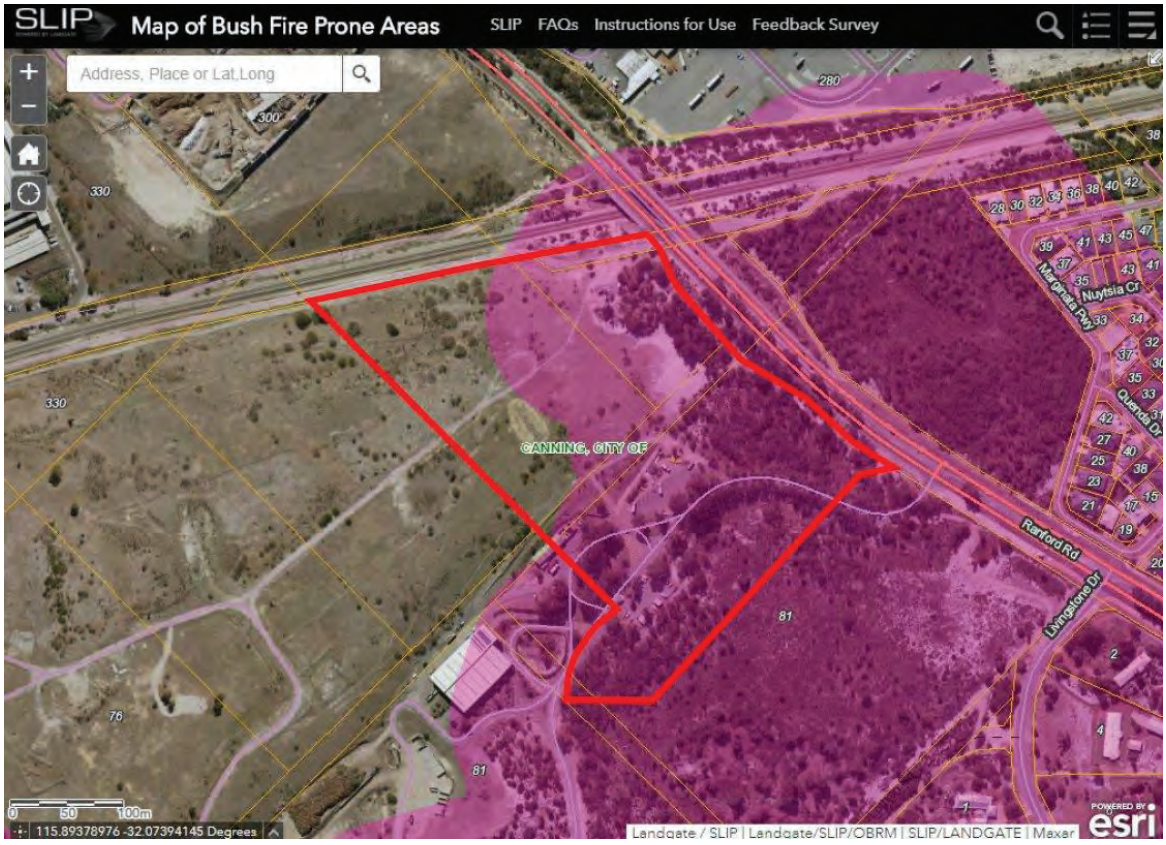
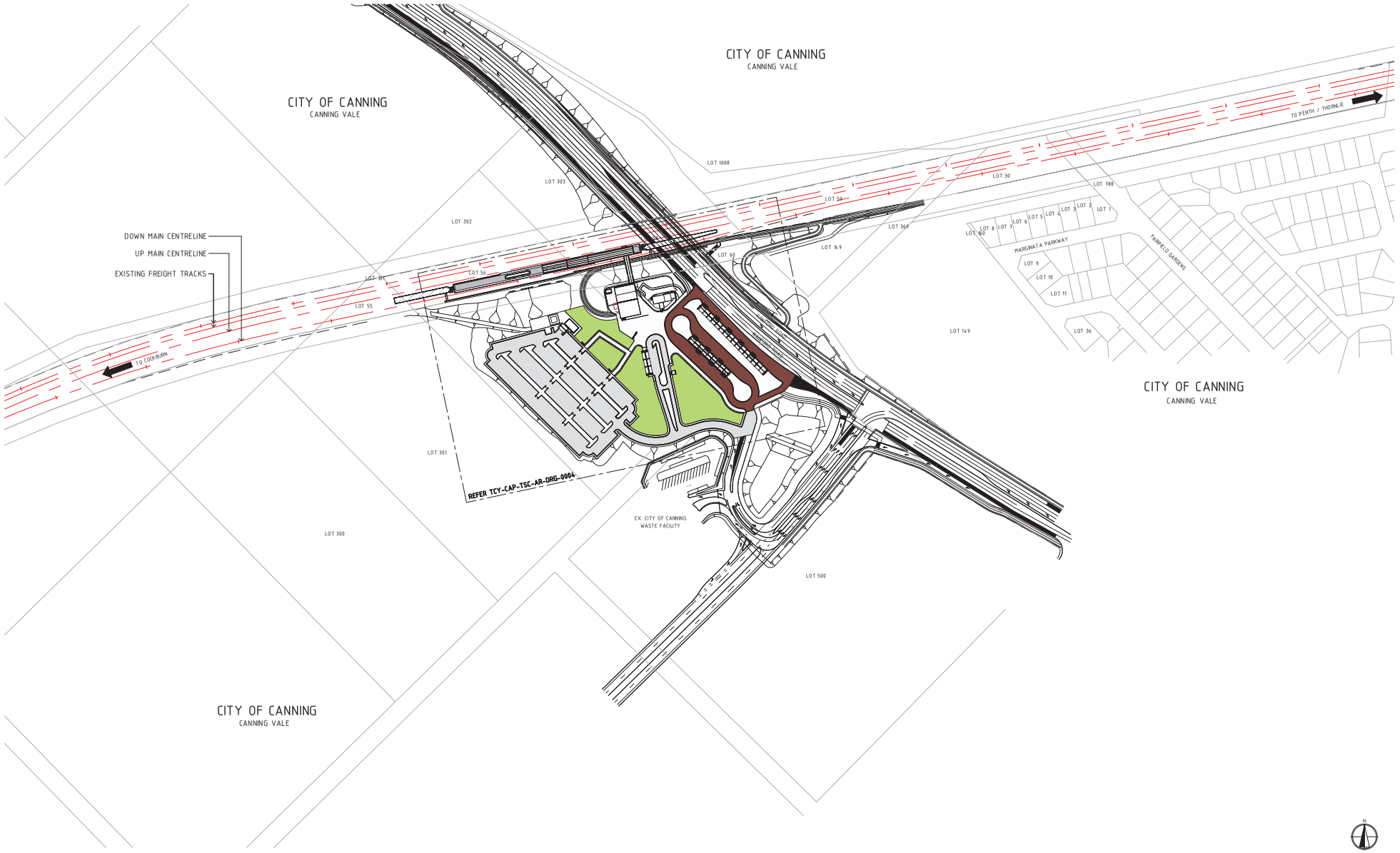


Plate 1: Map of Bush Fire Prone Areas (DFES 2020)

NOTE: REFER TCY-CAP-TSC-AR-DRG-0001 FOR GENERAL NOTES & REQUIREMENT TO DESTROY RECORDS



LOCATION / LIMIT OF WORKS PLAN
Scale: 1 : 2000

PRELIMINARY

DETAILED DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHKD	APP
A	06.07.20	15% DESIGN ISSUE	MG	KP	AA	

ORIG SIZE A1

0 10 20 30 40 50 100mm
AT ORIGINAL PLOT SIZE

NEWest Alliance

TCY-CAP-TSC-AR-DRG-0003

REFERENCES

SCALE : 1 : 2000 (@ A1)

DATUM : HORIZONTAL: VERTICAL:

PTA ACCEPTANCE STAMP

DESIGNED M.GIBBINS
DRAWN F.CHAN
CHECKED A.AINSWORTH
APPROVED FOR ISSUE
EXECUTIVE DIRECTOR PTA Division / External Company
DATE

Government of Western Australia Public Transport Authority

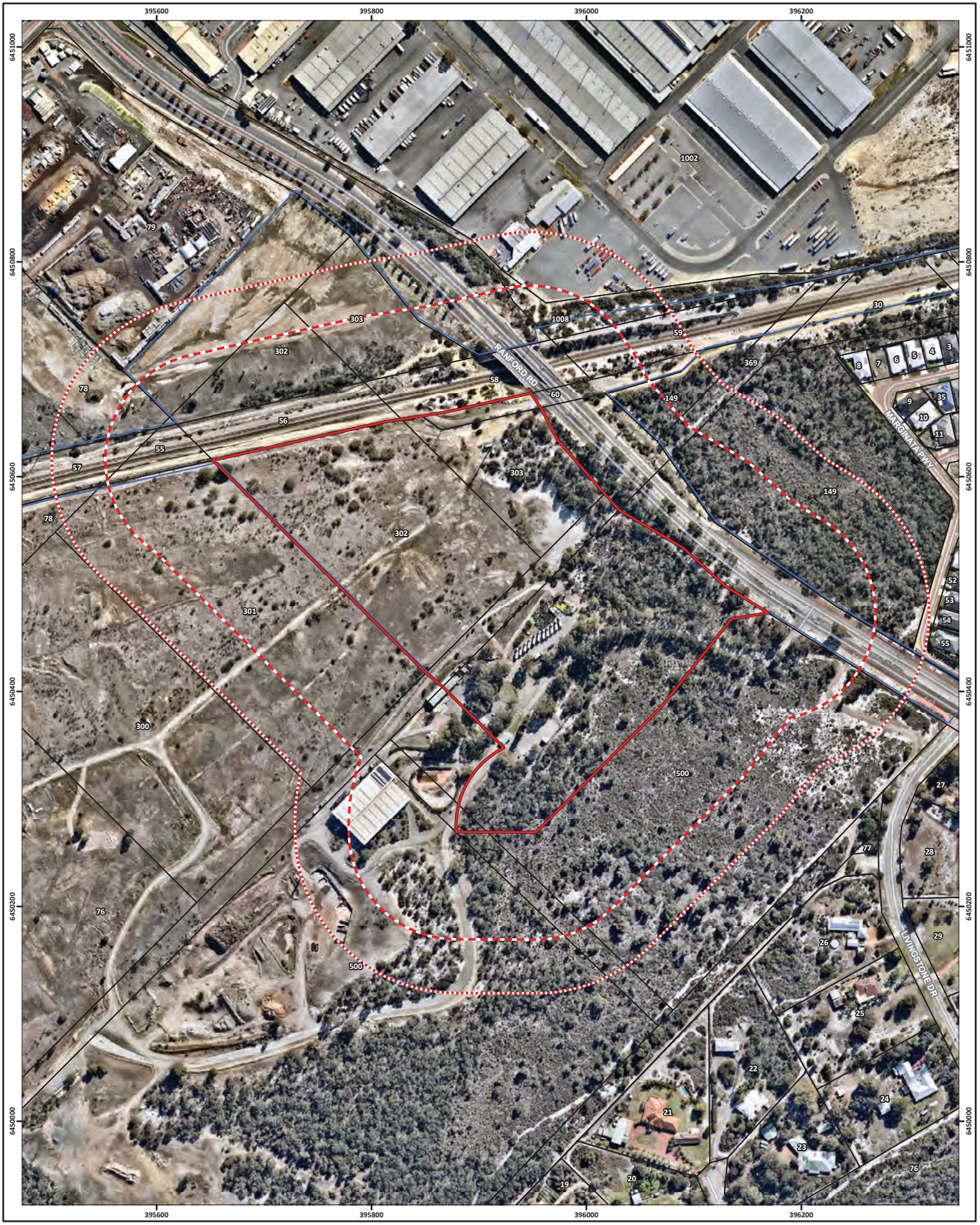
THORNLIE COCKBURN LINK

RANFORD ROAD STATION
LOCATION & LIMIT OF WORKS PLAN

PTA Drawing No:

REV: A

CAD DRAWING PATHNAME BIM 360://Metronet - TCY/TCY-CAP-TSC-AR-MOD-0001_RANFORD STATION.rvt



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary
- TCL Development envelope
- Roads (MRWA)

strategen JBS&G

0 100 metres

Ranford Road
City of Canning, WA

Job No: 59400		Scale 1:3,200 at A3		SITE OVERVIEW RANFORD ROAD STATION
Client: NEWest Alliance		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: jcrute	Checked By:	Version: A	Date: 27-Aug-2020	FIGURE: 2

Document Path: W:\Projects\1)Open\NEWest Alliance\59400 Yanchep Rail and Thornlie Link Bushfire Services\GIS\Maps\R014_Rev_A\59400_02_SiteOverview.mxd
Image Reference: www.nearmap.com© - Imagery Date: 3 May 2020.

2. Environmental considerations

2.1 Native vegetation – modification and clearing

The project area has been partially cleared as part of historical landfill-associated land uses and contains environmental assets in the form of remnant vegetation in the eastern half of the site. This remnant vegetation will be cleared as part of the proposal.

Table 1 provides a summary of a search of publicly available environmental data, which identifies that habitat for conservation significant species may occur within the project area boundary.

Impacts of the proposal on conservation significant species will need to be confirmed. Strategen-JBS&G understands that all relevant environmental/clearing approvals will be sought prior to any clearing or earthworks being conducted.

Table 1: Summary of environmental values

Environmental value	Not mapped as occurring within or adjacent to the project area	Mapped as occurring within or adjacent to the project area		Description
		Within	Adjacent	
Environmentally Sensitive Area		✓	✓	An Environmentally Sensitive Area is mapped as occurring within the southern and eastern portions of the project area and within adjacent land.
Swan Bioplan Regionally Significant Natural Area	✓			N/A.
Ecological linkages	✓			N/A.
Wetlands		✓	✓	The southern and eastern portions of the project area are mapped as containing Conservation Wetlands. Adjacent areas may contain Conservation and Resource Enhancement Wetlands. Ramsar sites are not mapped as occurring.
Waterways	✓			N/A.
Threatened Ecological Communities listed under the EPBC Act		✓	✓	Threatened Ecological Communities are mapped as occurring within and adjacent to the project area. Endangered Banksia Woodlands of the Swan Coastal Plain TEC is mapped as likely occurring within and adjacent to the project area. Tuart Woodlands are not mapped as occurring.
Threatened and priority flora				Mapping layer not available at time of report preparation.
Fauna habitat listed under the EPBC Act		✓	✓	Potential Quenda habitat is mapped as occurring in the southern and eastern portions of the project area, and adjacent areas. With respect to Carnaby's Black Cockatoo, the project area and adjacent areas contain potential feeding areas (southern and eastern portion pf the project area) and confirmed roosting areas.
Threatened and priority fauna				Mapping layer not available at time of report preparation.
Bush Forever Site		✓	✓	Bush Forever site 388 is located in the southern and eastern portion of the project area, and adjacent areas.

Environmental value	Not mapped as occurring within or adjacent to the project area	Mapped as occurring within or adjacent to the project area		Description
		Within	Adjacent	
DBCA managed lands and waters (includes legislated lands and waters and lands of interest)	✓			N/A.
Conservation covenants	✓			N/A.

2.2 Revegetation / Landscape Plans

No revegetation is proposed as part of the proposal. Any landscaping proposed will consist of low threat and managed gardens and street scaping in accordance with *AS 3959—2018* Clause 2.2.3.2 (f) and Schedule 1 of the Guidelines (refer to Appendix B).

3. Bushfire assessment results

3.1 Assessment inputs

3.1.1 Vegetation classification

Strategen-JBS&G assessed classified vegetation and exclusions within the 150 m assessment area through on-ground verification on 20 August 2020 in accordance with *AS 3959—2018 Construction of Buildings in Bushfire-Prone Areas* (AS 3959; SA 2018) and the *Visual Guide for Bushfire Risk Assessment in Western Australia* (DoP 2016). Georeferenced site photos and a description of the vegetation classifications and exclusions are contained in Appendix A and depicted in Figure 3.

Site observations indicate that classified vegetation within the 150 m assessment area predominantly consists of scrub and grassland vegetation, including:

- Class D scrub to the south, east and north of the project area
- Class G grassland to the west and south of the project area.

Existing areas excluded from classification within the 150 m assessment area include mineral earth tracks, existing urban development, existing road/rail infrastructure and areas already cleared within portions of the project area and broader TCL Development Envelope, excluded under Clauses 2.2.3.2 (e) and (f).

The proposed development will require further modification and management of all vegetation within the project area and TCL Development Envelope to achieve exclusion of these areas under Clauses 2.2.3.2 (e) and (f). Broader development works to construct a new railway track within the TCL Development Envelope (see Figure 1) will result in additional vegetation within the railway reserve either being removed or modified to a low threat state as per the following ongoing management regime:

- removal of all dead vegetation
- uplift of any trees
- brush cut/mow grass/weeds between fences and road verges
- removal of any vegetation inside the rail reserve that is a hazard or the potential to become one within 6 m of the closest rail
- maintenance of a 3 m wide firebreak, with an additional horizontal clearance of 0.5 m on both sides and a vertical clearance of 4 m established within the rail reserve against the reserve fencing.

On this basis, any vegetation within the rail reserve will be excluded under Clause 2.2.3.2 (f) and cleared areas will be excluded under Clause 2.2.3.2. (e).

3.1.2 Effective slope

Strategen-JBS&G assessed effective slope under classified vegetation within the 150 m assessment area through on-ground verification on 20 August 2020 in accordance with AS 3959. Results were cross-referenced with DPIRD 2m contour data and are depicted in Figure 3.

Site observations indicate that the project area and surrounding 150 m of land are situated on relatively flat terrain, with slope beneath classified vegetation being predominantly flat or upslope in relation to the project area. On this basis, Strategen-JBS&G has assigned effective slopes accordingly of flat/upslope for all classified vegetation plots.

3.1.3 Summary of inputs

Figure 3 illustrates the anticipated post-development vegetation classifications and exclusions following completion of subdivision works and implementation of low threat landscaping throughout the project area and adjacent 150 m. The post-development vegetation classifications/exclusions and effective slope are summarised in Table 2.

Table 2: Summary of post-development vegetation classifications, exclusions and effective slope

Vegetation plot	Vegetation classification	Effective slope	Comments
1	Class D Scrub	Flat/upslope (0°)	Scrub vegetation predominantly 2-6 m in height, dominated by acacia and banksia species.
2	Class G Grassland	Flat/upslope (0°)	Unmanaged grassland vegetation greater than 10 cm in height with no legally enforceable mechanism requiring it to be managed.
3	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Existing non-vegetated areas (i.e. mineral earth firebreaks, service tracks, existing cleared footprint, existing urban development, road/rail infrastructure) and low threat managed vegetation (i.e. managed gardens and road verges, mowed lawn, street trees).
4	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Area to be modified to a low threat state.

Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary
- TCL Development envelope

Vegetation classification
- Class D Scrub
- Class G Grassland
- Clause 2.2.3.2 (e) & (f) Area to be modified to non-vegetated and low threat state

- Topographic contours (mAHD)
- Photo point and direction
- Roads (MRWA)

strategen JBS&G

0 100 metres

Ranford Road
City of Canning, WA

Job No: 59400		Scale 1:3,200 at A3	
Client: NEWest Alliance		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: jcrute	Checked By:	Version: A	Date: 27-Aug-2020

VEGETATION CLASSIFICATION AND EFFECTIVE SLOPE RANFORD ROAD STATION

FIGURE: 3

Document Path: W:\Projects\1)Open\NEWest Alliance\59400 Yanchep Rail and Thornlie Link Bushfire Services\GIS\Maps\R014_Rev_A\59400_03_VegClassSlope.mxd
Image Reference: www.nearmap.com© - Imagery Date: 3 May 2020.

3.2 Assessment outputs

3.2.1 Bushfire Attack Level (BAL) contour assessment

Strategen-JBS&G has undertaken a BAL contour assessment in accordance with Method 1 of AS 3959 for the project area (Figure 4). The Method 1 procedure incorporates the following factors:

- state-adopted FDI 80 rating
- vegetation classification
- effective slope
- distance maintained between proposed development areas and the classified vegetation.

The BAL rating gives an indication of the level of bushfire attack (i.e. the radiant heat flux) that may be received by proposed development and subsequently informs the standard of building construction and/or setbacks required for proposed habitable development to potentially withstand such impacts.

The BAL contours are based on:

- the vegetation classifications and effective slope observed at the time of inspection as well as consideration of the proposed on-site clearing extent, resultant vegetation exclusions and separation distances achieved in line with the site plan
- the entire project area and broader TCL Development Envelope being modified to a low threat state as part of proposed development and managed in a low threat state to maintain exclusion under Clauses 2.2.3.2 (e) and (f).

Results of the BAL contour assessment are detailed in Table 3 and illustrated in Figure 4. The initial BAL applicable to both proposed habitable buildings is BAL–FZ. Implementation of the proposed APZ over the project area and TCL development envelope reduces the BAL rating for both habitable buildings to BAL-Low. The external portion of the APZ is discussed further in Table 4 and Section 5.2.

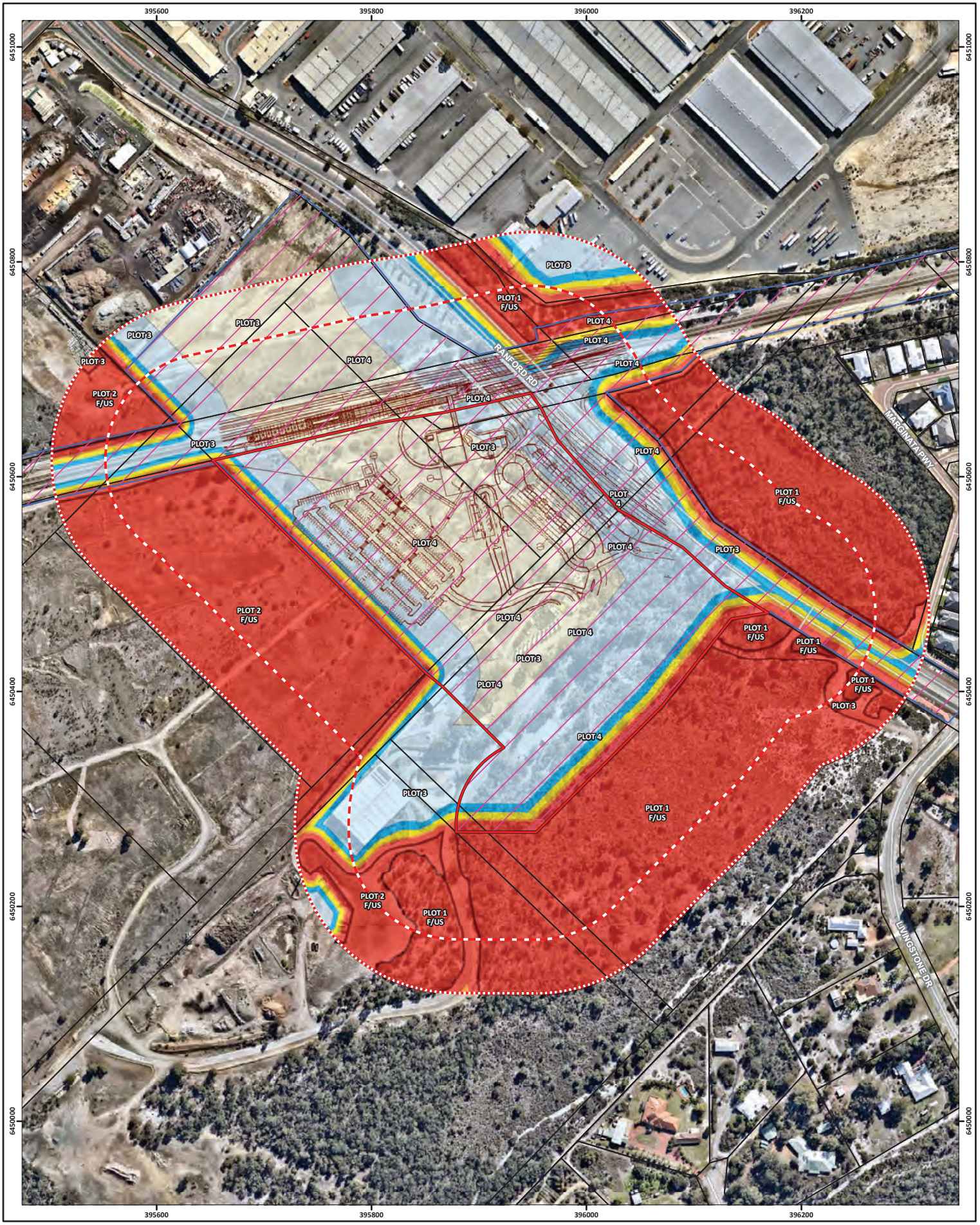
Table 3: BAL contour assessment results

Method 1 BAL determination				
Plot	**Vegetation classification**	**Effective slope**	**Separation distance to project area boundary**	**Highest BAL to project area boundary**
1	Class D Scrub	Flat/upslope (0°)	<10m	BAL–FZ
2	Class G Grassland	Flat/upslope (0°)	<6m	BAL–FZ
3	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	N/A	N/A
4	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	N/A	N/A

Table 4 lists the BAL applicable to each habitable building within the proposed development.

Table 4: BAL applicable to each habitable building

Building	Initial BAL	APZ	Revised BAL
Entry building	BAL–FZ	Entire project area and external TCL development envelope	BAL–Low
Staff office on platform	BAL–FZ	Entire project area and external TCL development envelope	BAL–Low



Legend

- Cadastral boundary
- TCL Development envelope
- APZ
- Classified vegetation

BAL contours
- BAL FZ
- BAL 40
- BAL 29
- BAL 19
- BAL 12.5
- BAL Low

- Design layout
- Roads (MRWA)

strategen JBS&G

0 100 metres

Ranford Road
City of Canning, WA

Job No: 59400		Scale 1:3,200 at A3		BAL CONTOUR MAP RANFORD ROAD STATION
Client: NEWest Alliance		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: jcrute	Checked By:	Version: A	Date: 10-Sep-2020	FIGURE: 4

Document Path: W:\Projects\1)Open\NEWest Alliance\59400 Yanchep Rail and Thornlie Link Bushfire Services\GIS\Maps\R014_Rev_A\59400_04_BALs.mxd
Image Reference: www.nearmap.com© - Imagery Date: 3 May 2020.

4. Identification of bushfire hazard issues

4.1 Bushfire context

The project area is surrounded by unmanaged grassland to the north and west and remnant bushland to the east and south. The project area has the potential to be impacted by bushfire attack from three scenarios outlined below.

4.1.1 Scenario 1: Bushfire approaching from the south

A bushfire approaching from the south is the most likely scenario with the most potential for significant fire behaviour. Remnant scrub vegetation to the south, albeit fragmented by patches of grassland, has the potential to support fire runs of up to 500 m. Fire behaviour will be unpredictable given the changes in vegetation, making rate of spread calculations difficult. Livingston Park Estate comprises rural-residential lots with significant pockets of remnant bushland retained within each property. Hot-works (i.e. welding, grinding etc), burn piles and other activities associated with semi-rural living and 'lifestyle' lots increase the potential for accidental ignition in these areas.

4.1.2 Scenario 2: Bushfire approaching from the west

Ken Hurst Park, approximately 600 m west of the site, has the potential to support significant fire behaviour over extended fire runs in dense scrub vegetation. However, grassland dominates the land between this vegetation and the project area which will support less significant fire behaviour. Grass fire will travel more rapidly towards the project area but will not produce the radiant heat and ember attack of a scrub fire.

4.1.3 Scenario 3: Bushfire approaching from the east

Remnant bushland bound by the Thornlie train line, Marginata Parkway and Ranford Road has the potential to support fire behaviour with fire runs up to 190 m. Strategen-JBS&G considers this to be the least likely scenario given the setback of the vegetation from the road and retaining/fencing along Marginata Parkway. The 35 m of separation between the remnant bushland and the project area provided by Ranford Road reduces the radiant heat impact of a bushfire in this vegetation on the project area.

There is no landscape scale bushfire risk to the project area given the following surrounding land uses:

- Jandakot Airport/industrial estate 1.5 km to the southwest with entirely non-vegetated footprint
- Canning Club rifle range 600 m to the south and Acourt Retreat Estate which have a significantly cleared (mineral earth) and degraded footprint.

Further to the abovementioned bushfire scenarios, the context of the development needs to be considered in relation to bushfire risk exposure. In particular, the following points are significant factors that will further reduce the bushfire risk to the site:

- design of the proposed development with carparks and driveways/roads at the high-risk interfaces
- suppression capability afforded by Canning Vale Fire Station within 1.6 km (five minute drive) of the project area
- the site is predominantly surrounded by urban development within a 5 km radius (i.e. densely populated, residential built out suburbs of Piara Waters, Canning Vale, Bull Creek, Leeming, Willetton and Murdoch).

4.2 Bushfire hazard issues

It is considered that the bushfire risk to the proposed development posed by the abovementioned hazards can be managed through standard application of acceptable solutions under the Guidelines, as well as through a direct bushfire suppression response if required. Bushfire mitigation strategies applicable to the proposed development are addressed in Section 5 of this BMP.

Examination of the bushfire hazards to the project area (Section 3) has identified the following bushfire hazard issues:

1. Based on the existing extent of vegetation external to the project area, the proposed habitable development is subject to an initial BAL of BAL-FZ. In order for the habitable buildings to achieve BAL-29 or lower, an APZ will be established across the entire project area and TCL development envelope. Implementation and enforcement of the APZ is further addressed in Section 5.2.

The proposed development will be serviced by a reticulated water supply from the Ranford Road reserve; and the proposed private driveway network within the site will provide occupants/emergency services with ample access points to Ranford Road and throughout the site. On this basis, and following implementation of the proposed APZ, the proposed development will be compliant for development location, siting and design of development, vehicular access and water supply. A compliance assessment against the bushfire protection criteria of the Guidelines is provided in Section 5

5. Assessment against the bushfire protection criteria

5.1 Compliance table

An acceptable solutions assessment against the bushfire protection criteria is provided in Table 5.

Table 5: Compliance with the bushfire protection criteria of the Guidelines

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies
Element 1: Location	A1.1 Development location	The BAL contour map (Figure 4) indicates that the proposed development can achieve BAL-29 or lower.
Element 2: Siting and design	A2.1 Asset Protection Zone	Implementation and maintenance of the entire project area and TCL Development Envelope as an APZ in accordance with Schedule 1 of the Guidelines (refer to Appendix B) will be sufficient to ensure future habitable buildings are subject to BAL-29 or lower. The APZ is illustrated in Figure 4 and discussed further in Section 5.2.
Element 3: Vehicular access	A3.1 Two access routes	The project area is provided with two-way public access through the proposed connection to Ranford Road, which is a major arterial road (State Route 13) providing access northwest and southeast of the site. The connection to Ranford Road is a 25 m wide low threat strip containing a footpath, 4 exiting lanes, 3 entering lanes and landscaped shoulders, which is unlikely to be compromised I the event of a bushfire impacting the project area. Two additional access points to Ranford Road are available via the bus interchange.
	A3.2 Public road	N/A – no public roads are proposed as part of the development and the project area is serviced by an existing compliant public road.
	A3.3 Cul-de-sac (including a dead-end-road)	N/A – no cul-de-sacs are proposed as part of the development and the project area is not serviced by an existing cul-de-sac.
	A3.4 Battle-axe	N/A – no battle-axes are proposed as part of the development and the project area is not serviced by an existing battle-axe.
	A3.5 Private driveway longer than 50 m	All private driveways longer than 50 m are to be constructed to the relevant technical requirements of the Guidelines (see Appendix C), including turn-around areas within 50 m of a building, passing bays if driveways are longer than 200 m and additional turn-around areas for fire appliances every 500 m.
	A3.6 Emergency access way	N/A - no permanent emergency access ways (EAWs) are proposed and the project area is not serviced by an existing EAW.
	A3.7 Fire service access routes (perimeter roads)	N/A – the proposed development does not require fire service access routes (FSARs) to achieve access within and around the perimeter of the project area.
	A3.8 Firebreak width	N/A – the lots within the project area are not zoned as 'Rural' or 'Special Rural' and the development footprint will comprise built form and low threat landscaping with sufficient internal access such that firebreaks will not be required.
Element 4: Water	A4.1 Reticulated areas	The proposed development will be connected to reticulated water supply via surrounding development in accordance with Water Corporations Design Standard 63 requirements (refer to Appendix D). Existing water hydrants are located at 200 m intervals along Ranford Road.
	A4.2 Non-reticulated areas	N/A – the proposed development is located within an existing reticulated area.
	A4.3 Individual lots within non-reticulated areas (Only for use if creating 1 additional lot)	N/A – the proposed development is located within an existing reticulated area.

5.2 Additional management strategies

Strategen-JBS&G makes the following additional bushfire management recommendations to inform ongoing planning stages of the development and increase the level of bushfire risk mitigation across the site.

5.2.1 External APZ

The project area will be modified to APZ standards as part of proposed development in accordance with the site plan (Figure 1) and Schedule 1 of the Guidelines Appendix B. In addition, the APZ will be established external to the site via vegetation modification to APZ standards throughout the broader TCL Development Envelope, as outlined in Figure 4. The external portion of the APZ will be established in line with the proposed site plan (see Figure 1), which will result in vegetation within the railway reserve either being removed or modified to a low threat state as per the following ongoing management regime:

- removal of all dead vegetation
- uplift of any trees
- brush cut/mow grass/weeds between fences and road verges
- removal of any vegetation inside the rail reserve that is a hazard or the potential to become one within 6 m of the closest rail
- maintenance of a 3 m wide firebreak, with an additional horizontal clearance of 0.5 m on both sides and a vertical clearance of 4 m established within the rail reserve against the reserve fencing.

5.2.2 Road verge fuel management

Existing and proposed road verges that have been excluded as low threat are to be managed to ensure the understorey and surface fuels remain in a low threat, minimal fuel condition in accordance with Clause 2.2.3.2 (f) of AS 3959. Ongoing road verge management is the responsibility of the City.

5.2.3 Building construction standards

The proposed development does not include any Class 1, 2, or 3 residential buildings and associated Class 10a structures, and as such, there is no statutory requirement for proposed buildings to meet the construction requirements of AS 3959.

5.2.4 BAL compliance report

A BAL compliance report will be prepared as a condition of DA approval following completion of construction works and prior to issue of building permits to validate the accuracy of the BAL contour assessment and confirm implementation of bushfire management actions.

5.2.5 Landscaping plan

The BAL contour assessment is reliant on all landscaping being implemented and maintained as low threat vegetation in accordance with Schedule 1 of the Guidelines (refer to Appendix B). Strategen-JBS&G recommends that a landscape management plan be prepared by the developer and approved by the City to ensure that the landscaping does not introduce an on-site bushfire hazard. Responsibility for establishment and maintenance of low threat landscaping is discussed in Section 6.

5.2.6 Compliance with annual firebreak notice

The developer/land manager are to comply with the City of Canning annual firebreak notice as amended (refer to Appendix E).

The City of Canning annual firebreak notice requires that all land which is not zoned 'Rural' or 'Special Rural' is required to clear and maintain the land free of all flammable matter, except for living trees, shrubs, plants, and lawns under cultivation, to a height of no greater than 10 cm. The project area is not zoned 'Rural' or 'Special Rural' and is therefore required to comply with these hazard reduction works.

6. Responsibilities for implementation and management of the bushfire measures

Implementation of the BMP applies to the developer, prospective landowners and the City to ensure bushfire management measures are adopted and implemented on an ongoing basis. A bushfire responsibilities table is provided in Table 6 to drive implementation of all bushfire management works associated with this BMP.

Table 6: Responsibilities for implementation and management of the bushfire measures

Implementation/management table	
Developer – prior to occupation of buildings	
No.	Implementation action
1	Establish any proposed landscaping across the project area and TCL development envelope to low threat standards, as stated in this BMP.
2	Establish the APZ to the dimensions and standards stated in this BMP.
3	Construct the private driveways to the standards stated in this BMP.
4	Construct the reticulated water supply and network of hydrants to the standards stated in this BMP.
5	Undertake BMP compliance reporting to confirm all necessary management actions have been implemented to achieve the outcomes intended under this BMP.
Landowner/occupier – ongoing	
No.	Implementation action
1	Maintain the Asset Protection Zone (APZ) to the dimensions and standards stated in this BMP.
2	Maintain the private driveways and reticulated water supply/hydrants to the standards stated in this BMP.
3	Comply with the City of Canning annual firebreak notice as amended.
Local government – ongoing management	
No.	Implementation action
1	Ensure compliance with the City's annual firebreak notice.
2	Maintain any landscaping/verges in a low threat minimal fuel condition as per Clause 2.2.3.2 (f) of AS 3959.

7. References

Department of Fire and Emergency Services (DFES) 2020, *Map of Bush Fire Prone Areas*, [Online], Government of Western Australia, available from: https://maps.slip.wa.gov.au/landgate/bushfireprone/, [13/08/2020].

Department of Planning (DoP) 2016, *Visual guide for bushfire risk assessment in Western Australia*, Department of Planning, Perth.

Standards Australia (SA) 2018, *Australian Standard AS 3959–2018 Construction of Buildings in Bushfire-prone Areas*, Standards Australia, Sydney.

Strategen-JBS&G 2020, *BAL Contour Assessment Report: Ranford Road Station*, Strategen-JBS&G, Bunbury/Perth.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth.

Western Australian Planning Commission (WAPC) 2017, *Guidelines for Planning in Bushfire Prone Areas*, Version 1.3 August 2017, Western Australian Planning Commission, Perth.

8. Limitations

Scope of services

This report ("the report") has been prepared by Strategen-JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen-JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen-JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen-JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen-JBS&G has also not attempted to determine whether any material matter has been omitted from the data. Strategen-JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen-JBS&G. The making of any assumption does not imply that Strategen-JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen-JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

Strategen-JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by Strategen-JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

Appendix A Vegetation plot photos and description

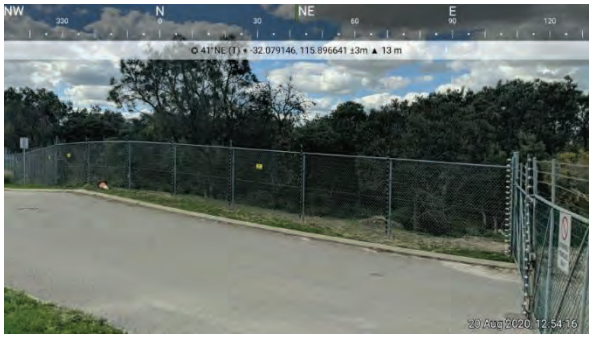


Photo ID: 1a

Photo ID: 1b

Photo ID: 1c

Plot number		Plot 1
Vegetation classification	**Pre-development**	Class D Scrub
	Post-development	Class D Scrub
Description / justification		Scrub vegetation predominantly 2-6 m in height, dominated by acacia and banksia species.

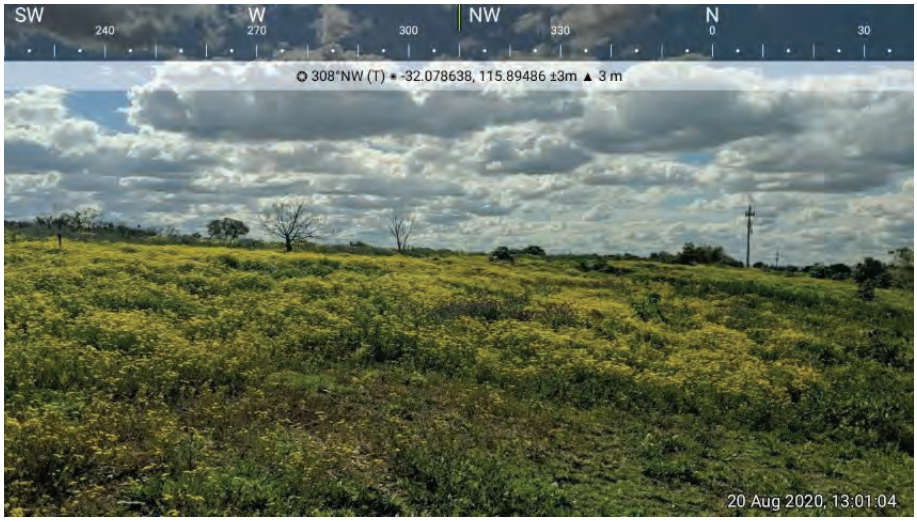


Photo ID: 2

Plot number		Plot 2
Vegetation classification	**Pre-development**	Class G Grassland
	Post-development	Class G Grassland
Description / justification		Unmanaged grassland vegetation greater than 10 cm in height with no legally enforceable mechanism requiring it to be managed.

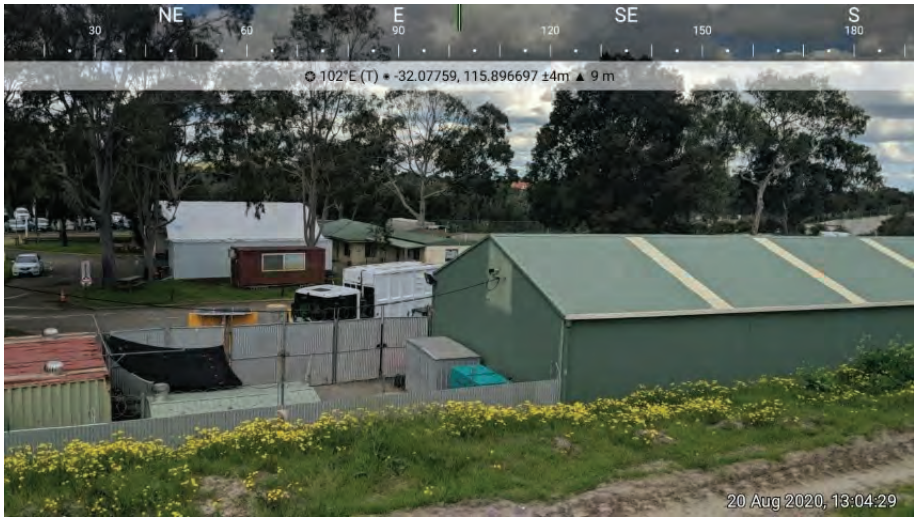


Photo ID: 3

Plot number		Plot 3
Vegetation classification	**Pre-development**	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
	Post-development	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
Description / justification		Existing non-vegetated areas (i.e. mineral earth firebreaks, service tracks, existing cleared footprint, existing urban development) and low threat managed vegetation (i.e. managed gardens and road verges, mowed lawn, street trees).

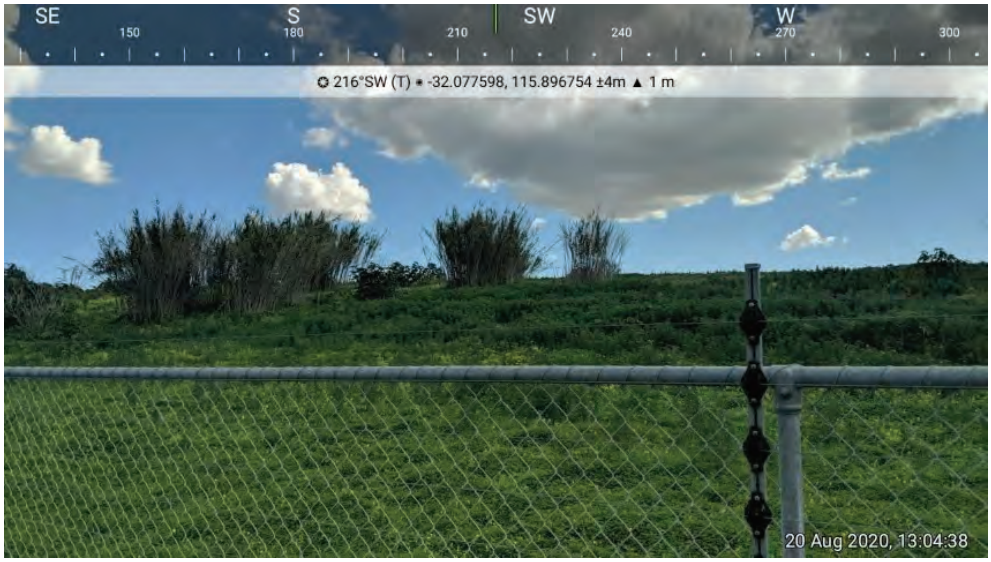


Photo ID: 4a

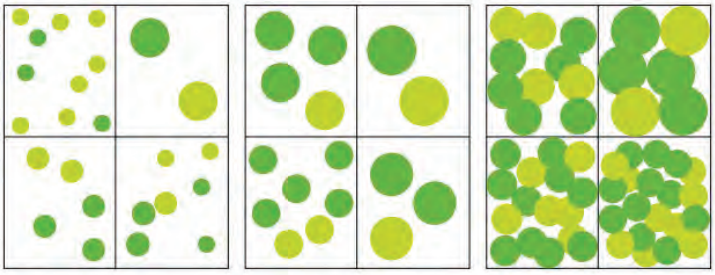
Photo ID: 4b

Plot number		Plot 4
Vegetation classification	**Pre-development**	Class D scrub / Class G grassland
	Post-development	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
Description / justification		Area to be modified to a low threat state as part of proposed development.

Appendix B APZ standards (Schedule 1 of the Guidelines)

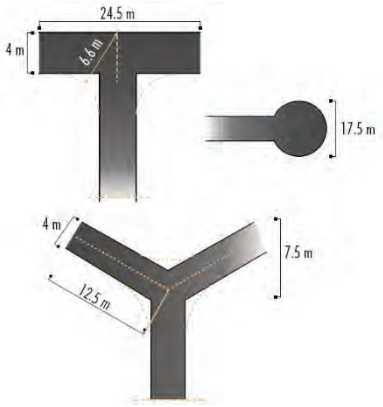
Schedule 1: Standards for Asset Protection Zones

- **Fences:** within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.
- **Objects:** within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.
- **Fine Fuel load:** combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare.
- **Trees (> 5 metres in height):** trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.



- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.
- **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.
- **Grass:** should be managed to maintain a height of 100 millimetres or less.

Appendix C Vehicular access technical standards of the Guidelines

Private driveway longer than 50 metres	
Acceptable solution A3.5	A private driveway is to meet all of the following requirements: • Requirements in Table 1, Column 3 • Required where a house site is more than 50 metres from a public road • Passing bays: every 200 metres with a minimum length of 20 metres and a minimum width of two metres (i.e. the combined width of the passing bay and constructed private driveway to be a minimum six metres) • Turn-around areas designed to accommodate type 3.4 fire appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres) and within 50 metres of a house • Any bridges or culverts are able to support a minimum weight capacity of 15 tonnes • All-weather surface (i.e. compacted gravel, limestone or sealed).
Explanatory note E3.5	For a driveway shorter than 50 metres, fire appliances typically operate from the street frontage however where the distance exceeds 50 metres, then fire appliances will need to gain access along the driveway in order to defend the property during a bushfire. Where house sites are more than 50 metres from a public road, access to individual houses and turnaround areas should be available for both conventional two-wheel drive vehicles of residents and type 3.4 fire appliances. Turn-around areas should be located within 50 metres of a house. Passing bays should be available where driveways are longer than 200 metres and turn-around areas in driveways that are longer than 500 metres. Circular and loop driveway designs may also be considered. These criteria should be addressed through subdivision design. Passing bays should be provided at 200 metre intervals along private driveways to allow two-way traffic. The passing bays should be a minimum length of 20 metres, with the combined width of the passing bay and the access being a minimum of six metres. Turn-around areas should allow type 3.4 fire appliances to turn around safely (i.e. kerb to kerb 17.5 metres) and should be available at the house sites and at 500 metre intervals along the driveway. 

Technical requirement	1	2	3	4	5
	Public road	Cul-de-sac	Private driveway longer than 50 m	Emergency access way	Fire service access routes
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal distance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5	4.5
Maximum grade <50 m	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius	8.5	8.5	8.5	8.5	8.5
* Refer to E3.2 Public roads: Trafficable surface					

Appendix D Water technical standards of the Guidelines

Reticulated areas	
Acceptable solution A4.1	The subdivision, development or land use is provided with a reticulated water supply in accordance with the specifications of the relevant water supply authority and Department of Fire and Emergency Services.
Explanatory note E4.1	Water supply authorities in Western Australia include the Water Corporation, Aqwest and the Busselton Water Board. The Water Corporation's 'No. 63 Water Reticulation Standard' is deemed to be the baseline criterion for developments and should be applied unless local water supply authorities' conditions apply.

Appendix E City of Canning annual firebreak notice

Approval to Burn

City approval is required prior to burning within the district.

Outside the Prohibited burning period, the City may issue approval to burn on land that is greater than 2000m^2.

Approvals are issued free of charge for a period of up to seven days and always expire on the Sunday.

An Application for Approval to Burn must be completed and submitted to the City at least three business days prior to the intended burn period.

To download an Application for Approval to Burn, please visit: **canning.wa.gov.au**

2 November to 14 December	**Restricted Burning**	**Permits required**
15 December to 31 March	**Prohibited Burning**	**No Burning – Penalties Apply**
1 April to 30 April	**Restricted Burning**	**Permits required**
1 May to 1 November	**Restricted Burning**	**Contact the City's Environmental Health Team**

Total Fire Ban

A Total Fire Ban effects everyone, whether you live near bush or in a built up area.

They are declared on days when fires will be difficult to control, are most likely to threaten lives and property, or when widespread fires are impacting the availability of resources.

When a Total Fire Ban is declared, it prohibits the lighting of any fires in the open air and any other activities that may start a fire.

To check if a Total Fire Ban is in place visit dfes.wa.gov.au or call DFES information line 13 3337

Did you know…

Lighting fires in the open air on properties under 2000m^2 is an offence and penalties may apply. Restrictions also apply to the lighting of fires on properties over 2000m^2

Additional Information

For additional information please call:
Department of Fire and Emergency Services (DFES)
on **13 3337** or **visit dfes.wa.gov.au**

City of Canning Ranger and Community Safety Services
on **1300 4 CANNING (1300 422 664)** or visit **canning.wa.gov.au**

City of Canning
1317 Albany Highway, Cannington WA 6107
Ph: 1300 4 CANNING (1300 422 664)
E: customer@canning.wa.gov.au
canning.wa.gov.au

cityofcanning

October 2016

Annual Fire Hazard Reduction Notice

& Important Fire Information

Working together for a safe community.

Annual Fire Hazard Reduction Notice

Bush Fires Act 1954 Section 33(1)

As a measure for preventing the outbreak of a bush fire, or for preventing the spread or extension of a bush fire which may occur, all owners and occupiers of land within the City's district are required to comply with the requirements of this notice.

Land zoned 'Rural' or 'Special Rural'

On or before the 1st day in November in each year, all owners or occupiers of land zoned 'Rural' or 'Special Rural' under the City of Canning Town Planning Scheme No.40 (Scheme) are required to:

(a) Clear the land free of all flammable matter, except for living trees, shrubs, plants and lawns under cultivation, to a height no greater than 10cm; or

(b) Clear a bare earth three (3) metre wide firebreak around all buildings, immediately inside all external boundaries of each lot on the land and within 20 metres of all stockpiled flammable matter by removing all flammable matter and all vegetation within the three (3) metre wide firebreak between the ground and four (4) metres above the ground so that the firebreak provides unrestricted vehicular access. The firebreaks must be continuous with no dead ends.

The firebreaks and measures set out above must be maintained up to and including the 30th day of April in the following year.

All other land, that is land which is not zoned 'Rural' or 'Special Rural'

At all times throughout the year, all owners or occupiers of land zoned other than 'Rural' or 'Special Rural' under the Scheme are required to clear and maintain the land free of all flammable matter, except for living trees, shrubs, plants and lawns under cultivation, to a height no greater than 10cm.

Flammable Matter

Flammable matter includes, but is not limited to, vegetation (except for living trees, shrubs, plants and lawns under cultivation), prunings, cardboard, wood, paper, general rubbish and any other combustible material.

Permission needed to vary requirements

If it is impracticable for any reason to clear firebreaks or to take measures in accordance with this Notice, owners and occupiers may apply in writing to the City for permission to provide firebreaks in alternative locations or take alternative measures.

Unless and until permission in writing is granted by the City, owners and occupiers shall comply with the requirements of this Notice.

Penalty for non-compliance

A person who fails to comply with the requisitions in this notice is guilty of an offence and liable to a penalty of $5,000. In addition, where the owner or occupier of the land fails to comply with a notice given pursuant to section 33(1) of the *Bush Fires Act 1954*, the City may enter upon the land and carry out the requisitions of the notice which have not been complied with. The City may recover the amount of any costs and expenses incurred in carrying out those requisitions as a debt due from the owner or occupier of the land.

Property Owner Notification

The City of Canning advises property owners of their legal responsibilities each year by way of advertising in the local newspaper, website and mailing of the Annual Hazard Reduction Notice with the residential rates notice.

Firebreak and Fire Hazard Inspections

The City of Canning is working towards ensuring all owners and occupiers of land within the district complete and maintain adequate fire hazard reduction measures.

Firebreak and Fire Hazard Inspections are conducted by Authorised Fire Control Officers to ensure compliance with the City's Annual Fire Hazard Reduction Notice.

Firebreak Contractors

For a list of contractors who may be willing to assist landowners comply with the Annual Fire Hazard Reduction Notice. Please visit **canning.wa.gov.au**

Bush Fire Prone Zones

Bush Fire Prone Zones are areas identified by the Fire and Emergency Services Commissioner as being subject, or likely to be subject, to bush fire attack. A Bush Fire Prone Zone is identified by the presence of and proximity to bush fire prone vegetation. If you live in a designated Bush Fire Prone Zone you may be subject to additional planning and construction requirements.

To see if you live in a Bush Fire Prone Zone visit

dfes.wa.gov.au

Document Status

Report version	Rev No.	Purpose	Author	Reviewed and Approved for Issue	
				Name	Date
Draft Report	**Rev A**	**For client review**	**Brodie Mastrangelo (BPAD 45985, Level 1)**	**Zac Cockerill (BPAD 37803, Level 2)**	**10 September 2020**
Final Report	Rev 0				


www.jbsg.com.au

APPENDIX H SITE MANAGEMENT PLAN

Public Transport Authority of Western Australia

Thornlie-Cockburn Link: Site Management Plan
Ranford Road Station Development

September 2020

Table of contents

Table index

Figure index

Appendices

1. Introduction

Public Transport Authority (PTA) engaged GHD Pty Ltd (GHD) to prepare a Site Management Plan (SMP) with respect to the Ranford Road Station development (the 'Site'), as part of the Thornlie-Cockburn Link (TCL) Project.

1.1 Site identification

The Site is located within an existing rail corridor and former landfills in the suburb of Canning Vale, approximately 14 km south-east of the Perth Central Business District (CBD). The indicative extent of the Ranford Road Station site is shown in Figure 1 below.

The Site comprises portions of land parcels identified as:

- Portion of Lot 79 on Plan 2903, Lots 302 and 303 on Plan 30748 (former landfill sites comprising: former Bannister Road Landfill to the north of the rail corridor and former Ranford Road Landfill to the south of the rail corridor).
- Lots 56 and 58 on Plan 10039 (existing rail corridor).
- Portion of Lot 500 on Plan 15262 (City of Canning Waste Transfer Station - CCWTS).
- Lot 60 on Diagram 60697 (rail corridor access road/Ranford Road).
- Portion of land parcel 3855416 (between Lot 302 and portion Lot 500).
- Portion of land parcel 3964676 (to the south of land parcel 3855416 and adjacent to Lot 501 to the west).
- Portion of land parcel 3836919 (to the east of Lot 303).
- Ranford Road reserve (refer to Section 1.2.4).

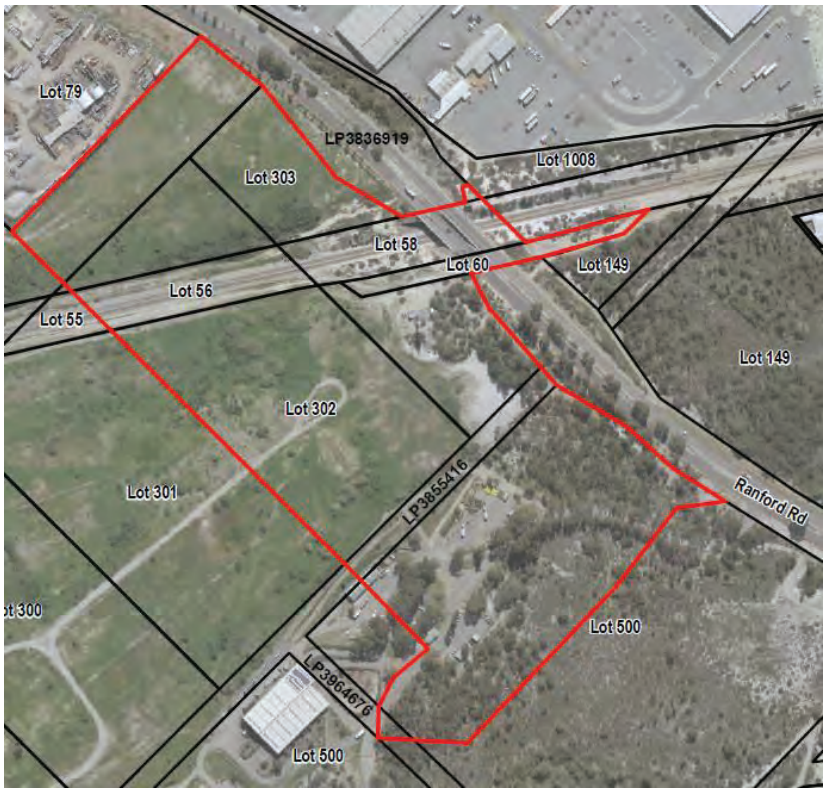


Figure 1 Ranford Road Station Site – indicative extent (red)

The surrounding land use of the Site is summarised below:

- North-west (portion of Lot 79): Commercial premises comprising 'Soils Aint Soils' (part of the former Bannister Road Landfill Site).
- North-east: Road reserve (Ranford Road: with Canning Vale Markets, bush forever area (site 388) and residential further to the north east).
- South-east: Vacant land (portion of Lot 500) and bush forever area (site 388) further south-east.
- South-west: Vacant land (portion of rail corridor Lot 55, portion of Lot 301, former Ranford Road Landfill Site) and a waste transfer facility further south-west.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.8 and the assumptions and qualifications contained throughout the report.

1.2 Proposed development

1.2.1 Thornlie-Cockburn Link (TCL)

As part of the station development project, the Public Transport Authority (PTA) is planning the construction of the Thornlie Cockburn Link (TCL), which will provide a 17.5 km link connecting the existing Thornlie Rail Line to Cockburn Central Station on the existing Mandurah line, via an existing freight rail corridor. The project will provide two new stations and park and ride facilities at Nicholson Road and Ranford Road in Canning Vale.

1.2.2 Ranford Road Station, Canning Vale

As noted above, a new station will be constructed at Ranford Road in Canning Vale, on the southern corner of the crossing of Ranford Road and the existing freight railway as shown in development plans provided in Appendix A.

The new station will occupy portions of Lot 302 and 303 on Deposited Plan 30748 and portion of Lot 500 on Plan 15262. Lot 500 is currently used for the City of Canning Waste Transfer Station Disposal Facility (CCWTS). Lots 302 and 303 within the site boundary are vacant and form part of the former Ranford Road Landfill that was operated by the City of Canning.

The new station will cover the area of the former landfill and the waste transfer station at the Site as shown in Appendix A. This will comprise the following key features:

- Train station (station entry building and concourse connecting to an island platform).
- Bus interchange
- Car parking facilities and drop-off area.
- Infiltration basin to receive station run-off (no infiltration within landfill areas is proposed).

Based on concept designs provided by the PTA, it is understood that the proposed form of development will involve cut to fill activities in order to create a development platform across the Site, as shown in Appendix A. This includes areas of previous landfilling activities. Imported fill material will also be required to balance the expected deficit of fill material required for the development.

Whilst it is acknowledged that future development plans may change, for the purpose of this SMP, it is considered that plans provided in Appendix A provide a reasonable worst-case development scenario for the purpose of seeking to achieve the objectives of the SMP (Section 1.6).

1.2.3 Ranford Road – laydown area (construction phase)

During construction phase, the northern portion of the Site (portions of Lot 302, 303 and 79: part of the former Bannister Road Landfill) is to be used as a laydown area (e.g. storing of materials for construction and associated equipment/machinery) and potentially for siting of temporary offices. It is understood that land disturbance and/or dewatering within this area is not anticipated and use as a laydown area is an interim measure during construction only.

1.2.4 Ranford Road Reserve and associated development features

PTA has also advised of the following development works associated with the existing Ranford Road reserve; these works will be undertaken within both the existing road reserve (Ranford Road) and within the Site:

- Permanent road construction of Ranford Road, together with its various temporary staging to produce the final alignment
- All required road furniture to achieve design (i.e. street lighting, kerbing, road barriers, line marking, road drainage).
- Waste Transfer Station temporary and permanent access.
- JELR permanent road with its associated infrastructure (traffic signals, shared paths).
- Construction of all retaining walls; both temporary and permanent.
- Relocation and installation of all utilities required to feed both existing facilities (waste transfer station, monopole) and new facilities (station) and any current verge facilities (those required to be relocated to facilitate the bridge construction have already been covered in the previous SMP (refer to Section 1.2.5)
- Construction of shared path or principal shared paths and any connections to existing paths.

1.2.5 Excluded items

Land disturbance work comprising the following construction activities are not included in this SMP:

- Installation of pile infrastructure for the purpose of a new bridge within the existing rail corridor.
- Relocation, installation and protection of underground services/utilities associated with the Ranford Road Bridge modifications.

For details of management measures for these works, reference should be made to the separate SMP that has been developed for such works (GHD, 2020b).

1.3 Contamination status of the site

Portions of Lot 302, 303 and 500 to the south of the rail corridor comprises a portion of the former Ranford Road Landfill, currently classified as '*Possibly contaminated – investigation required'*. Previously, Mr Nicholas Owen of Australian Environmental Auditors (AEA) was appointed on a voluntary basis for this area of the site. The current Auditor, Andrew Lau of JBS&G, has been appointed on a mandatory basis as the DWER accredited Contaminated Sites Auditor for this area of the site and is herein referred to as 'the Auditor.'

Portions of Lot 302, 303 and 79 to the north of the rail corridor comprise the former Bannister Road Landfill Site. It is understood the site is currently classified by DWER as '*Possibly contaminated – investigation required'* under the Act.

On July 2020, Lots 56, 58 and 60 were classified by DWER as '*Possibly contaminated – investigation required'* under the Act.

Investigations have been undertaken previously at the site, which are relevant to the proposed development as summarised below.

1.4 Previous investigations

Previous environmental/geotechnical reports concerning known or expected site conditions that are relevant to development of this SMP are identified below (in chronological order):

- *PTA Metronet – Thornlie to Cockburn Link Preliminary Acid Sulfate Soil Investigation* (Golder, 2018).
- *Metronet – Thornlie to Cockburn Geotechnical and Environmental Investigations* (Golder, 2019)[1].
- *Ranford Road Metronet - Additional Groundwater Data – Review* (GHD, 2019a).
- *Ranford Road Metronet - Landfill Gas Modelling* (GHD, 2019b).
- *Ranford Road Metronet – Addendum gas monitoring report* (GHD, 2020a).
- *Ranford Road Metronet – Additional Groundwater Review – Summary Letter* (GHD, 2020c).
- *Ranford Road Metronet - Detailed Site Investigation* (GHD, 2020d).
- *Detailed Site Investigation. Lot 79 and part of Lots 78, 302 and 303 Bannister Road, Canning Vale.* July 2020 (Talis, 2020).

All documents referenced above are current at the time of preparing the SMP.

1.4.1 Existing rail corridor

Previous investigations within the existing rail corridor were undertaken as part of a geotechnical and environmental investigation along the proposed rail alignment from Thornlie to Cockburn Stations (Golder, 2018 and 2019). Specifically in relation to work within the rail corridor in the vicinity of the proposed Ranford Road Station, the advancement of six soil bores and installation of two groundwater monitoring wells, one geotechnical bore and one landfill gas bore took place. These were completed as part of a broader field and laboratory program, which sought to assess and characterise potential contamination of soil and groundwater, and establish baseline conditions to assist the preparing of management plans during civil phase of works (Golder, 2019).

Based on the work completed by Golder (2019), there was no indication of existing soil contamination based on field visual and laboratory analytical results; concentrations of contaminants of potential concern (COPC) were recorded below the adopted assessment levels. However, Golder identified that the potential for encountering unexpected finds during development (including asbestos-containing material [ACM]) could not be discounted.

Golder (2019) recommended that a management plan should be prepared to outline a process of managing ACM and/or unexpected finds/contamination that may be encountered during construction works.

Further detail in relation to previous investigations within the existing rail corridor is provided in Section 2.1.

[1] Note: Subsequent groundwater sampling was conducted by Golder in February and May 2020, however a copy of the groundwater monitoring report was provided to GHD at the time this SMP was prepared. The review of Golder 2020 data was limited to the review of laboratory analytical data provided by PTA.

1.4.2 Portion of Lot 302, 303 and 500 (south of rail corridor)

Portions of Lot 302 and Lot 303 on Deposited Plan 30748 and portion of Lot 500 on Plan 15262 are located immediately to the south of the rail corridor. This comprises part of the former Ranford Road Landfill Site (equivalent to a Class II putrescible landfill as per current guidelines[2]), remnant native vegetation, and wetland areas. A portion of Lot 500 is currently used for the City of Canning Waste Transfer Station (CCWTS); Lots 302 and 303 are vacant.

Previous environmental investigations have comprised a Preliminary Site Investigation (PSI: GHD, 2016) with limited sampling (soil, groundwater and landfill gas). The PSI identified that landfilling activities were likely to have occurred from 1981 to 1996. Landfill waste material encountered during the PSI was predominantly putrescible in nature, with organic material indicative of household waste.

The PSI developed an initial conceptual site model (CSM) to identify potentially complete source-pathway-receptor (SPR) linkages that may be present for the proposed development and resultant risks that may exist. In relation to these potential risks, the PSI identified data gaps requiring further assessment and recommended the development of a Sampling and Analysis Quality Plan (SAQP) to facilitate such assessment.

GHD subsequently prepared a SAQP (GHD, 2017) and associated Data Quality Objectives (DQOs) to address the identified data gaps (GHD, 2016) and outline the proposed sampling approach and methodologies for a Detailed Site Investigation (DSI). Subsequent DSI (GHD 2019a) completed at the Ranford Road Station site identified:

- Surface ACM (bonded, non-friable), waste inclusions (physical hazards) and possible presence of ACM at depth in the landfill capping material (if disturbed).
- Physical hazards and ACM associated with the landfill waste mass (if disturbed).
- Elevated aluminium, chloride and ammonia in groundwater exceeding non-potable use of groundwater (NPUG) assessment criteria.
- Elevated per- and polyfluoroalkyl substances (PFAS) in groundwater exceeding 99% fresh water (FW) guidelines.
- Elevated landfill gas/vapours in the former landfill.

An assessment of risks posed to relevant human health and ecological receptors undertaken in the DSI with respect to proposed development (and the current site condition) identified risks to relevant receptors that required management measures to be implemented to ensure no unacceptable risks during development, with respect to landfill gases and vapours, soil (capping material and landfill waste), and groundwater.

GHD (2020d) recommended, *inter alia*:

- A SMP be prepared to document the remediation and other management actions to be implemented to address risks posed to relevant receptors and to inform the design of the proposed development.
- The SMP should include construction phase site management measures (i.e. transient measures to be adopted for construction phase).
- Risks associated with working at the Site during construction will also require specific management through the implementation of the Construction Environment Management Plan (CEMP)[3].

[2] Landfill Waste Classification and Waste Definitions 1996 (as amended 2018) [DWER, 2018], Table 2.

[3] The CEMP shall cover environmental risks and management/controls only. Health and safety related risks and management/ controls will be covered under the NWA Safety Management Plan.

Further detail in relation to previous investigations within this portion of the Site is provided in Section 2.1.

Additional assessment since completion of the DSI

Based on the recommendations of the DSI, additional work has been completed, comprising the following (as identified in Section 1.4):

- *Ranford Road Metronet - Additional Groundwater Data – Review* (GHD, 2019a).
- *Ranford Road Metronet - Landfill Gas Modelling* (GHD, 2019b).
- *Ranford Road Metronet – Addendum gas monitoring report* (GHD, 2020a).
- *Ranford Road Metronet – Addendum Groundwater Data Review – Summary Letter* (GHD, 2020c).

Further detail in relation to the additional assessments is provided in Section 2.1.

1.4.3 Portion of Lot 79, 302 and 303 (north of rail corridor)

This portion of the Site vacant land which is immediately north to the existing rail corridor. Prior to such use, the site was a landfill operated by the City of Canning (former Bannister Road Landfill Site).

Previous investigations within these areas of the Site have comprised groundwater monitoring, a PSI, landfill gas assessment, and a DSI undertaken by Talis (2020). The DSI undertaken by Talis (2020) was intended to inform redevelopment of this area for commercial/industrial use.

The DSI included twenty three grid-based soil bores (completed with landfill gas monitoring wells), ten targeted soil bores (six completed as gas monitoring wells), three groundwater monitoring wells, soil and groundwater analysis, monthly landfill gas monitoring for 1 year and a surface landfill gas emissions survey. The DSI identified the following:

- Sand cap (average 0.9 m thickness) over landfill waste material to a maximum observed depth of 10.5 m below ground level (bgl), underlain by fine to coarse grained sand.
- Occasional minor fragments of ACM and fly-tipped ACM (fence panels) observed at the site surface.
- Elevated metals, chloride and ammonia in groundwater exceeding NPUG assessment criteria.
- Pathogens in groundwater exceeding relevant assessment criteria for urban recreational areas, open spaces, parks and gardens.
- Elevated PFAS in groundwater exceeding 99% fresh water FW guidelines.
- Elevated landfill gases/vapours in the former landfill. In particular the assessment identified a ‘Very Low’ to “Low” risk classification (i.e. Characteristic Situation CS1 at the boundaries of the property and CS2 across the remainder of the property) from monitoring data collected. However this was elevated to CS3 across the entirely of the property as a conservative measure due to the property being a former putrescible landfill.

Based on development of a CSM and associated risk assessment, this portion of the Site was considered by Talis (2020) to be suitable for future commercial/industrial use (with respect to risks posed by contamination). This was based on the following factors identified by Talis (2020):

- Groundwater is not utilised during the redevelopment of the site (i.e. use of scheme water only).

- Any users of groundwater within 400 m of the investigated site to be informed of groundwater assessment findings (elevated ammonia, slightly elevated aluminium) and testing of groundwater for suitability to be recommended.
- Vegetation planted within any open space etc. is selected to ensure the root systems do not intersect the waste mass.
- Confirmatory testing beneath all footprint of all existing ASTs and soil stockpiles following removal (existing Soils Aint Soils occupied area at Lot 79).
- Implementation of gas management measures prior, during and after construction (within all buildings, services and beneath areas of hardstand). To include monitoring of adjacent buildings following redevelopment.
- Development of suitable management plans to mitigate ongoing risk posed by landfill gases. To include:
  - Assessment of gas mitigation measures vulnerability to volatile organic compounds (VOC).
  - Current site users possibly entry into confirned sapces (i.e. service trenches).
  - Construction Environment Management Plan (CEMP) for future development of the assessed site.
- Remediation of ACM fragments prior to development ('emu bob').

Further to the DSI (Talis, 2020) and with particular respect to groundwater, GHD conducted a review of additional groundwater data from sampling events conducted by Talis in 2017 and 2019 and Golder in 2020. The additional groundwater data review was intended to provide off-site context with respect to the nature and extent of impacts in groundwater (including PFAS and other substances) up- and down-hydraulic gradient of the former Ranford Road Landfill[4] and to supplement the understanding of groundwater impacts beneath the former Ranford Road landfill (GHD, 2019a). Based on the review of additional groundwater data (provided by City of Canning and PTA) and comparison with GHD (2019a) groundwater data, the following conclusions were made:

- The Talis 2017 and 2019 and Golder 2020 analytical results were generally consistent with the GHD (2019a) analytical results (PFAS and substances other than PFAS).
- The dominant PFAS detected at the former landfills (Ranford Road and Bannister Road) were PFSAs and PFCAs comprising PFOA, PFHxS, PFOS, PFHxA, PFBA, and PFBS. This contrasts with up gradient location RR02 where PFHxS, PFOS, PFOA, and PFBA only were the dominant PFAS and at concentrations generally an order of magnitude lower than at the former landfills.
- Off-site monitoring well GWOS02 reported concentrations of PFOA, PFHxS, and 6:2 FTSA above LOR and PFOS above adopted assessment criteria in 2020. This contrasts with the previous 2019 Talis data which reported all PFAS concentrations below LOR at GWOS02. It is noted that this concentration is marginally higher than the down gradient concentration closer to the Site at GW13 and detected PFOS at the offsite landfill area closest to GWOS02 (GW01 and GW02). The data collected appears more indicative of local background concentrations in the vicinity of the Roe Highway and commercial industrial area rather than landfill influence directly attributable the site.
- Additional Golder monitoring wells GW14 and GW15 sampled in 2020 and located adjacent to the northern boundary of the Site generally reported PFAS concentrations an order of

[4] As defined by the site boundary presented in GHD, 2019a which comprises a portion of the station development site boundary identified and referred to in this SMP.

magnitude lower than report in onsite monitoring well MW01 and cross gradient monitoring well RR08.

- The results indicate that there are offsite sources of PFAS contributing to PFAS detected in groundwater, specifically:
  - Larger part of the (same) former landfill south-west of the Site (former Ranford Road landfill site).
  - Separate landfill to the north of the Site (Bannister Road).
  - Up gradient ambient background sources (PFAS and other substances).
- The relative contribution of PFAS and other substances (particularly ammonia and aluminium) from the portion of the landfill waste mass (at the former Ranford Road and Bannister Road landfill sites) to the concentrations observed down gradient (i.e. to the north of the landfills) is uncertain, and may not be possible to reliably determine given the proximity of offsite waste masses. With respect to this, the following was considered relevant to note:
  - There is evidence to indicate that the down gradient extent of influence that may be attributable to the landfills as a whole, may be limited to within approximately 500 m. This was indicated by the 2019 and 2020 results for monitoring well MC located down gradient of the former landfills, which reported PFAS below LOR and significantly lower concentrations of ammonia and aluminium.
  - Potential for contribution to down gradient PFAS concentrations within groundwater from other possible sources in the developed, commercial environment down gradient of the Site cannot be precluded.
  - Microbial activity appears limited to the immediate vicinity of the landfills.

Further detail in relation to previous investigations within the portion of the Site comprising Lot 79, Lot 302, and Lot 303 is provided in Section 2.1.

1.4.4 Refined conceptual site model (CSM)

The proposed change in Site use from a former landfill to a station has the potential to introduce new pathways and receptors to sources of contamination associated with the former landfill at the Site. This can create risks that did not exist previously if not appropriately managed, due to:

- Disturbance of waste materials (e.g. exposing waste materials at surface).
- Potential for enhancing landfill leachate migration (and potentially generation).
- Potential for enhancing landfill gas generation and promoting migration of landfill gases/vapours, resulting in:
  - Enhanced degradation of wastes by biological processes due to drainage infiltration.
  - Development of hazardous atmospheres within enclosed spaces.
  - Enhanced lateral landfill gas/vapour migration (on-site and potentially off-site).
  - Cross-boundary migration towards the Site from the remainder of the landfill waste mass off-site to the south-west.
  - Vertical migration of landfill gases and/or vapours towards buildings/infrastructure associated with deep foundations such as piled foundations.

The CSM for the proposed development has been refined with respect to outcomes from investigations completed to date with respect to development of a new station at the Site as presented in Section 2.

1.5 Purpose

As part of the TCL project State environmental approval, the State issued Ministerial Statement 1114 which contains conditions the project is required to comply with to ensure that the development does not pose a risk to human health or environmental values. Of specific relevance to the proposed development works, Condition 10-2 states that prior to ground-disturbing activities within the Ranford Road Station site, the proponent shall, *inter alia*, prepare and submit a management plan that includes details of the management of contamination management during construction.

The above condition is consistent with recommendations generated from previous assessments (GHD, 2020d; Golder, 2019). On this basis, the purpose of the SMP is to provide a framework to manage potential risks from contamination associated with the Ranford Road Station Development.

1.6 Objectives

Site management objectives and targets proposed have been developed on the basis of ensuring no unacceptable risks to relevant receptors for development of the Ranford Road Station. Specifically, the objective of this SMP (in response to Ministerial Statement 1114) is to ensure no unacceptable risk to relevant receptors during construction of the Ranford Road Station.

For the purpose of this SMP, relevant receptors (as defined in the Conceptual Site Model in Section 2) comprise:

- Construction workers due to:
  - exposure to potential soil contamination, including chemical exposure risk and ACM.
  - potential for landfill gas (LFG) and vapour migration to the Site and accumulation in enclosed spaces (where present) at the Site.
- Off-site adjacent land users due to:
  - possible exposure to soil contamination (e.g. chemical substances and ACM) as a result of wind-blown dust.
  - LFG and vapour migration off-site and accumulation in enclosed spaces off-site.

1.7 Assumptions

The SMP has been developed based on the following assumptions:

- A separate Ongoing Site Management Plan (OSMP) is to be developed at a later stage (i.e. on completion of construction). The specific objective of the OSMP will be to manage residual risks for ongoing operation of the Site as a new station using appropriate measures to eliminate risks (or otherwise control activities) where a residual risk of exposure to contamination may still occur without such ongoing management (e.g. maintenance workers undertaking future excavations in an uncontrolled manner).
- The measures identified in this SMP are robust and conservative for the nature of development features proposed and future changes are expected to relate to matters of detail rather than fundamental changes to the nature of management proposed. However, the currency of the SMP shall be reviewed and amended as required in response to the maturity of development proposals.
- Development plans current at the time of reporting are provided in Appendix A.
- Development features will be designed or otherwise selected that will adequately mitigate future leachate generation for each relevant stage of the development. It is assumed that a

water balance shall be developed for each relevant stage of the development to support the design and identify appropriate water and leachate management measures for subsequent implementation.

- The existing gas extraction system at the Site was not designed or installed for the purpose of mitigating risks to development. On this basis, the existing gas extraction system is assumed not to be suitable for reuse in its current condition (Appendix A).
- Removal of the existing gas extraction system at the Site is required to permit construction of the proposed development.
- Foundation design and specification should include appropriate measures to mitigate risks of degradation that may affect the performance or durability of the piles (e.g. such as from the potential presence of ASS or substances in groundwater associated with the presence of the former landfills). This matter is to be addressed separately in pile design and specification to be undertaken by others and is not considered in this SMP.
- No excavation of Acid Sulfate Soil (ASS) is required within the inferred extent of the waste mass at the Site.
- Dewatering will not be required at the Site.
- The Contractor will be responsible for ensuring that all service provider specific requirements are met for the duration of all works associated with the protection and relocation/installation of underground services/utilities.
- All necessary community consultation will be undertaken by the Contractor (except where noted otherwise in this SMP).
- Based on a portion of the waste mass remaining at the Site it is currently anticipated that, subject to successful implementation of management measures, the following classifications would likely permit the proposed development to take place in a sustainable and cost effective manner:
  - '*Contaminated - restricted use'.*
  - *'Remediated - restricted use'.*
- It is assumed that one of these classifications under the Act are acceptable outcomes for the PTA, including relevant stakeholders.

Of relevance to the SMP, the following supporting plans have been prepared by the Contractor:

- Construction Environmental Management Plan (CEMP : NWA 2020a)
- Safety Management Plan (NWA 2020b)
- Emergency Management Plan (NWA 2020c)
- Community Engagement Plan (NWA 2020d)

It is important to note that all documents referenced are current at the time of preparing the SMP; the PTA should be consulted in relation to any future iterations of the plans subsequent to this document (the SMP). Additional information is provided in Section 6.2 and Section 7.

1.8 Limitations

This report has been prepared by GHD for Public Transport Authority of Western Australia and may only be used and relied on by Public Transport Authority of Western Australia for the purpose agreed between GHD and the Public Transport Authority of Western Australia as set out in Section 1.5 of this report.

GHD otherwise disclaims responsibility to any person other than Public Transport Authority of Western Australia arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to Section 1.7 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Public Transport Authority of Western Australia and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

As identified in previous assessment (GHD, 2020d) the lines of evidence available do not indicate that a BP oil pipeline present immediately south of the Site within the rail corridor to be a credible source of contamination at this time. The BP oil pipeline is not therefore considered in this SMP.

This SMP does not address the Ranford Road Bridge Modification works; a separate SMP has been prepared for this component of the development (GHD, 2020b).

This SMP does not address ongoing management requirements for the development.

2. Conceptual site model

2.1 Existing site conditions

The conceptual site model (CSM) for the proposed development has been refined with respect to outcomes from investigations completed to date. Specifically, the CSM has been refined in relation to potentially complete source-pathway-receptor (SPR) linkages that may be present during the proposed development, based on outcomes from previous investigations within and in the vicinity of the Site with respect to existing site conditions concerning soil, groundwater and landfill gas.

Previous environmental/geotechnical reports concerning known or expected site conditions that are relevant to development of this SMP are identified in Section 1.4. A summary of the previous findings (in the context of known/expected site conditions) provided in Table 1. The CSM is provided in Section 2.2.

Table 1 Existing site conditions

Environmental media	Comment
Soil	
Lithological profile	**Existing rail corridor** Ground conditions encountered during previous assessment within the rail corridor in the vicinity of the Site (Golder, 2019) generally consisted of: • FILL – SAND and gravelly SAND: fine to coarse grained, brown to grey, with gravels; overlying • SAND: fine to coarse grained, dark-pale grey, yellow-orange to dark brown-brown (inferred 'coffee rock'). **North and south of the existing rail corridor** Substantial landfill waste masses are present beneath sand caps at the former landfill sites to the north and south of the rail corridor, overlying natural strata. The landfill waste masses are indicated to have been formed predominantly above surrounding ground levels forming elevated topographic features in the locality such that their base profiles, although variable, are not indicated to extend to significant depth beneath the ground level of the rail corridor between them. Maximum recorded base depths indicated in previous investigation were approximately 14 m BGL in the south (GHD, 2020d) and 10.5 m BGL to the north (Talis, 2020). ACM was identified on the surface of the site in the area south of the rail corridor (GHD, 2020d). The toe of earthworks slopes for these adjacent landfill waste masses and overlying capping material are indicated to terminate at the boundary with the rail corridor. However, the potential presence of landfill capping (potentially containing inclusions of waste material) at the former landfill boundaries with the rail corridor cannot entirely be precluded (e.g. due to localised, marginal encroachment across the rail corridor boundary in past ground-disturbing maintenance works).
Visual and chemical results	**Existing rail corridor** No evidence of ACM (bonded or otherwise) on the surface and/or at depth (Golder, 2019). No evidence of landfill waste mass (Golder, 2019) and/or extending beyond the northern boundary of the former Ranford road landfill (GHD, 2020d). Concentrations of COPC in soil were recorded below the adopted ecological and health-based assessment levels for commercial/industrial land use (Golder, 2019). **North and south of the existing rail corridor** To the north of the rail corridor, Talis (2020) identified a sand cap (average 0.9 m thickness) over landfill waste material to a maximum observed depth of 10.5 m below ground level (bgl), underlain by fine to coarse grained sand. Occasional minor fragments of ACM and fly-tipped ACM (fence panels) observed at the site surface. Concentrations of COPC in soil (capping material) were identified below the adopted ecological and health-based assessment levels for commercial/industrial land use (GHD, 2020d). To the south of the rail corridor, concentrations of COPC in soil (capping material) were identified below the adopted ecological and health-based assessment levels for commercial/industrial land use (GHD, 2020d). However, it was determined that the presence of bonded, non-friable ACM in good condition within surface soils (landfill capping material) and physical hazards (waste inclusions) associated with landfill capping material and deleterious material (including potential odours) associated with landfill waste material would require management during development.

Environmental media	Comment
Acid sulfate soils (ASS)	**Existing rail corridor** Available desktop information indicates that the rail corridor lies within a Class II ASS risk area: *Moderate to low risk of ASS occurring within 3m of natural soil surface but high to moderate risk of ASS beyond 3m of natural surface* (Golder, 2018). Based on review of previous data, no indication of ASS presence based on field screening results and/or confirmatory laboratory testing, from samples tested in vicinity of the Site within the existing rail corridor (Golder, 2019). Notwithstanding this, Golder (2019) identified presence of 'coffee rock' associated with Bassendean sand formation, both of which are considered to be ASS and understood to be present within the Site, and requires management during construction phase activities (Golder, 2019).

Environmental media	Comment
Groundwater	
Depth to water and flow direction	**Existing rail corridor** Groundwater measurements within the existing rail corridor recorded in February 2019 identified a depth to water (m bgl) range of 4.5 m bgl (GW14) to 8.5 m bgl (GW13) during monitoring well installation (Golder, 2019). **North and south of the existing rail corridor** Depth to groundwater was identified between approximately 1.5 m bgl to 17 m bgl to the south of the rail corridor (GHD, 2019a). Talis identified GW flow direction to the north/north-easterly direction, consistent with previous assessments (GHD, 2019a).
Chemical results	To the south of the existing rail corridor, GHD (2019a) identified concentrations of the following substances up-hydraulic gradient of the Site: • Elevated aluminium, chloride and ammonia in groundwater exceeding NPUG assessment criteria. • Elevated per- and polyfluoroalkyl substances (PFAS) in groundwater exceeding 99% FW guidelines. Groundwater monitoring undertaken by Golder (2019 and 2020) identified the following groundwater quality cross-hydraulic gradient of the Site: • pH, nitrogen, aluminium, chromium and zinc exceedance FW guidelines. • Ammonia and iron exceeding NPUG assessment criteria. • PFOS exceeding 99% FW guidelines. Similar groundwater characteristics were identified down-hydraulic gradient of the Site by Talis (2020) and Golder (2020) in particular: • Elevated metals, chloride and ammonia in groundwater exceeding NPUG assessment criteria. • Pathogens in groundwater exceeding relevant assessment criteria for urban recreational areas, open spaces, parks and gardens. • Elevated PFAS in groundwater exceeding 99% FW guidelines. Further assessment of groundwater quality down-hydraulic gradient from the Site is being progressed separately.
LFG and vapours	
Landfill gases and vapours	**Existing rail corridor** Landfill gas risks within the existing rail corridor have been classified as 'very low risk' under the CIRIA Risk Classification for Situation A (CIRIA 2007) for both methane and carbon dioxide (Golder, 2019). LFG and vapours have been detected at the former landfill sites to the north and south of the Site where substantial waste masses are present (summary information is provided below). Whilst it is acknowledged that development may introduce new pathways and receptors, in relation to the proposed land disturbance work documented in this SMP (i.e. installation of pile infrastructure), it is considered that such work will be undertaken prior to significant disturbance at adjacent sites (i.e. to the south) and therefore landfill gas generation is not expected to materially change from current site conditions. **South of the existing rail corridor (Portions of Lot 302, 303 and 500)** In relation to presence of landfill gas and vapours migrating to the south of the existing rail corridor, GHD (2020d) identified:

Environmental media	Comment
	• Significantly elevated concentrations of landfill gas/vapour within the former landfill waste mass indicative of early- to mid-stage anaerobic degradation processes (although hydrogen sulphide concentrations were indicative of localised variability in anaerobic degradation processes in parts of the landfill). In particular, significantly elevated hydrogen sulphide was identified at LFG01, located approximately 40 m south of the boundary with the rail corridor (at the adjacent former Ranford landfill site). • Landfill gases typically absent or very low level detections only at monitoring locations beyond the northern, eastern and southern boundaries of the site (Characteristic Situation 1* conditions evident). • Information did not indicate the waste mass to be a significant source of VOCs, although the potential for these to be locally elevated within discrete parts of the waste mass could not be precluded. • The pattern of occurrence of elevated gas concentrations was consistent with the presence of waste mass and did not at that time indicate landfill gases to have migrated significantly beyond the lateral extent of the waste mass with respect to the confines of the site. • The dominant migration mechanism for landfill gases at the Ranford Road Station site was considered to be via diffusion. • Potential for lateral migration to the north, east and south was limited by reduced ground elevations in the surrounding area. Results from monitoring wells immediately beyond the waste mass also displayed CS1 characteristics within a short distance from the waste mass and do not therefore indicate migration occurring for the current site condition. • Migration characteristics have likely reached a relatively steady state with respect to the maximum concentrations that can be expected at the site boundaries by diffusing landfill gases for the current site condition • As diffusion is a slow process, it was not at that time considered likely that diffusion will be responsible for future rapid temporary fluctuations in gas concentrations beyond the waste mass on a significant scale for the current site condition. This interpretation was however subject to amendment with respect to limited further assessment concerning hydrocarbon interference effects and further assessment of the gas extraction system. • The landfill gas extraction and flaring system operated at the Site by the City of Canning was identified as a source of uncertainty due to issues with the system and resultant intermittent operation. • Periods of gas extraction and flaring system operation are a potential influencing factor upon gas concentrations within the waste mass. Significant rainfall events (and resultant infiltration into the waste mass) may also be capable of influence upon gas generation and resultant concentrations in the short term. • The existing gas extraction system at the Site may also be a significant contributing factor to mitigate migration of landfill gases and vapours beyond the extent of the waste mass. It was identified that the presence of landfill gases (and localised occurrence of vapours) associated with the landfill waste mass at the Ranford Road Station site represented a constraint for development that will require management (GHD, 2020a). Specifically, it was considered by GHD that the Station development at the Site will result in a material change in site condition and will introduce new pathways and receptors. In particular, the following matters require further consideration: • Potential for enhanced landfill gas generation within parts of the waste mass associated with enhanced degradation of wastes by biological processes as a result of drainage infiltration (e.g. swales and/or soak wells) receiving run-off from low permeability sealed surfaces. • Potential for development of hazardous atmospheres within enclosed spaces (e.g. migration of landfill gases and/or vapours into services infrastructure and building structures and their accumulation with resultant toxic, asphyxiation and/or explosion hazard). • Potential for enhanced lateral landfill gas/vapour migration due to: – Presence of lower permeability surfacing and/or structures which limits surface emissions from the waste mass.

Environmental media	Comment
	– Consolidation/compression of the remaining waste mass from development loadings creating potential advective flow conditions as void spaces are reduced. – Presence of buried services infrastructure which may act as enhanced lateral migration pathways. – Removal of the current gas extraction infrastructure. • Potential for cross-boundary migration towards the Ranford Road Station site from the remainder of the landfill waste mass off-site to the south-west. • Potential for enhanced vertical migration of landfill gases and/or vapours towards buildings/infrastructure associated with deep foundations such as piled foundations (if required to penetrate the remaining waste mass thickness in order to transmit development structure loadings to suitable strata beneath the remaining part of the landfill waste mass). *Characteristic Situation 1 – (CS1) based on CIRIA (2007) and NSW EPA (2012), i.e. 'very low' risk. Further assessment work undertaken by GHD identified: **Landfill Gas Modelling (GHD, 2019b):** • The Site is generating LFG and will continue to do so into the future, albeit at declining rates over time. • The precise LFG generation rates that will occur over time cannot be accurately predicted based on current information. 'Real world' generation rates at the Site may lie somewhere between the 65% and 100%. The hypothesis that the LFG generation rates may lie towards the lower end of the estimates is supported by the low gas flow rates measured during the DSI in wells located in the landfilled waste mass. • The estimated LFG generation rates at the Site in FYE 2020 may lie somewhere between 68 m3/h and 105 m3/hr. Such rates may require the installation of LFG management measures within and/or adjacent to the proposed development to prevent adverse impact upon it and to prevent off-site LFG emissions from the Site. • The existing LFG extraction system in its current condition is likely to provide minimal (if any) control of LFG generated by the Site. Furthermore, that system in its current condition is likely to provide minimal (if any) control of LFG generated at the larger adjacent landfill site. • The most likely emission pathways for LFG from the Site are considered to be via the Site's surface and via the adjacent sub-surface geology. The available monitoring data for these locations suggest that LFG emissions via these pathways were not significant at the times of monitoring. ***Addendum gas monitoring report (GHD, 2020a).*** Based on Gasflux monitoring data obtained, the potential for the gas extraction system to influence gas characteristics within the waste mass cannot be precluded. However, the influence (if any): • Does not appear capable of causing future rapid increases in methane and carbon dioxide concentrations (for current site conditions) from the maxima determined in monitoring to date. • Does not appear capable of causing future rapid increases in flow (for current site conditions) from the maxima identified in Gasflux monitoring.

Environmental media	Comment
	• Previous uncertainty concerning maximum concentrations of methane at LFG02 (associated with Gasclam results, GHD 2020a) are considered to be addressed by data obtained from Gasflux monitoring. • The Gasflux dataset supports the findings of the previous DSI with respect to overall expectations concerning gas generation and migration characteristics, i.e. • The dominant migration mechanism for landfill gases at the Site is considered to be via diffusion. Low magnitude flows do not indicate a potential for significant advective flow conditions to develop in the waste mass for the Site in its current form. • Surface emission is a dominant migration pathway, including for landfill gases generated at depth in the central part of the waste mass (where these are capable of migration towards the boundaries of the waste mass). • Methane oxidation near to the lateral extent of the waste mass where both waste thicknesses and ground levels reduce significantly (as supported by gas concentrations at or beyond the waste mass. • Migration characteristics have likely reached a relatively steady state with respect to the maximum concentrations that can be expected at the site boundaries by diffusing landfill gases for the current site condition. • It is not at this time considered likely that dominant diffusion processes will be responsible for future rapid increases in gas concentrations and flows beyond the maxima detected to date for the current site condition. Notwithstanding the above, the data obtained has identified that where (low-range) gas flows occur, there are limited instances in which hydrogen sulphide within natural strata beyond the waste mass can briefly exceed relevant exposure limits for public protection (2 ppm). The provisional CS for development at the footprint area of the waste mass within the Site should be elevated to CS4 with respect to methane and carbon dioxide. This reflects a conservative and precautionary approach based on data obtained from LFG02; the current CSM (GHD 2020d); status of development proposals and that further data can be obtained. **Area north of the existing rail corridor (portions of Lot 302, 303 and 79)** Talis (2020) identified similarly elevated LFG and vapour characteristics at the former Bannister Road Landfill Site to the north of the rail corridor (including commercial Soils Aint Soils existing commercial premises). In particular, Talis (2020) identified a 'Very Low' to "Low" risk classification (i.e. CS 1 at the boundaries of the area and CS2 across the remainder of the area) from monitoring data collected, however this was elevated to CS3 across the entirely of the area investigated as a conservative measure due to the area being a former putrescible landfill. Landfill gases at the area investigated were considered to require management with respect to risks posed to workers entering below ground services at the property, along the western side of Ranford Road and for future proposed redevelopment of the property.

2.2 Conceptual site model for proposed development

A CSM, reflective of the proposed land disturbance work and specific to development of this SMP, is provided in Table 2.

With respect to characteristic situation (CS) values, the following has been identified:

- Footprint area of the waste mass (CS4): required gas protection scores = 5.
- Site areas beyond the footprint area of the waste mass (CS3): required gas protection scores = 3.

The above values may be refined in response to more detailed information concerning development proposals, further monitoring and assessment.

Table 2 Conceptual site model (station development)

Area of concern	Contaminants of concern	Receptor (including exposure route – refer to footnotes)	Risk rating # ~	Risk rating (with the implementation of appropriate management measures for proposed development including construction phase)
(1) Waste inclusions in the landfill capping material (2) Landfill waste material	ACM, physical hazards (also odour and aesthetic considerations)	On-site • Members of the public (1, 2) • Occupants, construction and maintenance workers at the new station (1, 2) • Property ^	**Risk: Low (ACM)** *Consequence: Minor* *Probability: Possible* **Risk: Moderate (other)** *Consequence: Moderate* *Probability: Possible*	**Risk: Very low** *Consequence: Minor* *Probability: Rare*
(3a) General landfill area	(3b) Groundwater: aluminium, chloride, ammonia, PFAS	On-site (human health) • Members of the public (4) • Personnel (4) • Occupants, construction and maintenance workers at the new station (4) Off-site (human health) • Private bore users (3) • Commercial bore users (4) Off-site (ecological) Down-gradient aquatic ecosystems (Canning River) (5)	**Risk: Low** *Consequence: Minor* *Probability: Possible* **Risk: Low** *Consequence: Minor* *Probability: Possible* **Risk: Moderate (PFAS)*** *Consequence: Moderate* *Probability: Possible*	**Risk: Very low** *Consequence: Minor* *Probability: Rare* **Risk: Very low** *Consequence: Minor* *Probability: Rare* **Risk: Low (PFAS)*** *Consequence: Moderate* *Probability: Rare*

Area of concern	Contaminants of concern	Receptor (including exposure route – refer to footnotes)	Risk rating # ~	Risk rating (with the implementation of appropriate management measures for proposed development including construction phase)
(3a) General landfill area			*Not significant* (other contaminants)	*Not significant* (other contaminants)
	(3c) Landfill gases: CO_2, CO, H_2S, CH_4 and vapours	On-site (human health) • Members of the public (6) • Occupants, construction and maintenance workers at the new station (6)	**Risk: Moderate (excluding below ground maintenance workers)** *Consequence: Moderate* *Probability: Possible*	**Risk: Low (excluding below ground maintenance workers)** *Consequence: Moderate* *Probability: Rare*
		Off-Site (human health) • Below ground maintenance workers (6) • Occupants of commercial buildings (6) • Inhabitants of nearby residential dwellings (6)	**Risk: High (below ground maintenance workers)** *Consequence: Moderate* *Probability: Likely*	**Risk: Low (below ground maintenance workers)** *Consequence: Moderate* *Probability: Rare*
			City of Canning Waste transfer station visitors and site workers: Moderate (risk) *Consequence: Moderate* *Probability: Possible*	**City of Canning Waste transfer station visitors and site workers: Low (risk)** *Consequence: Moderate* *Probability: Rare*
			Land to north of Site: *No credible pathway* (also a former landfill and assumed to have appropriate management practices in place)	Land to north of Site: *No credible pathway* (also portion of a former landfill and assumed to have appropriate management practices in place)

Area of concern	Contaminants of concern	Receptor (including exposure route – refer to footnotes)	Risk rating # ~	Risk rating (with the implementation of appropriate management measures for proposed development including construction phase)
(3a) General landfill area			**Residents (0.4 km to the east and south-east): *Low risk*** *Consequence: Minor* *Probability: Possible* Area of waste mass- Characteristic Situation 4 Site area beyond waste mass – Characteristic situation 3. *Note: development will need to manage emissions to mitigate potential impacts to air quality.*	**Residents (0.4 km to the east and south-east): *Low risk*** *Consequence: Minor* *Probability: Possible*

*requires further off-site assessment to assess impact and finalise risk rating.
Management action is considered to be necessary for future redevelopment of the Site to mitigate risks posed by landfill gases and vapours at the Site for such redevelopment. It is considered that risks can be reduced to low or very low for the Site subject to implementation of appropriate management measures. Refer to column '*Risk rating (with the implementation of appropriate management measures for proposed development including construction phase*).'
^Development should consider the 'severe' exposure of concrete piles in landfill waste material.
Risk rating is based on risk matrix provided in the DSI (GHD 2020d) and also provided in Appendix B for completeness. Ratings are subject to change following finalisation of development plans.

Exposure Pathways:
1. Inhalation of asbestos fibres (via wind-blown dust) during development
2. Direct contact with waste constituents and physical hazards
3. Incidental ingestion/dermal contact of groundwater via garden irrigation (abstraction and use for non-potable purposes)
4. Incidental ingestion/dermal contact during commercial use of groundwater (abstraction and use for non-potable purposes)
5. Leaching of contaminants into groundwater and discharge of groundwater to down-gradient surface water (Canning River) and direct contact with and/or uptake by aquatic organisms
6. Lateral or vertical migration of gases and/or vapours and accumulation to form toxic, explosive and/or asphyxiating atmospheres (i.e. hazardous atmospheres).

3. Extent of management required

3.1 Requirement for management

As identified in the CSM, potentially complete SPR linkages exist at the Site posing a risk to relevant receptors. Management action is therefore required with the overall objective to ensure that the Ranford Road Station development does not pose a risk to human health or environmental values during construction phase.

Station development characteristics and the extent of management required for such development are presented in the following sections.

3.2 Summary of activities requiring management for construction

As identified in the CSM, construction activities for the new station have the potential to introduce new pathways and receptors to sources of contamination associated with the former landfill. This can create risks that did not exist previously if not appropriately managed. It should be noted that the management of risks can be commenced prior to construction (i.e. incorporated into the design of the new station) which serve to manage risks during construction phase (and for subsequent operational use).

The extent of management required is summarised in Table 3.

Table 3 Extent of management required: for construction

Area/media requiring management	Management required
(1) Waste inclusions in the landfill capping material (2) Landfill waste material	Waste inclusions within landfill capping material and landfill waste material will require management during construction phase. Options to mitigate transient risks for construction associated with the waste materials at the former landfill comprise: a. Removal and disposal of waste materials off-site to a suitably licenced landfill facility. The viability of large-scale removal is however uncertain due to the scale of disturbance required, associated construction-phase impacts (e.g. odours, dust, vehicle movements) and available landfill capacity elsewhere in the metropolitan area that would be needed to accommodate the excavated waste. b. Treatment (e.g. screening/processing of capping and/or waste materials to separate undesirable constituents from inert materials such as sand). Undertaken to create materials suitable for re-use (e.g. as fill below the finished ground surface) and minimise the volume of material requiring off-site disposal. The viability of large-scale removal and treatment is however uncertain due to the scale of disturbance required and associated construction-phase impacts. c. Avoid development features and construction methods requiring deep excavation into the former landfill. In particular, in the design process, set development levels that are sympathetic to existing ground contours and elevations in order to minimise excavation and resulting disturbance of waste materials at the former landfill. This more effectively limits the volume of waste materials requiring management in construction (e.g. by a. or b. as identified above) to that which is unavoidable to construct the new station. d. Specification of appropriate measures for protection of foundations and other buried structures from deleterious chemical effects. e. Construction of a robust engineered cover system over the former landfill to prevent physical contact with underlying waste materials. It is currently expected that options c, d and e will be adopted for the development to minimise contamination risks and other negative impacts from disturbance of waste materials at the Site whilst achieving a final site condition, which is suitable for the new station use in line with a sustainable approach to development. Options for the engineered cover system will depend upon the intended use of particular areas at the former landfill. For example, car parks and paved areas present more robust finished surfaces to restrict access to underlying soils than landscaped areas where a cover system comprises soils to support vegetation and needs to be of greater thickness. Options for a cover system comprise the following components: • Geotextile separator (to prevent mixing of waste materials with overlying 'clean' soils which have been validated to confirm suitability for use with respect to geotechnical and environmental properties) and to act as a 'warning' barrier for any future below ground maintenance works involving excavation. • Placement of engineered fill layers (i.e. imported 'clean soils') over the geotextile separator to create a suitable stiff 'raft' with properties to mitigate future settlement issues and prevent physical contact and to receive final surfaces such as roads, paved areas, landscaping. Soil imported for use within construction of the cover system are to be suitable with respect to geotechnical and environmental properties and validated to confirm suitability.

Area/media requiring management	Management required
	• Installation of all service infrastructure within the cover system to protect future maintenance workers undertaking below-ground maintenance works for services infrastructure so that potential for contact with waste materials in any future maintenance works is minimised. • Subsoil and topsoil layers to support vegetation (landscaped areas). • Final finished surface (e.g. low permeability sealed surfaces for roads, car parks and paved areas, grass, vegetation and other materials in landscaped areas).
(3a) General landfill area	Appropriate management measures will be implemented for protection of human health (i.e. the public and construction workers), the environment, and environmental values including aesthetic concerns. Health and safety related risks associated with working at the Site during construction will be managed under the NWA Safety Management Plan. Environmental risks and management controls will be managed through the implementation of the CEMP (NWA 2020a). The following matters will need to be addressed: dust, odours, noise, vibration, stockpiling, waste management, materials tracking, stormwater run-off, drainage, sedimentation, leachate management and groundwater protection, traffic management (including measures to prevent dust or mud being deposited on public roads by vehicles leaving the site), existing (protected) vegetation, contamination, unexpected finds, emergency preparedness and response, monitoring requirements, security, training. Community engagement requirements will also need to be met for relevant stakeholders such as (but not limited to): local residents, businesses and landowners, owners/operators of underground services infrastructure in the vicinity of the former landfill. Subject to finalisation of the design process and adopted construction method, possible options for such management comprise: • Application of water sprays, use of ground covers and installation of screens to act as wind breaks, to aid in the control of dust generation. • Temporarily re-covering exposed excavations from within the landfill waste mass (if disturbed) overnight and/or during periods of low excavation activity, to aid in the control of nuisance odours. • Creation of appropriate (temporary) stormwater and surface run-off drainage system (e.g. temporary bunding and collection ponds), to aid in the control of surface and stormwater run-off. • Appropriate management of excavated spoil particularly where generated from within the landfill waste mass (if disturbed), such as limiting the height of stockpiles and installation of leachate collection systems to contain potentially contaminated stockpile run-off. • Exclusion of worker access to excavations/confined spaces or other contact with waste in the former landfill area wherever possible. Implementation of controls for access which is unavoidable. • Confirm appropriate control measures are in place for below ground maintenance works undertaken by owners/operators of underground services infrastructure in the vicinity of the former landfill. • Monitoring of the above actions with respect to relevant developed 'trigger levels' to determine when and how an additional management action should be implemented (i.e. contingency measures – see below).

Area/media requiring management	Management required
	Contingency measures, if determined to be required, should include, but not be limited to: • Re-instatement of surfaces and/or fencing. • Increased monitoring or further site characterisation, amendment of management measures. • Increased community engagement.
(3b) General landfill area - Groundwater	Design and construction phase measures can be implemented to minimise impact of construction upon leachate within the waste mass and potential mobilisation of this to impact groundwater flowing beneath the Site. Options comprise: <u>Design phase:</u> • Limiting the footprint area of sensitive structures (e.g. station ticket hall) to minimise bearing pressures upon the underlying soils or landfill waste. This: – Minimises ground treatment requirements for compressible/unstable waste materials to address settlement effects. – Minimises the need for deep foundations (e.g. piled foundations) to transmit foundation loads below the landfill which may otherwise act as a migration pathway for leachate. • Location of sensitive structures (e.g. station ticket hall) away from deeper parts of the former landfill to minimise ground treatment requirements for waste materials to address settlement effects. • Construction of a robust engineered fill cover system to form a 'stiffened raft' type foundation in surfaced areas which is less sensitive to settlement effects and reduces the need for deeper treatment of underlying waste materials. • Implementation of further assessment actions identified in the DSI (GHD 2018) to support the design process. <u>Construction phase:</u> Optimised staging of construction earthworks and ground treatment to limit the scale of disturbance to the former landfill at any one time so that induced compression of the waste mass is gradual and limits the potential for leachate migration to groundwater. Timing of the works with respect to seasonal conditions (e.g. periods of heavy rainfall which may enter the waste mass to generate leachate) will also be optimised, where practical. These measures may be supported by: • A detailed groundwater monitoring programme from a dedicated network of groundwater monitoring wells to detect any potential adverse effects upon groundwater quality that may be attributable to the construction works and allow preventative/corrective action to be implemented (e.g. adjustment to scale/nature/timing of earthworks and ground treatment). • Contingency groundwater response measures in order to address any unavoidable and temporary adverse effects upon groundwater quality in the locality.
(3c) General landfill area - Landfill gases and vapours	Development of a train station at the Site could enhance landfill gas generation and promote migration of landfill gases/vapours during construction, resulting in:

Area/media requiring management	Management required
	• Enhanced degradation of wastes by biological processes due to drainage infiltration (e.g. swales and/or soak wells) receiving run-off from low permeability sealed surfaces. • Development of hazardous atmospheres within enclosed spaces (e.g. migration of landfill gases and/or vapours into services infrastructure and building structures and their accumulation with resultant toxic, asphyxiation and/or explosion hazard). • Enhanced lateral landfill gas/vapour migration (on-site and potentially off-site) due to: lower permeability sealed surfaces and/or structures which limit surface emissions from the waste mass; compression of the waste mass by development loadings displacing gases and vapours as void spaces are reduced; presence of buried services infrastructure which may act as enhanced lateral migration pathways; removal of the current gas extraction infrastructure. • Cross-boundary migration towards the Site from the remainder of the landfill waste mass off-site to the south-west. • Vertical migration of landfill gases and/or vapours towards buildings/infrastructure associated with deep foundations such as piled foundations (if required to penetrate the remaining waste mass thickness in order to transmit development structure loadings to suitable strata beneath the remaining part of the landfill waste mass). The options which can be implemented to manage risks to groundwater (refer to 3b above) for construction phase are also valid options to mitigate the risk of increasing landfill gas and vapour migration from the former landfill (e.g. into surrounding permeable soils during construction). Options to mitigate risks are possible in the choice of new station design features to seek to render this insensitive to risks posed by landfill gases and vapours. However, it is difficult to achieve full protection from such measures alone where a former landfill occupies a substantial part of the Site (e.g. the development cannot be located sufficiently far away from the landfill such that no other protection is needed). Whilst incorporation of certain design features may be possible which act to reduce risks, gas protection measures are required. Options considered relevant at this time are summarised below. *Design features:* • Location of sensitive structures (e.g. station ticket hall) away from the former landfill (if feasible) or deeper parts of the landfill to reduce exposure to landfill gases and vapours. • Limiting the footprint area of sensitive structures (e.g. station ticket hall) to minimise bearing pressures upon the underlying soils or landfill waste to minimise the need for deep foundations (e.g. piled foundations) to transmit foundation loads below the landfill which may otherwise act as a preferential pathway for landfill gases/vapours to reach structures. • Structural design features which do not permit ingress and accumulation of landfill gases and vapours (e.g. structures elevated above ground level to create an open air-gap, open-sided structures/ground floor parking, services entry points above ground level, no below ground enclosed spaces such as basements). It is also relevant to note that in the longer term, compression of the waste mass at the former landfill to address issues such as settlement would also be expected to have a beneficial effect upon landfill gas generation (reduction) due to void space reduction. However, such disturbance of the waste mass also poses shorter term risks as identified in Table 3, item 3(b).

Area/media requiring management	Management required
	Gas protection measures: Protection measures are expected to be necessary for buildings, other occupied structures and confined spaces (e.g. offices, toilets, retail spaces at ticket hall, storage rooms, services risers). These are required to limit potential for migration of landfill gases and/or vapours into enclosed spaces via services penetrations, floor slab joints and other openings and their accumulation to form hazardous atmospheres with resultant toxic, asphyxiation and/or explosion hazards. Subject to refinement of development proposals and structure types, typical options comprise combinations of the following barriers in conjunction with ventilation measures to form a protection system as recommended in relevant guidelines (NSW EPA 2019): • Well-constructed ground floor slab (monolithic cast in-situ reinforced concrete raft foundations with as few joints as possible). Such foundation types are also likely to be needed for sensitive structures to address ground stability constraints associated with the former landfill such as settlement of compressible waste materials. • Gas and vapour resistant membrane. • Passive venting: sub-slab dispersal layer or pressure relief pathway (e.g. no-fines gravel layer and horizontal collection pipe network or proprietary void formers or open void) to provide ventilation and limit potential for accumulation of landfill gases and vapours beneath a structure. This is used in conjunction with perimeter vents at the surface or above ground. • Active measures: as for passive measures with powered extraction (fans) to remove landfill gases and vapours from a sub-slab dispersal layer or positive pressurisation (pumps) to introduce fresh air. This requires use of fail-safes (e.g. back-up power, monitoring, alarms). <u>On-site areas of sealed surfacing (e.g. roads, car parks, paved areas)</u> Likely options to manage the potential for landfill gases and vapours to accumulate below areas of low permeability surfacing at the Site comprise: • Vertical gas collection wells and vents (potentially with horizontal collection network to improve collection efficiency – subject to refinement of the new station design). • Areas of permeable surfacing to allow surface venting of landfill gases and vapours. <u>Site boundary</u> Likely options to manage the potential for landfill gases and vapours to migrate beyond the Site (or onto the Site from the remainder of the landfill to the south-west) comprise perimeter in-ground gas barriers and/or passive ventilation measures. These typically consist of gas vertical gas collection wells, horizontal collection pipes and vents placed at critical boundaries to intercept landfill gases and vapours that migrate within the ground towards the site boundary.

Area/media requiring management	Management required
	Subject to refinement of the new station design, similar measures can also be implemented at other boundaries if the extent of low permeability surfacing required at the Site (e.g. car parks) may restrict surface emission of landfill gases/vapours at the Site to the extent that lateral migration off-site to the north-west, north-east and south-east could occur to a significant extent. Buried services infrastructure Potential options to manage the potential for landfill gases and vapours to accumulate below areas of low permeability surfacing at the Site comprise the following: • Removal of existing shallow gas extraction system pipework and grouting (backfill) of deeper vertical extraction wells within the Site (to separate this from the off-site network and remove potential preferential migration pathway). Irrespective of this, the existing gas extraction system pipework is expected to require removal from the Site to facilitate development due as this is not likely to be compatible with development. • Where possible in design stage, limit the size and nature of services infrastructure needing to be placed at (or within influencing distance) of the former landfill. • Gas protection measures for buried infrastructure which must be placed at (or within influencing distance) of the former landfill to limit the potential to form hazardous atmospheres within enclosed spaces (e.g. migration of landfill gases and/or vapours into infrastructure, occupied spaces and their accumulation with resultant toxic, asphyxiation and/or explosion hazard). Typical options comprise gas barriers to limit potential for entry and/or passive ventilation measures to prevent accumulation. • Surface water drainage to be constructed as for (3b) above to direct surface run-off away from the former landfill area to limit infiltration of water into the former landfill area that may otherwise enhance production of landfill gases within the waste mass. All new station development features In conjunction with the above options, a landfill gas and vapour monitoring programme is expected to be implemented for the whole site or critical features: see (3a) above. The monitoring programme will utilise a dedicated gas and vapour monitoring well network and/or automated monitoring equipment for relevant features (subject to refinement of new station development design). Gas monitoring An expanded gas monitoring well network is required to be installed to assist in monitoring of the former landfill for indications of enhanced lateral migration of landfill gases and vapours from the waste mass. Where deemed appropriate, this may include installation of continuous monitoring instruments with telemetry to provide ‘real time’ data at key locations to inform decision-making. If necessary, construction activities can be curtailed or modified to manage the potential for any short-term adverse effects arising in construction works. Existing landfill gas extraction system The existing landfill gas extraction system, which has a network of extraction pipework extending onto the Site, will also be modified at the commencement of construction to separate this from the majority of the network at the larger off-site portion of the landfill. This will allow the

Area/media requiring management	Management required
	on-site part of the network to be removed to provide access for construction work and to prevent the pipework acting as a preferential migration pathway.

3.3 Management targets

Site management objectives and targets proposed have been developed (in the context of the proposed land disturbance) on the basis of ensuring no unacceptable risks to relevant receptors during construction works. These will be monitored through the assessment of data with respect to management targets detailed in Table 4.

Validation of remedial targets will be undertaken through implementation of a site-specific monitoring program proposed as part of this SMP (refer to Section 5 and Section 6).

Table 4 Site management targets for construction phase

Environmental media	Management objective	Management target and derivation detail
Surface soils (ACM in sand cap overlying waste materials, physical hazards also odour and aesthetic considerations)	No unacceptable risk to relevant receptors during construction (construction workers).	1. Management as per Section 8.3. 2. Dust management limits as per Table 5.
	No visible asbestos within the top 0.1 m of soil at the Site (finished level).	
	No other undesirable materials exposed at site surface (e.g. refuse materials that may be aesthetically undesirable and/or result in public concern).	
Soil arisings	No increase in risk to relevant receptors (construction workers during development related ground disturbance, beneficial use of groundwater, environmental values of groundwater) during development-related land disturbance activities.	1. Documented appropriate induction for all site workers to promote awareness of potential contamination risks associated with the works and management measures to address them. 2. Dust management limits as per Table 5. 3. Appropriate management of spoil arisings with respect to potential ASS risk and validation of treatment (if required). ASS assessment criteria (DER, 2015a)*: • $pH_{FOX} \leq 3$ (Potential Acid Sulfate Soil [PASS]) • $pH_F \leq 4$ (Actual Acid Sulfate Soil [AASS]) • Net acidity/Scr = 0.03 %S (refer below to account for Bassendean sands). • TAA = 0.03 %S In order to account for Bassendean sand profiles, as specified in the document *Identification and investigation of acid sulfate soil and acidic landscapes* (DER, 2015a) - where a chromium reducible sulfur (Scr) value is less than 0.03 %S and field $pH_{Fox} < 3$, the soil should be treated by neutralisation with alkaline materials as if it had an inorganic sulphur content of 0.03 %S. A laboratory detection limit of 0.005 %S should be requested. *As per SCR method.

Environmental media	Management objective	Management target and derivation detail
		ASS treatment validation criteria (DER, 2015b): • pH_{FOX} > 5 • Soil pH (pH_F) in the range of 6.0 to 8.5 • Excess ANC recorded higher than the Scr value • Total Potential Acidity (TPA) below the laboratory LOR value (to account for Bassendean sands. 4. Appropriate management of spoil arisings with respect to potential contamination risks (risk-based approach with reference to the *ASC NEPM*). 5. Appropriate management (via a suitably robust unexpected finds protocol) of ACM and/or presence of otherwise undesirable constituents (e.g. inclusions of landfill waste material) within spoil.
	Appropriate disposal off-site of soil arisings (if required)	1. Dust management limits as per Table 5. 2. Spoil material shall be classified in accordance with *Landfill Waste Classification and Waste Definitions 1996 (As amended 2019)* (DWER, 2019) which provides criteria for assessing the appropriate waste classification and subsequent disposal locations for spoil material to be disposed offsite.
Landfill gases and vapours	No unacceptable risk to relevant receptors during construction from hazardous atmospheres at surface and within the subsurface: -Onsite: construction workers -Offsite: below ground maintenance workers, occupants of commercial buildings, inhabitants of nearby residential dwellings) Minimise odours emitted to the atmosphere.	1. Appropriate monitoring for the presence of hazardous atmospheres during the works. Specific targets identified in Table 6. 2. Appropriate contingency measures implemented in response to any detection of a potentially hazardous atmosphere (Section 8.2). 3. Prevention of any offensive odours beyond the boundary of the Site and control of all dust emissions as per Table 5.
Imported fill material	No unacceptable risk to relevant receptors during construction (construction workers during development related ground disturbance, beneficial use of groundwater, environmental values of groundwater).	1. Dust management limits as per Table 5. 2. If demand for fill material, the requirements identified in Section 6.10 must be met.
Groundwater	No unacceptable risk to relevant receptors during construction (beneficial use of groundwater, environmental values of groundwater).	No significant trends* indicative of adverse impact during construction as determined from Mann-Kendall analysis (or similar). *(Significant increase or decrease for relevant substances/parameters, e.g. pH).

Dust management limits are provided in Table 5.

Table 5 Air quality standards/limits

Pollutant	Averaging period	Maximum concentration (ug/m^3)	Maximum allowable exceedances	Contingency action
PM_{10} [1]	24 hours	50	No more than 5 days per year [3]	All excavation, loading and any other dust generation activities will halt and additional dust prevention measure will be undertaken by the Contractor.
	15 minutes	250 [4]	None	
	1 year	25	None	
	Any time	400 [4]	None	Immediate halt to all works on-site until unfavourable dust generating conditions (e.g. high winds) cease. Dust control measures may be permitted at the Superintendent's discretion.
If required - Asbestos airborne fibres [2,5]	Any time	<0.01 f/mL	None	Excavation, loading and any other dust generation activities will halt and additional dust prevention measure will be undertaken by the Contractor.

Table notations:
1, 2: 24 hour and 1 year air quality standards for PM_{10} and asbestos airborne fibres adopted from NEPM (ambient air quality) measure (as amended 2016) and EnHealth Council (2005), respectively.
3: Excluding 'exceptional' events; exceptional event means a fire or dust occurrence that adversely affects air quality at a particular location, and causes an exceedance of 1 day average standards in excess of normal historical fluctuations and background levels, and is directly related to: bushfire; jurisdiction authorised hazard reduction burning; or continental scale windblown dust.
4: Total suspended particles (TSP) management limits.
5: It is recommended that in the event that visual observations identify the presence of friable asbestos during construction, boundary air monitoring for asbestos fibres (using the membrane filtration method) should be undertaken during excavation work into potentially contaminated fill materials and any other activity, which could potentially generate airborne asbestos fibres.

Landfill gas/vapour management limits are provided in Table 6. LFG monitoring should be undertaken using suitable hand-held devices capable of undertaking measurements for landfill gases and vapours as identified in 6.4.2 and Table 6.

Table 6 LFG and vapour management limits

Area/feature	Hydrogen Sulphide	Carbon Monoxide	Methane	Carbon dioxide	Vapours
Nominated site boundary wells (refer to Table 8).	2 ppm*	30 ppm^	1% v/v [A]	1.5% v/v[A]	100 ppm[B]
Existing buried services infrastructure at adjacent land to north-west (commercial premises), north-east (Ranford Road) - refer to Section 6.4). Existing buried services infrastructure at operational portions of CCWTS (refer to Section 6.4).	Not used	Not used	2500 ppm (0.25% v/v) (5% LEL)[D]	Not used	Not used
Completed development features comprising buildings, other occupied structures and other permanent development features which are confined spaces (refer to Section 5.2.1).	15 min at 15 ppm (STEL)^ 8 h at 10 ppm (TWA)^ 30 min at 2 ppm* 24 hours at 0.1 ppm# 90 days at 0.014 ppm#	15 min at 200 ppm (STEL)^ 8 h at 30 ppm (TWA)^	Investigation trigger: 2500 ppm (0.25% v/v) (5% LEL)[D] Evacuation trigger: 10,000 ppm (1% v/v) (18% - 20% LEL)[F]	Investigation trigger: 2500 ppm (0.25% v/v)[E] Evacuation trigger: 10,000 ppm (1% v/v)[E] 15 min at 30000 ppm (STEL)^ 8 h at 5000 ppm (TWA)^	100 ppm[B]
Within completed development features comprising buried services infrastructure (refer to Section 6.4).	10 ppm^	Not used	10,000 ppm (1% v/v) (18% - 20% LEL)[F]	Not used	Not used

Area/feature	Hydrogen Sulphide	Carbon Monoxide	Methane	Carbon dioxide	Vapours
Temporary structures (refer to Section 6.4).	15 min at 15 ppm (STEL)^ 8 h at 10 ppm (TWA)^ 30 min at 2 ppm* 24 hours at 0.1 ppm# 90 days at 0.014 ppm#	15 min at 200 ppm (STEL)^ 8 h at 30 ppm (TWA)^	Investigation trigger: 2500 ppm (0.25% v/v) (5% LEL)[D] Evacuation trigger: 10,000 ppm (1% v/v) (18% - 20% LEL)[F]	Not used	100 ppm[B]
Surface monitoring	2 ppm*	30 ppm^	100 ppm[G]	Not used	Not used

Table notations:
[A]NSW EPA (2019).
[B]Precautionary qualitative criteria based on experience at similar sites.
[C]50% of TWA and consistent with approach in CIRIA C665.
[D]Based on precautionary approach adopted in CIRIA C665.
[E]Based on 50% of threshold for observable effects of discomfort (NSW EPA 2019: Table 10; 2% v/v).
[F]Set at 20% of LEL on a precautionary basis.
[G]EPA Victoria (2015)
^Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [National Occupational Health and Safety Commission: 1003(1995)], TWA= time weighted average, STEL= short term exposure limit.
* DoH (2009) recommended exposure limits for public protection. Associated with bronchial effects in some sensitive asthmatics and so should not be exceeded.
# DoH (2009) recommended exposure limits for public protection. Have safety margins built in and so exceedance does not necessarily mean a health consequence.

4. Site management strategy

The site management strategy describes the overall management framework for the Site to address potential risks associated with the proposed development. Specifically, the management strategy addresses:

- Section 4.1: Timeframes required for implementation of the SMP.
- Section 4.2: Stakeholder roles and responsibilities
- Section 5: Management prior to construction.
- Section 6: Management controls during construction.
- Section 8: Circumstances and events requiring contingency actions and the associated procedures to be adopted.
- Section 9: Reporting requirements of the SMP, including the circumstances under which a revision to the SMP is warranted

A Sampling and Analysis Quality Plan (SAQP) has been developed to appropriately guide the monitoring requirements to be implemented as part of the SMP. The SAQP is provided in Appendix C.

4.1 Timeframe for site management

This SMP will be in operation over the design stage and construction stage of the station development. The SMP should be reviewed, and where necessary amended, as follows to confirm the adequacy of management measures or requirements for amendment:

- On completion of detailed design, including design of management measures that are required by this SMP (refer in particular to Section 5 and Section 6 for details of actions needed to identify and incorporate appropriate landfill gas/vapour mitigation measures into the design).
- Construction phase: In the event of a change to the station development features (such as, but not limited to: site features/layout/operations).
- Following the specified LFG and vapour monitoring events to confirm the frequency and duration of events are applicable or requirements for amendment.
- At completion of construction and validation of the effectiveness of management measures, prior to operational use.
- A separate Ongoing Site Management Plan (OSMP) is to be developed at a later stage (i.e. prior to commencement of operational use) to manage residual risks for ongoing operation of the Site as a new station (refer to Section 9.3.2).

4.2 Stakeholder identification

GHD notes the *ASC NEPM Schedule B8 – Guideline on Community Engagement and Risk Communication* (NEPC 1999). The community consultation process shall be addressed directly by the Contractor. Identified stakeholders and their associated roles and responsibilities as relevant to the SMP are summarised in Table 7.

Table 7 Stakeholder roles and responsibilities

Role and name of stakeholder	Responsibility
Principal (PTA)	Fulfil the requirements of the SMP and reporting/notification requirements. Responsible for appointment of suitably experienced competent person/s to undertake the required monitoring in accordance with this governing document Responsible for appointment of relevant organisations to undertake the works and stakeholder management. Responsible for contract document preparation and procurement. Review and approval of contractor plans such as Environmental Management Plans and Occupational Health and Safety Management Plans.
Contractor	The Contractor is responsible for: • Design of all aspects of the TCL including the Ranford Road Station. • All required civil works including all measures required to protect workers and public health and the environment during the works system and provision of 'As Constructed' information to the relevant parties. • Implementation of this SMP. • Development and implementation of relevant plans as identified in this SMP. • Obtaining all approvals necessary for the construction of the project including (but not limited to) meeting obligations under the Contaminated Sites Act (2003) and State issued Ministerial Statement 1114 (in particular Condition 10-2).
Environmental Consultant (TBC*) **SMP Rev 4 prepared by GHD. Subsequent updates to be prepared by the Contractor appointed Environmental Consultant.*	Appointed by the Contractor to prepare updates the SMP. Provision of advice to the Contractor (not supervision) and completion of technical work such as ACM and/or landfill gas and vapour assessment and management actions on behalf of the Principal, if required.
Contaminated Sites Auditor Mr Andrew Lau (JBS&G)	Audit the implementation of this SMP and report on its compliance to DWER and to meet EPA condition 10-2 (c) by preparing a Mandatory Auditor's Report (MAR). As required, review and provide comment on information relating to contamination for incorporation into future revisions of this SMP (if required). As required, provide approval to cease or vary any component of the SMP.
Independent consultant (Construction Quality Assurance – CQA – landfill gas protection measures.	Where appointed subject to CQA methodology to be implemented (refer to NSW EPA (2019) Appendix A, in particular Section A7.2). CQA role for relevant gas mitigation measures installed.
Independent consultant (Construction Quality Assurance – CQA – landfill cap	Where appointed subject to CQA methodology to be implemented (refer to EPA Victoria 2015). CQA role for landfill cap.
Regulatory body (DWER Contaminated Sites Branch)	Review and provide approval of the MAR.

Role and name of stakeholder	Responsibility
Community: Off-site adjacent land users, nearby residents	The Contractor is responsible for providing information in relation to the proposed works to off-site adjacent land users. Refer to Section 7.

4.3 Site-specific health, safety and environment management

A CEMP has been prepared by the Contractor to inform the construction requirements and methodology for completing the works in a manner that minimises adverse impacts to the environment and heritage (NWA, 2020a).

In addition to the CEMP, a Safety Management plan has been prepared to underpin all project activities including construction environmental management (NWA, 2020b).

An Emergency Management Plan has also been developed by the Contractor (NWA, 2020c). The plan includes the necessary procedures should fire be an issue during the proposed development.

Specific health, safety and environmental management requirements are not addressed within this SMP; such measures should be developed by the appointed Contractor and documented within a safe working method statement (SWMS).

4.4 Protection of existing monitoring infrastructure

Prior to ground disturbance works commencing, adequate protection measures shall be implemented (where not already in place) to preserve the integrity of existing monitoring infrastructure within the existing rail corridor in the vicinity of the Site. Infrastructure includes:

- Groundwater monitoring wells.
- LFG/vapour monitoring wells.

In the event of damage, contingency measures shall be implemented as detailed in the contingency plan (Section 8).

5. Management during design phase

The proposed change in Site use from a former landfill to a station has the potential to introduce new pathways and receptors to sources of contamination associated with the former Ranford Road Landfill. This can create risks that did not exist previously if not appropriately managed. In particular, development of a train station at the Site could:

- Create pathways which expose receptors to waste materials.
- Enhance landfill gas generation and/or promote migration of landfill gases/vapours.
- Enhance leachate generation and/or migration.

As identified in Section 3.1, management of these matters can be implemented during design phase (i.e. prior to construction) which serve to manage risks during the construction phase (and for operational use). Management measures to be implemented are identified below. This includes consideration of the level of community engagement that is needed prior to construction.

5.1 Surface profile and capping system

Surface profile

A concept layout has been prepared as identified in Appendix A. In the design process, finished development levels shall be refined/confirmed which are sympathetic to existing ground contours and elevations in order to achieve the above and:

- Minimise excavation and resulting disturbance of waste materials at the former landfill.
- Limit the volume of waste materials requiring management in construction to that which is unavoidable to construct the new station.
- Assist in achieving a stable capping system (in particular with respect to settlement effects which may otherwise compromise the integrity of the capping system – refer to 'capping system' below).

Capping system

Construction of a robust engineered capping system over the former landfill ('cap') is required to achieve the management targets identified in Section 3.3, in particular:

- Provide a long-term stable barrier over the Site to prevent physical contact of receptors with waste (i.e. human health, environment – note: including workers undertaking future below ground maintenance works) and be suitable to meet other requirements of the train station development. The capping system design shall therefore be required to accommodate all buried services infrastructure (except relevant gas mitigation measures as noted in Section 5.2.5) and other relevant development requirements such as (but not limited to) geotechnical considerations, engineering performance requirements, interface with structures and other development features.
- Prevent uncontrolled release of landfill gases and vapours.
- Minimise infiltration of water into the waste (i.e. infiltration rate less than seepage rate through base of the landfill), prevent water ponding and adequately shed water.

Finished levels should where possible be set to minimise disturbance (cut) required within landfill areas. The former landfill cap and waste mass materials should not form the top 0.5 m of fill for the finished site condition to assist in meeting the management target to exclude potential

for physical contact with ACM[5] and waste materials. The minimum depth to former cap and landfill waste mass material materials may need to be increased, or other barrier/warning features incorporated, to avoid disturbance such as (but not limited to) installation and/or future maintenance of below ground infrastructure.

Exceptions to the above may be possible where design measures are implemented that provide sufficient alternative protection to meet the management targets for the capping system. Subject to relevant other considerations such as engineering performance requirements, this may be possible for robust sealed surfaces (e.g. car parks) where:

- These can be designed and implemented to form an effective long-term stable barrier.
- Future below ground disturbance is not required or can otherwise be managed under an appropriate OSMP.

Further guidance on capping design features to achieve the above is provided in EPA Victoria (2015 – in particular Section 8). Given the nature of the development, a substantial part of the site surface will be covered with sealed surfaces (refer to Section 5.2.2). For other parts of the Site (unsealed surfaces), it is expected that the capping system will comprise a combination of engineered materials suitable for the intended purpose of those areas (e.g. landscaping). Where required, the cap shall also accommodate a growth medium for areas where landscaping is proposed. Reference should therefore be made to EPA Victoria (2015) and other relevant guidance as appropriate to ensure that the capping system in such areas is capable of meeting the above requirements.

5.2 Landfill gas/vapour mitigation measures

Landfill gas/vapour mitigation measures that are implemented prior to construction shall ensure that there is no unacceptable risk to relevant onsite and offsite receptors (as identified in the CSM: Section 2.2) during construction phase (and during operational use where measures require development and incorporation into the design of various development features, prior to construction).

The approach to mitigation of risks associated with landfill gases and vapours in this SMP is informed by relevant guidance, principally, by NSW EPA (2019), BSI (2019) and EPA Victoria (2015).

The station development occupies a substantial area of the Site (including the footprint area of the former landfill waste mass) and includes a range of features, the nature of which may change as development proposals are refined. The approach recognises that:

- Complete removal of the waste mass at the Site is not financially viable or sustainable.
- A substantial waste mass comprising the remainder of the former landfill will in any event remain to the south-west of the Site, adjacent to the station development.
- Due to the above, a management in-situ approach is required and the approach to mitigation of landfill gas/vapour risks therefore:
- Comprises a number of management measures applied to relevant features of the station development and to the development as a whole.
- Aims to mitigate risks by breaking or otherwise interrupting the pathway to relevant onsite and offsite receptors.

[5] A capping system of at least 0.5m thickness is recommended by DoH (2009) for uses other than public open spaces.

- Gives preference to passive intervention measures (i.e. measures that do not require human intervention other than periodic inspection and maintenance in order to maintain their effectiveness over the life of the development).
- Includes appropriate levels of redundancy to ensure adequate performance of the mitigation measures over the life of the development (including allowance for potential modes of failure such as blockage, and/or ground settlement effects).
- Is intended to be sufficiently flexible to allow updates (if required) in this 'live' SMP in response to:
  - Refinement of development proposals.
  - Additional data concerning landfill gases and vapours that will be obtained in further monitoring (Section 5.2.6) that is to be undertaken to support refinement of development proposals.

A number of these measures need implementation prior to construction as these require development and incorporation into the design of various development features. The selection and design of mitigation measures shall:

- Comply with guidance provided within NSW EPA (2019: in particular, Section 5).
- Be undertaken by a suitably qualified and experienced professional in landfill gas protection[6].
- Be documented as identified in Section 9 and be subject to review and approval by the appointed Contaminated Sites Auditor, prior to implementation of construction.

Mitigation measures that require implementation prior to construction to address potentially unacceptable risks associated with the above issues are set out in the following sections. This includes further landfill gas/vapour monitoring prior to construction to support the selection and design of gas management measures.

5.2.1 Buildings, other occupied structures and other permanent development features which are confined spaces

Landfill gas/vapour mitigation measures for buildings, any other occupied structures[7] and other permanent development features which are confined spaces[8] should be developed and incorporated into the detailed design of such structures. In particular, it is noted that the concept design (Appendix A) currently places the station ticket hall within the indicated extent of the waste mass. This has implications for the scale of management required to mitigate risks from landfill gases and vapours.

Other infrastructure is addressed in Section 5.2.5.

Selection of station design features

Selection of station design features shall consider opportunities to reduce sensitivity of the development to risks posed by landfill gases and vapours. This should include (but not be limited to):

[6] i.e. as stated in NSW EPA (2019: Section 1.6) *'possession of qualifications that are relevant to, and appropriate experience in, the assessment and management of hazardous ground gases'.*
[7] i.e. other permanent development features which are designed or intended for 'entry' (as defined by safe work Australia 2018) by a person or can otherwise be occupied and within which a hazardous atmosphere could potentially form. For the avoidance of doubt, this includes any development feature that is accessible to site users including (but not limited to) members of the public, construction and maintenance workers, PTA employees.
[8] i.e. confined spaces as defined by safe work Australia https://www.safeworkaustralia.gov.au/confined

- Location of sensitive structures (e.g. station ticket hall) away from the former landfill waste mass (if feasible) or away from deeper parts of the landfill waste mass to reduce exposure to landfill gases and vapours.
- Limiting the footprint area of sensitive structures (e.g. station ticket hall) to minimise bearing pressures upon the underlying soils or landfill waste to minimise the need for deep foundations (e.g. piled foundations) to transmit foundation loads below the landfill which may otherwise act as a preferential pathway for landfill gases/vapours to reach structures.
- Incorporation of design features which do not permit ingress and accumulation of landfill gases and vapours, such as (but not limited to):
  - Structures elevated above ground level to create an open air-gap[9].
  - Open-sided structures.
  - Minimise floor slab penetrations/services entry points services (or required services entry points above ground level where possible). Appropriately seal any required penetrations to prevent landfill gas ingress via those potential pathways.
  - No below ground enclosed spaces such as basements
  - Well-constructed reinforced concrete slabs [e.g. post-tensioned slabs], which are resistant to cracking).
  - Proprietary gas-resistant membranes
- Integration of geotechnical considerations (i.e. to address issues such as total and/or differential settlements within the waste mass) with gas management measures as recommended in GHD (2018), GHD (2019), NSW EPA (2019) and EPA Victoria (2015) so that:
  - Geotechnical solutions and gas management measures are compatible
  - Gas management measures are not sensitive to geotechnical issues such as settlement effects.

Further guidance on design features to reduce sensitivity of development to risks posed by landfill gases and vapours is provided in in NSW EPA (2019 – in particular Section 5 and Appendix 6) and BSI (2019 – in particular Annex A).

Characteristic situation (CS)

As identified in the Addendum Gas Monitoring Report (GHD 2020a) with respect to the former Ranford Road Landfill:

- The provisional Characteristic Situation (CS) for development at the footprint area of the waste mass within the Site is CS4 with respect to methane and carbon dioxide. This reflects a conservative and precautionary approach based on data obtained to date; the current CSM; and the status of development proposals and that further data can be obtained.
- The provisional CS for development beyond the footprint area of the waste mass at the Site is CS3 with respect to methane and carbon dioxide as a conservative and precautionary approach (in particular with respect to the current level of certainty concerning development proposals and implications of these for the CSM).

Management requirements under the provisional CS3 and CS4 identified for development at the Site (with respect to methane and carbon dioxide) shall also be capable of addressing residual risks posed to relevant aspects of development (i.e. buildings, other occupied structures and

[9] NSW EPA (2019) advises that: *Open voids are superior because of the much higher air and gas flows that can be achieved, and because they are less subject to blockage and water-locking.*

other permanent development features which are confined spaces) from hydrogen sulphide, carbon monoxide and vapours.

As noted above, the concept design (Appendix A) currently places the station ticket hall within the indicated extent of the waste mass (Provisional CS4). This has implications for the scale of management required to mitigate risks from landfill gases and vapours, as identified below.

It should be noted that the CS identified above are provisional. The above CS values shall be reassessed by the Contractor when relevant information becomes available during the progression of design for buildings and other occupied structures***. Where appropriate the CS values shall amended in response to such information and/or in response to results from further monitoring and assessment of those results.***

Quantitative risk assessment

Given the identification of provisional CS4 conditions for the waste mass at the Site, consideration has been given to the need for quantitative risk assessment to support development of an SMP. Based on the level of detail available for the proposed development (refer to Appendix A), it is not at this time considered that such assessment is appropriate. At this time, it is considered that appropriate gas protection measures for the Site can be selected based on guidance provide in NSW EPA (2019): Section 5.

This requirement shall be reassessed by the Contractor when relevant further information becomes available during the progression of design for buildings other occupied structures and other permanent development features which are confined spaces. If/where deemed necessary, an alternative approach shall be implemented for the selection and design of appropriate gas mitigation measures for development.

Gas protection scores

Based on the CSM and current information concerning the proposed development, required gas protection guidance values (NSW EPA 2019: Section 5) for relevant development features (i.e. based on the public buildings category) for use in consideration of management measures are considered to be as follows:

- Indicated landfill waste mass footprint area[10] (provisional CS4): required gas protection guidance value = 5.
- Site areas beyond the indicated landfill waste mass footprint area (provisional CS3): required gas protection guidance value = 3.

Reference shall be made to the landfill gas generation model (GHD, 2019b) prepared using currently available information to assist with design of landfill gas/vapour mitigation measures for buildings, other occupied structures and other permanent development features which are confined spaces.

The above values shall be reassessed by the Contractor when relevant information becomes available during the progression of design for buildings, other occupied structures and other permanent development features which are confined spaces. ***The characteristic situation applicable to any part of the Site, relevant protection scores and protection measures required shall be reviewed by the Contractor and where appropriate amended in response to such information and/or in response to results from further monitoring and assessment of those results***.

The concept design (Appendix A) currently places the station ticket hall within the indicated extent of the waste mass (Provisional CS4 and required gas protection guidance value = 5. As

[10] As identified in GHD (2019b) plus a nominal 5m additional buffer distance as a reasonable contingency to account for possibly variability in lateral extent of the waste mass at the Site.

identified in NSWEPA (2019), the location of the station ticket hall therefore requires a combination of protection measures with a high level of performance to achieve a score that meets or exceeds the corresponding gas protection guidance value. With respect to this matter, it is relevant to note:

- The unique nature and form of the building that is currently proposed at the Site (i.e. a station ticket hall).
- Sloping topography in the vicinity.

Consideration shall therefore be given to the opportunity to incorporate an open void space beneath the building slab (e.g. facilitated by a suspended floor construction) to maximise performance of passive venting as a protection measure[11]. Consideration shall also be given to minimising services penetrations into the building, which are below ground level and to, where possible, incorporate unavoidable services penetrations above ground level.

As noted in Section 5.2 above, appropriate levels of redundancy are required to ensure adequate performance of the landfill gas and vapour mitigation measures over the life of the development. Design of protection measures, particularly passive venting systems for buildings, any other occupied structures and other permanent development features which are confined spaces shall therefore include consideration of appropriate contingency measures for possible events that may detrimentally affect future performance. Such measures that may be incorporated into design, may include (but not be limited to) duplication of key pipe-runs or other critical components (to add redundancy) and ability to retrofit passive vents systems with semi-active measures (e.g. vent cowls) or other mechanical assistance (e.g. active measures).

Further guidance on selection and design of mitigation measures is provided in NSW EPA (2019 – in particular Section 5) and BSI (2019 – in particular Sections 7, 8 and Annexures).

Consideration should also be given to requirements for management of discharged gases including odorous gases that may be discharged from venting systems. The range of landfill gas generation rates estimated in GHD 2019c and the guidance provided in EPA Victoria (2015: Table 6.5) should be considered as part of this process. It is noted that a landfill gas pumping trial may ultimately need to be completed to inform the landfill gas design at the Site.

Requirements for documenting the selection and design of landfill gas/vapour mitigation measures are identified in Section 9.1.

5.2.2 Sealed surfaces

For the purpose of this SMP, sealed surfaces are surfaces which are formed using surface treatments such as (but not limited to): tar, bitumen, concrete or asphalt or other hard material (e.g. paving or compacted material which has the effect of creating a hard surface)[12]. This definition is intentionally wide because it needs to cover any surface that may restrict the migration of landfill gases and vapours, potentially causing these to:

- Accumulate and potentially form hazardous atmospheres (such as beneath car parks, roads, hardstand areas, pedestrian concourses and platforms, including within stormwater system and other sub-surface services).
- Promote or otherwise enhance lateral (and/or vertical) migration of landfill gases and vapours towards vulnerable receptors.

The design of sealed surfaces shall incorporate appropriate mitigation measures to manage risks associated with the above. These may include, but are not limited to:

[11] Such an arrangement may be similar to the typical arrangement presented in BSI (2019) Figure B.1 with an open void instead of a gas dispersal layer.
[12] Note: not buildings, other occupied structures and other permanent development features which are confined spaces.

- Vertical gas collection wells and vents with the some or all of the following features:
  - Centrally located wells and vents (to provide pressure relief beneath sealed surfaces).
  - Perimeter wells (to mitigate lateral migration from beneath areas of sealed surfaces).
  - Horizontal collection network to improve collection efficiency for large areas of sealed surfaces such as car parks.
  - Gas collection wells installed within the waste mass (however, full depth penetration may not be appropriate in order to minimise risk of creating preferential migration pathways for leachate).
  - Well heads installed with appropriate manhole type access points (within suitable landfill capping material) to reduce potential for damage during construction activities.
  - Appropriately selected and justified treatment technology for the discharged gases including odorous gases that may be discharged from venting systems. The range of landfill gas generation rates estimated in GHD 2019c and the guidance provided in EPA Victoria (2015: Table 6.5) should be considered as part of this process. It is noted that a landfill gas pumping trial may ultimately need to be completed to inform the landfill gas design at the Site.
- Horizontal collection pipes with permeable trench media and vents (or modular systems of equivalent or better performance). These shall have characteristics sufficient to achieve intended purpose over the life of the development including but not limited to:
  - Dimensions optimised to convey the volume of gases generated (but not oversized to ensure these maximise radius of influence).
  - Of sufficient strength to support expected development loadings (i.e. crush-proof).
  - Laid at gradients sufficient to prevent blockage from condensate (or leachate) and sufficient provision for condensate collection.
  - Consider duplication of critical pipe-runs to build in redundancy/capacity for repairs.
  - Pipe runs should be designed to be as short and direct as is possible (i.e. number of bend/direction changes minimised) to facilitate efficient gas movement.
- Condensate[13] management measures. Appropriate collection and drainage measures are needed to prevent condensate from causing blockage/damage or other disruption to the effectiveness of the collection system. Condensate management measures shall also include selection of appropriate materials for system construction to mitigate risk of damage/deterioration caused by potentially corrosive constituents of condensate. At this time, it has been assumed that all condensate generated at the Site would (and could) drain back into the landfilled waste at the Site without causing adverse impact.
- Incorporation of geomembranes and capping (where considered appropriate).
- Measures to minimise risk of damage from construction activity (short term) and settlement of the waste mass (longer term).

Reference shall be made to the landfill gas generation model prepared using currently available information and to available monitoring data (GHD 2019b and GHD 2020a – refer to ongoing monitoring – Section 5.2.6) to assist with the design of landfill gas/vapour mitigation measures for sealed surfaces. Further guidance on gas collection is provided in EPA Victoria (2015) and UKEA (2004: in particular Section 7).

Requirements for documenting the selection and design of landfill gas/vapour mitigation measures are identified in Section 9.1.

[13] Condensate is water that condenses from vapour form into liquid form from landfill gas as it travels through landfill gas collection pipework.

5.2.3 Perimeter gas collection measures at critical boundaries

Subject to refinement of the development layout, the design of the proposed development shall incorporate appropriate 'boundary' gas collection measures to mitigate risks from lateral migration of landfill gases and vapours where deemed necessary. This shall be determined as part of the design of gas mitigation measures where assessment of other gas mitigation measures identifies a requirement for additional collection measures to be implemented in order to manage risks posed by landfill gases and vapours.

Based on current information concerning the proposed development (refer to Appendix A), it is anticipated that such measures may be required at the following locations, which at this time are considered to be critical boundaries[14]:

- The perimeter of large sealed surface areas such as car parks in the vicinity of the waste mass,
- The north-east boundary of the waste mass (or north-west boundary of the Site with Ranford Road where implementation at the north-east boundary of the waste mass is not feasible).
- The south-west boundary of the Site (with the remainder of the waste mass to the south-west).
- Gas collection wells and horizontal collection pipes (refer to Section 5.2.2 for further details).

Reference shall be made to the landfill gas generation model prepared using currently available information and to available monitoring data (GHD 2019b and GHD 2020a – refer to ongoing monitoring – Section 5.2.6) to assist with the design of landfill gas/vapour mitigation measures for sealed surfaces. Further guidance on gas collection is provided in EPA Victoria (2015) and UKEA (2004: in particular Section 7).

Requirements for documenting the selection and design of landfill gas/vapour mitigation measures are identified in Section 9.1.

5.2.4 Existing gas extraction system

It is considered that at this time, there is no opportunity to connect a landfill gas collection system at the Site into the existing landfill gas collection and treatment system that will remain at the adjacent part of the remaining landfill for the following reasons:

- The existing gas extraction system at the former landfill (including the Site) is not understood to have been designed or installed for the purpose of mitigating risks to future development. Retention and/or amendment of the existing system is likely to be difficult and time consuming during construction and may not form a complete solution for the landfill gas in the relevant areas of the Site.
- Due to ongoing maintenance issues with the landfill gas extraction and flaring system, this is in effect 'non-operational' (refer to Table 1: GHD 2020a). Based on current information provided by the City of Canning:
  - The condition of this system is not well known at the Site and at the remainder of the landfill beyond the Site.
  - There is no known timeframe for the system to resume operation.
- The concept design (refer Appendix A) implies that the existing system in the Site will be impacted during the construction of the proposed development

[14] I.e. boundaries of development features and or the Site where potential for significant influence upon risk to relevant receptors exists if not appropriately managed.

- The Site needs to have a landfill gas collection and treatment system which is effective at managing risks posed by landfill gases and vapours at the Site. To achieve this, it is currently expected that such a system at the Site will need to be within the control of the Principal and not a third party.

On this basis, removal of the portion of the existing system at the Site is expected to be required in order to facilitate redevelopment. This matter therefore needs to be considered in the design for gas protection measures at the Site, including (but not limited to):

- Appropriate separation of the onsite portion of the gas extraction system from that offsite (to the south-east) such that this separation:
  - Does not affect the ability of the remaining offsite portion of the system to operate.
  - Prevents the remaining off-site portion of the system from affecting any portion of the onsite system that is abandoned.
- Liaison with the City of Canning to achieve the above.
- Appropriate removal of onsite gas extraction system infrastructure.

The design process shall therefore include (but not be limited to):

- Design of appropriate modifications to the existing gas extraction system to facilitate the above.
- Appropriate justification to support the design (including but not limited to provision of calculations to demonstrate performance of the design).
- Possible future operation of the adjacent landfill gas system at the remainder of the landfill adjacent to the Site and design for possible outcomes as far as reasonably practicable (e.g. re-commencement of operation of the system at the remainder of the landfill potentially resulting in air being drawn down a venting system installed at the Site with resulting adverse impacts at one or both sites).

Requirements for documenting the selection and design of modifications to the existing gas extraction system are identified in Section 9.1. Information concerning the exiting gas extraction system obtained from the City of Canning as part of previous work is provided in Appendix A.

5.2.5 Other infrastructure

Wherever practical to do so, below ground infrastructure should avoid the footprint area of the waste mass (or where this is unavoidable be rationalised/minimised, where feasible). All services infrastructure shall be accommodated within the capping system, except where required to penetrate the waste mass as an inevitable consequence of its purpose (e.g. gas mitigation measures such as gas collection wells).

Services infrastructure shall be designed to mitigate the potential for landfill gas to enter, impact upon, or potential for these to act as migration pathways for example:

- Using appropriate barriers/plugs/seals.
- Selection of types which do not contain void spaces (where feasible).
- Materials types which are resistant to entry by gases and vapours (and which are of material types that are resistant to degradation by vapours).
- Incorporation of vents to limit the potential for gases and vapours to accumulate and form hazardous atmospheres.
- Appropriate zoning and hazardous area design for electrical cables and equipment.

- Requirements for documenting the selection and design of landfill gas/vapour mitigation measures are identified in Section 9.1.

5.2.6 Landfill gas/vapour monitoring

Existing landfill gas/vapour monitoring bores

Landfill gas and vapour monitoring is required to inform the design of landfill gas/vapour mitigation measures for the completed development. A network of existing monitoring wells is present at the Site for use in such monitoring.

Monitoring requirements are summarised in Table 8 and proposed monitoring locations and sampling methodologies to be adopted are provided in the SAQP (Appendix C).

It is important to note that additional monitoring has commenced (first event undertaken in March 2020). This will be reported separately on completion and the SMP updated, if required.

Table 8 Landfill gas/vapour monitoring requirements prior to construction phase

Monitoring network area	Location ID	Analytes	Frequency and timing	Rationale for inclusion
Within Site	LFG01 LFG03 LFG04 LFG07	<u>Field parameters:</u> General gases: methane, carbon dioxide, carbon monoxide, oxygen and hydrogen sulphide; VOCs; flow rate; atmospheric pressure (refer to SAQP; Appendix C)	Quarterly monitoring (4 events)	To inform SMP requirements and update if required, prior to construction
Adjacent to rail reserve	LFG05 LFG06			
Eastern boundary	LFG08 LFG09 LFG10 LFG11			
Southern boundary	LFG12 LFG13			
Western boundary	LFG02 LFG14 LFG15			

New landfill gas/vapour monitoring bores

In addition to the existing monitoring wells, installation of new monitoring wells is required to:

- Reinforce the existing monitoring well network in response to further refinement of development proposals that will take place and requirements for further information as a result of this.
- Replace any existing monitoring wells which are required to be removed at any point during development construction works.

Requirements for new monitoring wells (anticipated at this time) are summarised in Section 6. Sampling methodologies to be adopted are provided in the SAQP (Appendix C).

The number and location of monitoring wells and monitoring requirements is however subject to outcomes from the design process. Requirements for new monitoring wells and associated monitoring shall be reassessed by the Contractor when relevant further information becomes available during the progression of design for the development.

Where necessary, the number, location and other relevant details shall be amended in order to provide a robust network of monitoring wells for use during construction and operation of the new station in order to manage risks posed by the former landfill to relevant receptors.

Further guidance to inform decision-making concerning the appropriate density/location of future monitoring wells is provided in NSW EPA (2019), UKEA (2004) and EPA Victoria (2015).

5.3 Water management

Design of the station shall incorporate water management measures to minimise generation of leachate within the waste mass (and generation of landfill gases through introduction of moisture). These essentially comprise measures to:

- Minimise disturbance of the waste mass.
- Direct surface water away from the waste mass.
- Limit/prevent infiltration of water into the waste mass.
- Minimise creation of new preferential pathways for migration of leachate to groundwater.

Such measures include (but are not limited to):

- Avoidance of surface water drainage infiltration measures within the footprint area of the waste mass. Wherever possible, surface water runoff shall be intercepted and directed away from the waste mass with appropriate precautions implemented to mitigate:
  - Settlement effects upon drainage infrastructure.
  - Accumulation and migration of landfill gases and vapours within drainage infrastructure. Requirements for documenting the selection and design of landfill gas/vapour mitigation measures associated with drainage infrastructure are identified in Section 9.1.
- Options to:
  - Minimise ground treatment requirements that may otherwise enhance leachate migration (construction phase) through compression of the waste mass by ground treatment methods[15], or

[15] For example, construction of a robust engineered fill capping system to form a ‘stiffened raft’ type foundation to receive features such as sealed surfaces may render these less sensitive to settlement effects and reduce the need for deeper treatment of underlying waste materials.

  - Control the duration and scale/rate of application of ground treatment that is unavoidable, in order to limit the potential for enhanced leachate migration.
- Measures to minimise requirements for deep foundations (e.g. piled foundations) that may otherwise form migration pathways for leachate, e.g.
  - Limit the footprint area of sensitive structures (e.g. station ticket hall) to minimise bearing pressures upon landfill waste.
  - Where deep foundations are unavoidable, consideration of pile types which minimise potential for these to act as migration pathways.

Drainage infrastructure forming part of water management at the Site shall also:

- Be designed to mitigate risk of failure associated with total and differential settlement of the waste mass, particularly at the boundary with adjacent natural strata.
- Comprise materials types which are resistant to entry by gases and vapours (and which are of material types that are resistant to degradation by gases and vapours).
- Incorporate vents to limit the potential for gases and vapours to accumulate and form hazardous atmospheres.
- Incorporate appropriate measures to allow for future inspection (e.g. by closed-circuit television methods) and cleaning.

A water balance may be developed for each relevant stage of the development to support the design and identify appropriate water and leachate management measures for subsequent implementation.

These water balances may identify specific leachate management measures need to be incorporated into development proposals to collect, treat and/or dispose of leachate in an appropriate manner. In such a case, opportunity for a collaborative approach with the City of Canning for management of leachate at the remainder of the former landfill could be explored.

Further guidance on water management is provided in EPA Victoria (2015) and UKEA (2004: in particular Section 7).

5.4 Groundwater monitoring

An initial groundwater monitoring event (GME) comprising sampling of existing onsite and offsite groundwater monitoring wells shall be conducted two months prior to the commencement of construction works for the purpose of obtaining baseline pre-construction groundwater quality data to inform the design of groundwater mitigation measures for the completed development.

Monitoring requirements are summarised in Table 9 and proposed monitoring locations and sampling methodologies to be adopted are provided in the SAQP (Appendix C).

Table 9 Groundwater monitoring requirements prior to construction phase

Monitoring network area	Location ID	Analytes	Frequency and timing	Rationale for inclusion
Within the site boundary	MW02 MW01 RR08	Metals/metalloids (Al, As, Cd, Cu, Cr, Fe, Mn, Ni, Pb, Zn & Hg); Total Recoverable Hydrocarbons (TRHs); Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene (BTEXN); Polycyclic Aromatic Hydrocarbons (PAHs); Organochlorine/ Organophosphorus Pesticides (OCP/OPP); Major anions (Cl, SO4, carbonate and bicarbonate); Major cations (Ca, Mg, Na and K); and nutrients (nitrate, nitrite, ammonia, TKN, total nitrogen, total phosphorus); Ammonia PCBs; Cyanide; Fluoride; Perfluoroalkyl and polyfluoroalkyl substances (PFAS) – ultra trace full suite; Dissolved methane (onsite wells only).	One GME to be undertaken two months prior to the commencement of construction works for the purpose of obtaining baseline pre-construction groundwater quality data.	Existing onsite groundwater monitoring well network (within landfill waste extent) to capture data representative of groundwater quality beneath the site.
Off-site (north)	GW02 GW03 GW14 RR03			Located on the 'Soils Aint Soils' property approximately 350 m north of the northern site boundary to capture offsite groundwater quality data in a down gradient direction.
Off-site (north-east)	MC CG			Located approximately 750 m and 800 m to the north-east of the northern site boundary to capture offsite groundwater quality data in a down hydraulic gradient direction.
Off-site (south-east)	RR02			Located approximately 200 m south-east of the south eastern site boundary to capture offsite groundwater quality data representative of background conditions in an up hydraulic gradient direction.
Off-site (west)	RR07			Located approximately 200 m west of the south-western site boundary within an offsite portion of the former landfill to capture offsite groundwater quality data in a cross-gradient direction.

5.5 Buried structures: durability of materials and degradation effects

Design and specification of buried structures should include appropriate measures to mitigate risks of degradation that may affect performance or durability, such as (but not limited to):

- Contact with substances in the waste mass at the Site that may be capable of affecting the durability of materials.
- The potential presence of ASS in the vicinity of the Site.
- Substances present in groundwater associated with the presence of former landfills at and in the vicinity of the Site).

This matter is to be addressed separately in design and specification of materials to be undertaken by others and is not addressed in this SMP.

5.6 Construction Quality Assurance (activities prior to construction)

It is critical to the effectiveness of cap integrity, gas/vapour mitigation and water management measures that:

- Physical components installed are protected from damage during construction.
- Allowance is made for these to be inspected and tested as required in order to demonstrate that the works have been carried out in accordance with the approved design.
- Appropriate monitoring protocols and assessment criteria for the relevant aspects of mitigation measures that are designed are identified by the Contractor for incorporation into the CQA plan (and OSMP as relevant for ongoing management).

A construction quality assurance (CQA) plan and program shall therefore be prepared in accordance with the requirements of Section 9.1 to facilitate the above. Where installation of measures takes place in separate stages over time, the CQA plan shall consider CQA reporting following completion of each relevant stage of the installation works.

Prior to construction commencing, all relevant parties identified in Section 4.2 shall also meet to confirm:

- Appropriate working practices to ensure that all physical components of gas/vapour mitigation measures (e.g. membranes, venting systems) and surface water management features are adequately protected from damage by all trades/work activities during construction.
- Awareness of all hold points required to facilitate required inspection and verification of physical components of installed mitigation measures for CQA purposes.

5.7 Community engagement

Consideration shall be given to the level of community engagement that is required prior to construction. Refer to Section 7 for further information.

6. Management during construction phase

6.1 Summary of management requirements during construction

As identified in Table 3, construction activities for the new station have the potential to introduce new pathways and receptors to sources of contamination associated with the former landfill and therefore require appropriate management. Management requirements considered to be appropriate at this time for the construction phase are identified in Table 10.

Table 10 Management requirements during construction

Site activity	Potential risk	Management requirement
All construction activities	Construction introduces new pathways and receptors to sources of contamination associated with the former landfill. Health and safety risks to contractors undertaking construction activities.	CEMP required as per Section 6.2 Health and Safety Management Plan (HSMP) required as per Section 6.3
All construction activities	Concern or nuisance to the surrounding community	Community engagement as per Section 7.
Land disturbance activities: • Cut to fill activities to form development platform • Piles/foundations • Underground services • Construction of drainage basin • Other, as required.	Contaminants (including ACM) in soil/landfill waste inclusions within fill.	Soil management as per Section 6.7
	LFG and vapours	Monitoring as per Section 6.4. Management limits provided in Table 6.
	Odour issues	Control of odours as per Section 6.6.
	Airborne dust	Control of dust as per Section 6.6.
	Litter and disease vector control	Control of litters/disease vectors as per Section 6.6.
	ASS	Soil management as per Section 6.8.
Spoil management: • Cut to fill activities to form development platform • Piles/foundations • Excavations • Trenching	Contaminants (including ACM) in soil/landfill waste inclusions within fill.	Soil management as per Section 6.7 and Section 6.9.
	ASS	Soil management as per Section 6.8.
	Airborne dust	Control of dust as per Section 6.6.
Importation of material (if required)	Contaminants in soil	As per Section 6.10.

Site activity	Potential risk	Management requirement
Construction of structures/infrastructure /built form Placement and use of temporary structures[16]	Groundwater	Implementation of a groundwater monitoring program as per Section 6.11.
	LFG and vapours	Monitoring as per Section 6.2. CQA as per Section 6.5 for gas/vapour mitigation measures. Incorporation of appropriate features for temporary structures (where present at/in vicinity of landfill waste is unavoidable) which do not permit ingress and accumulation of landfill gases and vapours (refer to Section 6.4.1)
Ongoing operational controls (construction phase)	Refer to Section 6.12	

6.2 Health, Safety and Environment Management Plans

A CEMP has been prepared by the Contractor to inform the construction requirements and methodology for completing the works in a manner that minimises adverse impacts to the environment and heritage (NWA, 2020a).

In addition to the CEMP, a Safety Management plan has been prepared to underpin all project activities including construction environmental management (NWA, 2020b).

An Emergency Management Plan has also been developed by the Contractor (NWA, 2020c). The plan includes the necessary procedures should fire be an issue during the proposed development.

6.3 Community engagement

Implementation of timely and effective community engagement at an appropriate scale is essential for the construction of the new station. Refer to Section 7 for further information.

6.4 Landfill gas/vapour management during construction phase

6.4.1 Temporary structures - landfill gas/vapour mitigation measures

Placement of temporary structures that are, or otherwise contain enclosed spaces into which landfill gases and vapours could migrate and accumulate, should be avoided where possible at or in the vicinity of landfill waste masses present at the Site (former Bannister Road Landfill to the north of the rail corridor and former Ranford Road Landfill to the south of the rail corridor).

Where such placement is unavoidable, requirements for appropriate landfill gas/vapour mitigation measures shall be considered, and where necessary, implemented for temporary structures. It is noted that temporary structures, by their nature may be able to be elevated above ground to create an open air-gap as part of measures implemented to mitigate risks from ingress and accumulation of landfill gases and vapours. Further measures include (but are not limited to):

[16] i.e. structures brought to the Site in connection with construction works which are not permanent features, such as but not limited to: intermodal containers used for storage and or temporary offices/mess/ablutions.

- Open-sided structures and other passive ventilation measure incorporated into temporary structures.
- Minimise floor slab penetrations/services entry points services (or required services entry points above ground level where possible). Appropriately seal any required penetrations to prevent landfill gas ingress via those potential pathways.
- No below ground enclosed spaces.
- Active measures (active ventilation, building gas monitoring and alarm systems).

Although intended for consideration of permanent structures, further guidance which may be of assistance on selection and design of mitigation measures is provided in NSW EPA (2109) NSW EPA (2019) and BSI (2019).

6.4.2 Monitoring in the vicinity of works

Appropriate fixed/handheld and personal monitoring devices should be deployed by the Contractor to provide continuous monitoring of any works in which hazardous atmospheres could form for the duration of the relevant works. Such works may include (but are not limited to):

- Surface works at/in the vicinity of landfill waste at the Site.
- Subsurface voids (e.g. formed for pile installation, buried services infrastructure containing cavities or other open spaces/annular spaces).

Appropriate fixed/handheld and personal monitoring devices should include capability for:

- Detection of LFG and vapours (refer to Table 10 for management requirements and Table 6 for management limits).
- Alerting workers in the vicinity.

It is required that the devices (at a minimum) have the capacity to monitor for:

- Methane
- Oxygen
- Carbon monoxide
- Hydrogen sulphide*
- Volatile organic compounds
- Lower explosive limit (LEL)

**In particular, significantly elevated hydrogen sulphide was identified at LFG01, located approximately 40 m south of the northern boundary within the rail corridor (at the adjacent former Ranford landfill site).*

In addition to the above:

- Detection levels should be sensitive enough to meet the required management levels.
- The devices shall be intrinsically safe, waterproof, and capable of operation for the duration of the work being undertaken work.
- All monitoring devices should be calibrated prior to use and capable of alerting the Contractor to any exceedances of the management levels.

The monitors should be located as close as practicable to the relevant surface or subsurface works within which hazardous atmospheres could form. All monitoring devices should be calibrated prior to use, used by appropriately trained and experienced staff and capable of alerting the Contractor to any exceedances of the management levels.

6.4.3 Monitoring during construction phase

Landfill gas monitoring bores

Landfill gas monitoring is required to confirm prevailing landfill gas conditions and identify any changes to these conditions and their associated risk during the construction phase.

An expanded gas monitoring well network shall be used to assist in monitoring of the former landfill for indications of enhanced lateral migration of landfill gases and vapours from the waste mass. Where deemed appropriate, this includes installation of continuous monitoring instruments with telemetry to provide 'real time' data at key locations to inform decision-making.

Data shall be obtained from the monitoring well network and used to identify potential short-term adverse effects concerning landfill gases and vapours arising from construction activities. It is expected that construction activities will be modified as needed to manage the potential for any short-term adverse effects arising in construction works (refer to Section 8.2).

Monitoring requirements are summarised in Table 11 and proposed monitoring locations and sampling methodologies to be adopted are provided in the SAQP (Appendix C) - additional monitoring wells will be required to expand the current monitoring well network. Relevant management limits for monitoring are presented in Table 6.

Monitoring requirements for new infrastructure constructed as part of the development will be determined following completion of design and the SAQP updated where needed to facilitate implementation

Monitoring from the expanded monitoring well network shall commence two months prior to the commencement of construction works for continuity purposes.

Buried services infrastructure, existing buildings and temporary structures

In addition to gas monitoring bores (above), landfill gas monitoring at buried services infrastructure and temporary structures shall also be undertaken to assist in identifying and managing potential short-term adverse effects concerning landfill gases and vapours arising from construction activities. Such monitoring shall be undertaken from:

- Existing accessible monitoring infrastructure and existing services infrastructure within the Site and at the Site boundary.
- Existing buildings at the adjacent waste transfer facility (offices, gatehouse and storage shed in the south eastern part of the Site).
- All on-site temporary structures (such as but not limited to): intermodal containers used for storage and or temporary offices/mess/ablutions which are required, irrespective of positioning at the Site (i.e. both outside and within the footprint of the landfill waste mass as a conservative approach).
- New infrastructure installed at the Site (where the nature of this will permit such monitoring).

Monitoring requirements are summarised in Table 11 and sampling methodologies to be adopted are provided in the SAQP (Appendix C). Relevant management limits for monitoring are presented in Table 6.

Monitoring requirements for new infrastructure constructed as part of the development will be determined following completion of design and the SAQP updated where needed to facilitate implementation.

Surface monitoring

It is recommended that transect monitoring of the surface of the Site is undertaken on a periodic basis as an additional precaution to promote early detection of potential short-term adverse effects concerning landfill gas surface emissions arising from construction activities.

Monitoring requirements are summarised in Table 11 and proposed sampling methodologies to be adopted are provided in the SAQP (Appendix C). Relevant management limits for monitoring are presented in Table 6.

Table 11 Landfill gas/vapour monitoring requirements during construction phase

Monitoring network area	Location ID	Analytes	Frequency and timing	Rationale
Additional wells to be installed outside waste mass and screened to full extent of waste mass. Location and number TBC by sub-consultants responsible for landfill gas design Install all monitoring wells to the specifications outlined in Tables B.2 and Table B.3 of the BPEM EPA Victoria, 2015)	TBC	<u>Field parameters:</u> General gases: methane, carbon dioxide, carbon monoxide, oxygen and hydrogen sulphide; VOCs; flow rate; atmospheric pressure (refer to SAQP, Appendix C). <u>*Gasflux:</u> LFG01 LFG02 LFG07	Once weekly during first two months of construction phase. Once monthly thereafter. Gasflux: Continuous during construction To be confirmed and optimised to construction program and key landfill disturbing activities.	To validate effectiveness of SMP during construction
Within Site	LFG01* LFG03 LFG04 LFG07*			
Adjacent to rail reserve	LFG05 LFG06 SGB025 (Talis bore)			
Eastern boundary	LFG08 LFG09 LFG10 LFG11			
Southern boundary	LFG12 LFG13			
Western boundary	LFG02* LFG14 LFG15			
Existing buried services infrastructure (and relevant existing buildings at adjacent waste transfer station i.e. offices, gatehouse and storage shed in the south eastern part of the Site).	Location and number to be confirmed by sub-consultants responsible for landfill gas design	Methane and hydrogen sulphide	Once weekly during first two months of construction phase. Once monthly thereafter. To be confirmed and optimised to construction program and key landfill disturbing activities	To validate effectiveness of SMP during construction

Monitoring network area	Location ID	Analytes	Frequency and timing	Rationale
New buried services infrastructure	To be confirmed/determined following completion of design.	Methane and hydrogen sulphide	To be confirmed and optimised to construction program and key landfill disturbing activities	To validate effectiveness of SMP during construction
Temporary structures	Where presence at/in vicinity of landfill waste is unavoidable.	Methane, hydrogen sulphide and carbon monoxide, vapours	Once per day To be confirmed and optimised to construction program and key landfill disturbing activities	To validate effectiveness of SMP during construction
Surface monitoring	Site-wide / any area of landfill waste mass disturbance earthworks as determined by sub-consultants responsible for landfill gas design.	Methane, weather conditions including wind speed	Once weekly during first two months of construction phase (site wide) and thereafter at the following intervals: -At any area of landfill waste mass disturbance earthworks (weekly basis) - Site wide (monthly) To be confirmed and optimised to construction program and key landfill disturbing activities	To validate effectiveness of SMP during construction

6.5 Construction Quality Assurance

It is critical to the effectiveness of gas/vapour mitigation measures that physical components installed are protected from damage during construction and that allowance is made for these to be inspected and tested (post-construction validation testing) as required by the CQA plan (refer to Section 9.1).

6.6 Control of dust, odour and litter

6.6.1 Dust

Appropriate dust management and an air quality monitoring program should be implemented by the Contactor. Dust management and associated air quality monitoring measures should be developed by the Contractor with reference to the following standards and guidelines:

- AS/NZS 3580.9.3:2003 *Methods for sampling and analysis of ambient air: Method 9.3: Determination of suspended particulate matter – Total suspended particulate matter (TSP High volume sampler gravimetric method*
- AS/NZS 3580.10.1:2003 *Methods for sampling and analysis of ambient air: Method 10.1: Determination of particulate matter – Deposited matter – Gravimetric method*
- AS/NZS 3580.1.1:2007 *Methods for sampling and analysis of ambient air: Part 1.1: Guide to siting air monitoring equipment*
- AS 3580.9.8:2008 *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM10 continuous direct mass method using a tapered element oscillating microbalance analyser*
- AS 2923-1987 *Ambient Air – Guide for Measurement of Horizontal Wind for Air Quality Applications*
- *A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities DEC* (2011).

Such measures should include (at a minimum):

- Implementing all measures necessary (Contractor) to effectively control all dust and windborne material emanating from the Site to prevent it from being blown over or onto property outside the Site. The measures shall include, but not be limited to:
  - Frequent watering of areas being disturbed or surface destabilised by the Contractor. Water used for dust suppression will not be allowed to escape off-site by the stormwater system, sewer or any other means.
  - At least one water cart to be held on-site at all times during importation of fill material (if any is to be imported).
  - Staging potential dust creating works (if required).
  - Discontinuing dust creating works when wind velocities are such that dust suppression is not achievable.
  - Stabilisation using watering equipment and any approved stabilisation agent to all disturbed and exposed areas prior to any shutdowns or the operation of water carts through these periods to control dust.
  - The timely stabilisation using approved hydromulch of completed earth-worked areas (if needed).
  - Street sweeping to occur frequently on intersections of site accessed and public roads.

A site risk assessment should be undertaken in accordance with *A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities* (DEC, 2011) to determine the level of dust management and monitoring required.

Where undertaken (if required), results from dust monitors shall be presented in a monthly report to the PTA and will be used to assess the effectiveness of dust control during the works.

6.6.2 Odours and litter control

Appropriate odour and litter management should be implemented by the Contactor. management and associated monitoring measures should be developed by the Contractor with reference to the following standards and guidelines:

- BEPM (EPA Victoria, 2015)
- *Assessment and management of contaminated sites* (DER 2014)

At a minimum, the following shall apply:

- Prevent any offensive odours migrating off-site.
- Where practicable, seek to cover all exposed waste during any cut activities within the landfill waste mass (i.e. at the end of each day).
- Where soil is used as capping, the soil should contain organic matter to attenuate landfill odours. Minimum thickness of between 0.15 to 0.3 metres for solid inert and putrescible waste landfills, will be required.
- Consideration of using odour suppressants, foggers and biodegradable foams. Monitoring at the site boundary should also be undertaken if the risk of potential emissions is significant (to be determined by the Contractor).
- With respect to litter associated with the landfill waste mass (if disturbed):
- Implement a litter control strategy to include both engineering solutions and management options during construction phase.
- If required, use litter screens (i.e. at site boundaries) and train staff in the appropriate placement of the screens to trap as much litter as possible (litter screens should be at least four metres high).

All measures are to be documented in the Contractor CEMP.

6.7 Soil Management: Cut to fill activities (within inferred extent landfill waste) to form development platform

It is understood that cut to fill activities are to be undertaken to form a development platform (Appendix A). As noted in Section 5.1, finished levels should where possible be set to minimise disturbance (cut) required within landfill areas.

Where any cut of the former landfill cap and/or waste mass materials is contemplated for re-use within the Site, the following shall be considered in management during construction phase:

- Movement and placement (including temporary storage) of former landfill cap and/or waste mass materials shall be restricted to within the inferred extent of the waste mass. This measure is necessary to minimise the risk of cross-contamination of soils at the Site beyond the inferred extent of the waste mass.
- Management targets for surface capping (refer to Section 5.1 and Section 5.2.2) shall be met for any reuse of former landfill cap and/or waste mass materials. In particular, former

landfill cap and/or waste mass materials should not form the top 0.5 m of fill for the finished site condition to assist in meeting the management target to exclude potential contact with ACM[17] and waste materials. Exceptions to the above are only permitted where, as noted in Section 5.1 design measures are implemented that provide sufficient alternative protection to meet the management targets for the capping system.

- If excess volumes existing capping material and/or landfill waste material cannot be re-used, off-site disposal is to be undertaken in accordance with Section 6.9.
- Adherence to all other relevant management measures identified in Section 6.

6.8 Soil management (ASS): Other excavation activities (outside inferred extent of landfill waste)

No excavation of ASS is required within the inferred extent of the waste mass. For all excavations outside the inferred extent, the following will be required.

6.8.1 Construction of a temporary pad and stockpiling

All generated spoil material which is suspected ASS shall be temporarily stockpiled on a temporary limestone pad for further testing. The following shall be undertaken:

- Placement of soil on a temporary holding pad comprising minimum 300 mm thick pad of crushed limestone and bunded with minimum 150 mm crushed limestone.
- The temporary holding pad may be located within a portion of Lot 302 or Lot 303 (on either the north or southern side of the existing tail corridor).
- All machinery transporting soil to the holding pad will be watertight, to ensure material is not spilled during transit.
- All temporary stockpiles will be clearly labelled stating the materials that they contain and the date that the first material was excavated. These labels will be checked daily and the dates provided by the Contractor.
- The surface of the stockpiled material will be kept moist using a spray of water from water trucks.
- If space within the holding pad becomes limited, no further excavation works will be undertaken until space becomes available.
- The level of compaction used for the limestone pad should produce an appropriately low permeability to prevent infiltration of leachate.

In addition, the following management strategies will need to be implemented to allow for sufficient time to complete characterisation of each stockpile:

- The volume stockpiled should not exceed 2 m in height and more than one week's volume of extraction.
- A leachate collection and treatment system should be installed. This may comprise grading the pad towards a lined collection pond to collect run-off and then installation of a sump pump to enable collection and disposal of water by a licenced waste removal contractor, or suitable other management measure (e.g. evaporation pond) as required.

Characterisation of each stockpile (spoil) should be undertaken as soon as practicable to ensure no adverse impact to human health or the environment as a result of the stockpiling process.

[17] A capping system of at least 0.5m thickness is recommended by DoH (2009) for uses other than public open spaces.

6.8.2 Acid sulfate soil testing

In order to determine whether the spoil material and exposed surfaces within trench excavations requires management with respect to the presence of ASS, field testing shall be undertaken on all generated stockpiles.

Field screening (comprising pH_F and pH_{FOX} tests) will be used to identify the presence of Potential Acid Sulfate Soils (PASS) and Actual Acid Sulfate Soils (AASS). The tests involve splitting a sample to create two sub-samples. Laboratory grade deionised water is added to one sample (pH_F) and hydrogen peroxide (diluted and weakened to pH 4.5 – 5.5) is added to the other sub-sample (pH_{FOX}), in accordance with DWER (2015a).

The required sampling frequencies for the field screening are identified in Table 12.

Table 12 ASS field screening sampling frequencies

Volume (m^3)	Number of field samples required
100 to 200	4
200 to 500	6
500 to 1,000	8
1,000 to 2,000	11
2,000 to 3,000	15

Submission of 25% of samples will be sent to a NATA-accredited laboratory for confirmatory Scr suite analysis. Field and laboratory results will be compared to management targets identified in Section 3.3.

If ASS material is confirmed, then the stockpile shall be classified as ASS material and will either require treatment on-site and/or treatment and disposal off-site (Section 6.8.3).

6.8.3 Treatment and validation of ASS (if required)

Stockpiles that have been confirmed to contain ASS material can be treated on-site; alternatively, consideration may also be given to treatment at a licenced facility and disposal off-site.

On-site treatment of stockpiles for ASS

All stockpiles should be treated using a neutralising material (e.g. aglime) using appropriate lime rates in accordance with the DWER lime rate calculator tool (DWER, 2019), based on the results of the analytical testing and specifications of the neutralising material (to be provided by the Contractor).

Following treatment, validation sampling to be undertaken in accordance with Table 11 and sampling at a rate of 25% of samples for laboratory analysis as confirmation of successful treatment. Field and laboratory results will be compared to management targets (validation criteria) identified in Section 3.3.

Off-site treatment (and disposal) of stockpiles for ASS

In the event that off-site treatment and disposal is contemplated, spoil material can be treated for ASS and disposed at a licensed soil treatment facility. The Contractor is to ensure that the chosen facility holds a DWER approved Acid Sulfate Soil Management Plan (ASSMP) with the capability of treating ASS and subsequently managing/disposing the material under its final landfill classification (refer to Section 6.9).

On-site treatment of exposed surfaces (excavation/trenches) for ASS

In the event that ASS is confirmed within stockpiles generated from excavations/trenching activities, all exposed surfaces are to be coated with a layer of neutralising buffer (e.g. aglime)

prior to backfilling, to reduce the risk of oxidation occurring and to provide future buffering capacity.

The liming of surfaces must be monitored and maintained in the event of site-specific conditions which may cause the neutralising buffer to deteriorate (e.g. rainfall, plant movement and vibration, and water ingress). The contractor is to provide photographic evidence of all liming undertaken.

For the avoidance of doubt, if spoil material generated from land disturbance works is identified as ASS, this spoil material will require treatment.

Timeframes for treatment of ASS

Regardless of whether the ASS material is treated off-site or transported and disposed off-site, the recommended maximum time period over which soils may be temporarily stockpiled at the Site prior to treatment is specified in Table 13.

Table 13 Maximum duration of medium-term stockpiling of untreated ASS (obtained from DER 2015b)

Type of material		Duration of stockpiling	
Texture range (AS 1726–1993)	**Approx clay content (%)**	**Days**	**Weeks**
Coarse texture **Sands to loamy sands**	≤5	14 days	2 weeks

It is anticipated that the management strategies provided will permit medium-term stockpiling of untreated ASS (i.e. while awaiting for reporting of laboratory results).

6.9 Off-site disposal of spoil material

In the event that off-site disposal is required for spoil material (e.g. it is determined to be unsuitable for use as backfill and/or there is no demand for fill), spoil material shall be classified using Landfill waste definitions (DWER, 2019) and disposed of accordingly at a licenced facility. The required sampling frequencies for the laboratory testing are identified in Table 14.

Table 14 Laboratory testing (chemical) sampling frequencies

Volume (m^3)	Number of samples
100 to 200	4
200 to 500	6
500 to 1,000	8
1,000 to 2,000	11
2,000 to 3,000	15
3,000 to 4,000	18
4,000 to 5,000	20
5,000 to 10,000	24
>10,000	24 plus 4 for each additional 10,000 m^3

Based on the history of the Site, samples will be submitted to a NATA-accredited laboratory for the following analysis:

- Metals/metalloids (*ASC NEPM* suite)
- Total recoverable hydrocarbons (TRH)
- Polycyclic aromatic hydrocarbons (PAH)
- Perfluoroalkyl and polyfluoroalkyl substances (PFAS)

- Asbestos (presence/absence).

The analytical schedule may be refined subject to consultation with the receiving licensed facility and based on the composition of the stockpile.

Validation of surface soils beneath stockpiled spoil material will be required. If the total spoil volume is relatively small (i.e. typically less than 200m^3) and will be present on site for a short duration only prior to removal, it is expected validation can be achieved by way of visual inspection to confirm removal. For larger stockpiles, sampling and laboratory testing will be required for validation of surface soils beneath stockpiled spoil material (refer to Section 8.3.6).

6.10 Importation of fill material

Imported fill (if this is required to facilitate the works) must be demonstrated by the Contractor to be suitable for its intended use. This shall include (but is not limited to) demonstrating the following with respect to the Site and proposed development:

- The fill shall not contain any substance at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value[18].
- Should imported fill be intended for use within 1.5 m of finished ground level, the imported material shall be certified weed and dieback *(Phytophthera cinnamomi)* free.

The Contractor shall provide appropriate documentation to confirm suitability of the proposed imported fill prior to importing fill to the Site. Certification shall be provided to demonstrate the fill to be imported is one of the following (as relevant depending upon the origin of the fill that is proposed to be imported):

- Evidence to demonstrate the fill to be imported is 'clean fill' where 'clean fill' means raw excavated natural material such as clay, gravel, sand, soil or rock fines that:
  - Has been excavated or removed from the earth in areas that have not been subject to potentially contaminating industries, activities and land uses[19]; and
  - Has not been processed except for the purposes of:
    - achieving desired particle size distribution; and/or
    - removing naturally occurring organic materials such as roots; and
    - does not contain any ASS; and
    - does not contain any other type of waste.
- Evidence to demonstrate the fill to be imported is 'uncontaminated fill' as defined in DWER (2019) including the requirements identified in Section 5 of DWER (2019).
- Evidence to otherwise demonstrate that the fill to be imported is suitable for the intended use i.e. where the fill is not 'clean fill' as identified above or 'uncontaminated fill' as defined in DWER, 2019). As a minimum, this will require an appropriate level of characterisation of the fill to be imported in accordance with relevant published guidelines including (but not limited to) DER (2014), NEPC (2013), HEPA (2020). In particular, the characterisation must present a robust and defensible characterisation of substances that may be present in the fill associated with the land-use development history of the fill source/site (and any associated processes) from which the fill originates.

[18] i.e. such that the fill does not meet the definition of 'contaminated' with respect to the Contaminated Sites Act 2003.

[19] A list of potentially contaminative industrial, commercial, mining or agricultural activities is provided in DWER (2014). As identified in DWER (2014), the list provided is not exhaustive – consideration of whether other contaminants could be present is needed.

In addition to the above, should imported fill be intended for use within 1.5 m of finished ground level, documentation certifying the imported material as weed and dieback *(Phytophthera cinnamomi)* free shall be provided by the Contractor.

If deemed necessary, additional testing of imported fill material will be undertaken by the Environmental Consultant, prior to use at the Site, to ensure compliance with the above requirements. In such a case, soil samples shall be forwarded to a NATA-accredited laboratory and analysed for COPC as specified by the Superintendent (advised by the Environmental Consultant). Sampling of imported fill will occur at the frequency agreed with the Superintendent (advised by the Environmental Consultant).

6.11 Groundwater monitoring program during construction

Implementation of a groundwater monitoring program is required to ensure:

- Concentrations of CoPC in groundwater remain, at a minimum, consistent with the current understanding of groundwater quality beneath the site and surrounds.
- Short and long term protection of identified receptors with respect to identified CoPCs in groundwater.

Monitoring requirements are summarised in Table 15 and proposed monitoring locations and sampling methodologies to be adopted are provided in the SAQP (Appendix C).

As noted in Section 5.4, monitoring shall commence two months prior to the commencement of construction works for continuity purposes. This may be subject to amendment depending on the season in which construction is proposed to commence.

Table 15 Groundwater monitoring requirements during construction phase

Monitoring network area	Location ID	Analytes	Frequency and timing	Rationale for inclusion
Within the site boundary	MW02 MW01 RR08	Metals/metalloids (Al, As, Cd, Cu, Cr, Fe, Mn, Ni, Pb, Zn & Hg); Total Recoverable Hydrocarbons (TRHs); Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene (BTEXN); Polycyclic Aromatic Hydrocarbons (PAHs); Organochlorine/ Organophosphorus Pesticides (OCP/OPP); Major anions (Cl, SO4, carbonate and bicarbonate); Major cations (Ca, Mg, Na and K); and nutrients (nitrate, nitrite, ammonia, TKN, total nitrogen, total phosphorus); PCBs; Cyanide; Fluoride; Perfluoroalkyl and polyfluoroalkyl substances (PFAS) – ultra trace full suite; Dissolved methane (onsite wells only).	Bi-annual groundwater monitoring events (reflective of post-summer and post-winter conditions) (2 GME's per year) comprising sampling of existing onsite and offsite groundwater monitoring wells shall be conducted throughout the duration of construction works for the purpose of monitoring groundwater quality/ identify any alterations to groundwater quality that may occur due to construction activities.	Existing onsite groundwater monitoring well network (within landfill waste extent) to capture data representative of groundwater quality beneath the site.
Off-site (north)	GW02 GW03 GW14 RR03			Located on the 'Soils Aint Soils' property approximately 350 m north of the northern site boundary to capture offsite groundwater quality data in a down gradient direction.
Off-site (north-east)	MC CG			Located approximately 750 m and 800 m to the north-east of the northern site boundary to capture offsite groundwater quality data in a down hydraulic gradient direction.
Off-site (south-east)	RR02			Located approximately 200 m south-east of the south eastern site boundary to capture offsite groundwater quality data representative of background conditions in an up hydraulic gradient direction.
Off-site (west)	RR07			Located approximately 200 m west of the south-western site boundary within an offsite portion of the former landfill to capture offsite groundwater quality data in a cross-gradient direction.

6.12 Operational controls during construction phase

Operational controls are to be implemented onsite continuously and are to be followed by personnel visiting/working on the Site and are presented in Table 16. The ‘responsible party’ is provided for guidance as an indication of the people most likely to encounter the particular potential hazard.

Table 16 Operational control measures

Site activity	Hazard to be managed	Responsible party	Management requirement
Driving on the Site	Driving into and compromising monitoring infrastructure	All parties identified in Section 4.2.	•Drive slowly onsite and adhere to speed restrictions. •Be cautious and vigilant of monitoring infrastructure. •Vehicles to remain on existing tracks. •Do not place materials upon monitoring well protective covers that may cause damage to the monitoring installations.
Temporary/permanent laydown on the Site	LFGs and vapours potentially accumulating in enclosed spaces ACM	Operator, as identified in Section 4.2.	No enclosed spaces/unventilated structures to be placed onsite (e.g. intermodal containers). If intermodal containers are deemed necessary, these shall be elevated from existing ground level using piers/blocks/beams to create an open ventilated void or placed on a suitable low-permeability sealed surface (e.g. concrete slab) which is free of defects (e.g. cracks. Joints) or other penetrations that may act as preferential gas/vapour migration pathways. Personal monitoring devices (e.g. lower explosive limit [LEL] device, or similar) could be used when entering these structures, as a precautionary measure. No ignition sources (refer to 'Working at the Site' below) at intermodal containers within which hazardous atmospheres may form. If suspected ACM is encountered, manage in accordance with contingency plan (Section 8).
Working at the Site	LFGs and vapours creating potentially hazardous atmospheres ACM and waste inclusions	All parties identified in Section 4.2.	No ignition sources in the vicinity of works at/in which hazardous atmospheres may form, such as: •Smoking (matches/cigarette lighters). •Live electrical equipment (other than intrinsically safe and flame proof equipment). •Hot works (e.g. welding, brazing, metal grinding and cutting). •Petrol powered generators, pressure washers or similar. •Equipment capable of generating mechanically generated sparks from impacts. In addition, in the vicinity of subsurface voids within which hazardous atmospheres may form: •Ensuring electrical equipment is effectively maintained. •Ensuring electrical equipment is properly earthed.

Site activity	Hazard to be managed	Responsible party	Management requirement
			• Reducing or where possible eliminating quantities of flammable and combustible materials. • Where possible, eliminate use of equipment likely to promote generation of hazardous atmospheres in enclosed spaces. Use of appropriate fixed/handheld and personal monitoring devices providing continuous monitoring of any works at/in which hazardous atmospheres may form. To include capability for: • Detection of LFG and vapours (refer to Table 6 for management limits). • Alert workers in the vicinity. If suspected ACM or waste inclusions are encountered, manage in accordance with contingency plan (Section 8).

A record to confirm periodic inspection monitoring and review of this SMP in accordance with the requirements set out in this SMP is to be maintained by the operator.

7. Community Engagement

The community consultation process shall be addressed directly by the Contractor as noted in Section 4.2 with stakeholders identified in Table 7. All community consultation is to be undertaken in line with the *ASC NEPM Schedule B8 – Guideline on Community Engagement and Risk Communication* (NEPC, as amended 2013).

An appropriate level of community engagement is to be implemented prior to, and during construction. The Contractor should continue to undertake an appropriate level of community engagement throughout construction to ensure interested parties are updated with details of the works and proposed development of the Site.

The Contractor has prepared a community engagement plan (NWA, 2020d) to document the community engagement activities. The activities may include:

- Distribution of letters to adjacent residents and business notifying them in advance of the works (including basic details of the work to be undertaken, expected duration of the works and relevant contact details for further information).
- Provision of letter updates concerning the above should details vary significantly (e.g. change in duration) or otherwise in response to requests for further information from interested parties.

In the event that requirements for additional community consultation are identified, additional actions may be implemented (e.g. telephone discussion/meetings) as needed in response to the nature of community interest or concern expressed. Further guidance may be sought from the BEPM (EPA Victoria, 2015), if required, to include:

- Working directly with the community throughout the process to ensure issues, concerns, opportunities and solutions are understood and considered.
- Undertaking workshops and/or setting up advisory group.
- Public meetings and creation of fact sheets.

7.1 Community engagement (prior to construction)

It is expected that community engagement will be undertaken prior to construction to inform the design process, planning for construction and to provide information to the community concerning the works to be implemented. It is expected that such consultation will include (but not be limited to):

- Consultation with the City of Canning concerning:
  - Interface of all relevant aspects of the new station with the remainder of the CCWTS (e.g. temporary features during construction and permanent features and related matters including, but not limited to, arrangements to facilitate ongoing operational use of the CCWTS).
  - Temporary laydown area to the north of existing rail corridor.
- Consultation with adjacent commercial site users concerning nature and timing of works to be undertaken to seek to identify possible impacts upon normal commercial activities of adjacent users from the construction process, measures that can be implemented to address them and communication arrangements.
- Provision of information to the wider community concerning the nature of works to be undertaken, management measures to be implemented, timing and duration of work and communication arrangements.

- Provision of additional information to regulators, if required (i.e. changes to development plans which trigger additional approvals).

7.2 Community engagement (construction)

It is expected that community engagement will be undertaken during construction to ensure interested parties are updated with details of the works and proposed development of the Site.

It is expected that construction staff will be briefed concerning the nature of materials that are expected to be encountered in disturbance of landfill waste deposited at the Site (including possible inclusions within overlying capping material), particularly in terms of visual appearance and odours. This important to address concerns that may otherwise be raised when such materials are encountered in relevant works such as (but not limited to) earthworks disturbance.

8. Contingency plan (construction phase)

The purpose of the contingency plan is to identify situations that could occur during the management of the Site (construction phase) that may need alternative action to that identified in previous sections and to specify procedures that can be implemented to manage such situations and prevent adverse impacts to human health, the environment and environmental values.

The roles and responsibilities, as outlined in Section 4.2, apply to the contingency plan.

8.1 Contingency response events

Contingency response measures may be triggered by one or more of the following events and/or circumstances:

1. Detection of a potentially hazardous atmosphere (refer to Section 8.2).
2. Other visual and/or odoriferous indicators of concerns (refer to Section 8.3).
3. Complaints from adjacent properties (refer to Section 8.4).
4. Damage to existing monitoring infrastructure (refer to Section 8.5).
5. Other potential nuisances, such as those related from control of dust, and noise and vibration (refer to Section 8.6 and Section 8.8).
6. If groundwater monitoring results indicate a significant change in trend potentially indicative of adverse impact (refer to Section 8.7).

Further information is provided below in the following sections, including examples of the procedures (contingency responses) to be adopted in the event of these occurrences.

8.2 Detection of a potentially hazardous atmosphere

8.2.1 Exceedance of LFG management targets

If a potentially hazardous atmosphere is detected (e.g. monitoring detects exceedance of relevant management targets for LFG and vapours [Table 6], then the following action shall be taken **immediately**:

- Stop work in the vicinity.
- Eliminate all sources of ignition (if safe to do so). For avoidance of doubt, this includes turning off all plant and machinery.
- Isolate/evacuate the affected area (evacuation procedures to be developed by the Contractor).
- Inform Superintendent and Principal. If the event is an **emergency situation**, see additional action below.
- Implement any additional precautions deemed necessary to ensure the safety of site workers and the public (e.g. isolate relevant utilities/services infrastructure if safe to do so).
- Superintendent to liaise with the Environmental Consultant concerning further assessment action needed (refer to Section 8.2.2 and 8.2.3) to quantify the risk and appropriate further contingency response action to mitigate the risk (e.g. Section 8.3.1), including notification to relevant government agencies (e.g. DWER, City of Canning).

The level of further action shall be commensurate with the level of risk identified.

In the event of an emergency situation (e.g. in event of fire/explosion/significant/injury), contact the emergency services and include the following details, where available:

- Site location and access details.
- Number of injured persons or casualties and the nature of injuries (if any).
- Type and scale of emergency, including a brief description
- Hazards involved.
- Details of person making the call (including telephone contact number.
- Any other useful information (e.g. wind speed and wind direction).

Further details are contained within the Emergency Management Plan (NWA 2020c).

8.2.2 Further assessment action (1)

Where the issue is not able to be resolved by other measures identified in Section 8.2.1 above, appropriate further assessment action is required. Subject to the issue identified and area of concern, this shall comprise one or more of the following:

1. Environmental consultant or other suitably experienced competent person to carry out visual inspection of the Site/adjacent areas (if not already carried out above).
2. Environmental consultant or other suitably experienced competent person to conduct LFG and vapour monitoring at the Site for comparative assessment to previous monitoring data.
3. Environmental consultant or other suitably trained and experienced competent person conduct a LFG and vapour survey and/or odour survey of relevant site area/site boundary/relevant properties (e.g. buildings and infrastructure) for the presence of landfill gases and vapours. For vapour detection, this should be conducted using a PID/FID/infra red/laser detector, as per the building survey method outlined in *Landfill Gas Fugitive Emissions Monitoring Guidelines (EPA Victoria, 2018)*. All LFG monitoring should be undertaken using suitable hand-held devices capable of undertaking measurements for landfill gases and vapours as identified in Section 6.4.2.
4. Subject to the concentrations of LFG and vapours identified at the Site and/or off-site, additional LFG monitoring wells may require installation to appropriately characterise potential risk to adjacent properties. Additional LFG monitoring wells shall be installed as per the specifications outlined in *Landfill Gas Fugitive Emissions Monitoring Guidelines (EPA Victoria, 2018)*.
5. In the event that VOC concentrations (vapours) are significantly elevated (>100 ppm), a sample should be collected using a thermal desorption tube and analysed in a NATA-accredited laboratory for the TO-15 VOC suite to determine the VOC component breakdown, in order to determine associated risks.
6. Review requirements for remedial action such as LFG management measures, partial or complete stoppage of works, installation of monitoring alarms or other measures (e.g. ventilation) in adjacent properties. Such action may be taken as a result of any of the above measures if it is considered that an unacceptable risk exists requiring action.
7. Following implementation of relevant management action, review the measures set out in this SMP for appropriateness and requirements for amendment such as revision of periodic monitoring (e.g. additional/higher frequency monitoring, installation and monitoring of wells on/off-site).

8.2.3 Further assessment action (2)

In the event that elevated concentrations of LFGs and vapours are not identified, but an issue is still apparent, a transect of the surface of the Site should be undertaken using a low concentration methane detector with an extendable probe, as per the methodology outlined in Section 5 of the *Landfill Gas Fugitive Emissions Monitoring Guidelines (EPA Victoria, 2018)*. A summary is provided in Diagram 1.

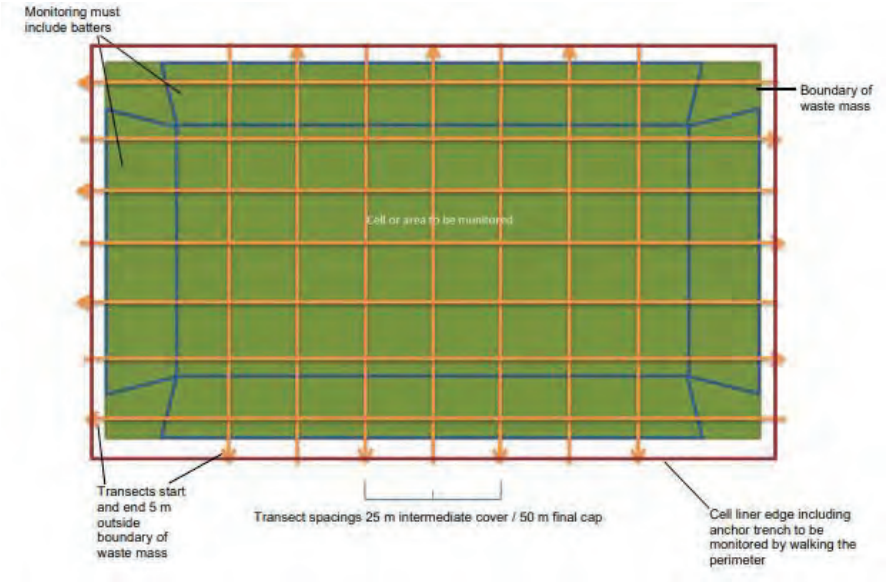


Diagram 1: Example transects of landfill surface cover. Reference: Figure 1 of *Landfill Gas Fugitive Emissions Monitoring Guidelines (EPA Victoria, 2018)*

Where undertaken, monitoring should also include deviation from the grid to all penetrations and cracks in the surface, as per EPA Victoria (2018).

8.3 Unexpected finds

Visual and/or odoriferous concerns may be identified during the proposed development work. For example:

Visual and/or odour concerns - within landfill waste mass

Landfill waste contains a wide range of inert and putrescible constituents reflecting the types of waste deposited that are consistent with a Class II putrescible landfill. A heterogeneous appearance and presence of odours would therefore be expected with such materials – i.e. **not** 'unexpected finds'. Examples of waste constituents characteristic of Class II putrescible landfill waste are provided in Table 2A and 2B of *Landfill Waste Classification and Waste Definitions 1996* (DWER, as amended 2019).

It cannot be precluded that 'unusual' waste constituents (substances/materials/objects or odours) which are not characteristic of Class II putrescible landfill waste may be encountered. Such materials (generally of hazardous and intractable nature[20]) may be identified by visual, odorous, and/ or audible characteristics such as (but not limited to) the following:

[20] E.g. as per Table 2C of DWER (2019)

- Visual indicators (examples: strong colours and/ or sheens, steam, visible vapour or smoke, drums and other large containers with markings such as ‘hazardous waste’, ‘toxic’, ‘flammable liquid’, ‘corrosive’, ‘poison’, ‘biological hazard’).
- Odorous indicators (example: distinct odour such as hydrocarbons).
- Audible indicators (example: hissing sound of pressurised gas leak from punctured gas cylinder).

Visual concerns - beyond the landfill waste mass

Presence of landfill waste materials and/or ACM in areas not known to have been subject to landfill waste disposal (e.g. as a result of inadvertent cross-contamination in past landfill completion earthworks activity).

Odour concerns - beyond the landfill waste mass

Hydrogen sulphide has a rotten egg odour at low concentrations <1 ppm (however becomes odourless at concentrations > approx. 50 ppm). Whilst some LFG such as methane are odourless, it is possible that an odour, which is considered unusual and/or of concern, may be identified at surface, within existing infrastructure or otherwise within the subsurface beyond the waste mass.

Other unexpected finds - beyond the landfill waste mass:

The potential cannot entirely be precluded for other contaminants or hazardous materials to be found in existing surface or subsurface soils, beyond the extent of the waste mass (e.g. hydrocarbon staining and/or odours in soils).

Contingency responses are identified in the following Section 8.3.1.

8.3.1 Contingency response

Upon discovery of an unexpected find, the Contractor should cease work in the area and restrict access in order to:

- Prevent further disturbance to the area to reduce the spread of potential contamination.
- Mitigate risk to human health and/or environment and environmental values whilst the unexpected find is being assessed.

The Contractor shall make initial observations to seek to determine the source/cause of what has been identified. The unexpected find shall be reported to the Principal within 24 hours including any relevant details (e.g. description, digital photographs, location).

The Contractor will assess the information provided and determine if an immediate response action and/or a site visit is required by the Environmental Consultant to assess the unexpected find.

The Contractor will then determine appropriate management action to mitigate potential risks to human health and/or the environment and environmental values. The action may include ‘short term’ recommended response actions, e.g. cessation of work in the vicinity/further investigation for delineation purposes, depending on the nature of the issue. Management of unexpected finds shall be undertaken in accordance with relevant guidance and legislation. Possible contingency response actions may include (but are not limited to) those identified below.

8.3.2 Odour concerns beyond the waste mass

Unexpected finds relating to odour concerns should be addressed as identified in Section 6.6.

8.3.3 Surface asbestos encountered beyond the waste mass extent

In the event that suspected ACM is observed on the surface in the works area beyond the waste mass (if identification is in doubt, the suspected ACM should be assumed to be asbestos until confirmed otherwise), the following procedures shall apply:

- All visible pieces of ACM should be hand-picked individually and placed in a tear resistant polythene bag no more than half filled (double bagged), labelled as asbestos and securely closed.
- The bagged ACM should be disposed to an appropriately licensed disposal facility. No ACM is to be disposed of in general workplace disposal bins or at other non-designated temporary locations.

All actions in relation to this matter are to be undertaken by the Principal (or Contractor as directed by the Principal) unless otherwise indicated.

8.3.4 ACM encountered in excavations beyond the waste mass extent

In the event that ACM fragments are visually identified in excavation works beyond the waste mass extent (including spoil material/stockpiles), the material shall be disposed off-site as *special waste type 1*. Alternatively, a decision will be made in relation to further evaluating the concentrations of ACM in the soil (if deemed necessary by the Environmental Consultant in consultation with the Principal) to guide refine decision-making concerning off-site disposal/ability to segregate material for disposal as different waste classifications or potential suitability for reuse within the extent of the waste mass.

Sampling of the affected in situ and/or stockpiled material should be undertaken with reference to DoH (2009) [or subsequent later iterations] if ACM is suspected as being present.

8.3.5 Undesirable constituents

The presence of undesirable constituents (e.g. refuse material) may be encountered during ground disturbing activities. In the event that refuse (or other anthropogenic material) is identified, the following procedures shall apply where this is determined to be practicable:

- Undesirable constituents shall be visibly removed (where practicable) from other spoil material and (temporarily) stockpiled on a suitable liner to separate this from the underlying site surface.
- Disposal off-site in accordance with *Landfill Waste Classification and Waste Definitions 1996* (DWER, as amended 2019) (refer to Section 6.9).

All actions in relation to this matter are to be undertaken by the Principal (or Contractor as directed by the Principal) unless otherwise indicated.

8.3.6 Other unexpected finds

In the event that other visual or odour concerns are identified, further assessment by the Environmental Consultant (in consultation with the Principal) is likely to be required to guide or otherwise refine decision-making concerning management action (e.g. requirements for appropriate offsite disposal (including ability to segregate material for disposal as different waste classifications) or potential suitability for reuse.

Such assessment is expected to include (but is not limited to) visual inspection, sampling and laboratory analysis to appropriately delineate and characterise the unexpected find.

Selection of an appropriate laboratory analytical suite should be determined by the Environmental Consultant based on the nature of the unexpected find (including composition of

any related stockpile). Sampling of the affected in situ and/or stockpiled material should be undertaken with reference to the *ASC NEPM* (Schedule B2, Section 7.5) and Section 6.9 (refer to Section 8.3.4 if ACM is suspected as being present).

Subject to the laboratory analytical results and comparison with risk-based assessment criteria (e.g. health-based criteria as provided in the *ASC NEPM*), the material may be:

- Used as backfill/fill with no restrictions (e.g. to existing surface levels) (Unrestricted fill).
- Used as backfill/fill with control measures implemented (e.g. capped with an appropriate thickness of clean fill and/or beneath a sealed surface) (restricted fill).
- Disposed off-site if unsuitable for re-use (refer to Section 6.9).

8.4 Complaint from adjacent property

All complaints should be directed to the Principal's nominated representative for further action (refer to Section 8.8).

8.5 Damage to existing monitoring infrastructure

Monitoring wells damaged above-ground surface should be inspected to identify if the headwork can be replaced (i.e. below ground pipework is still intact and uncompromised).

Where required, all monitoring wells should be installed, repaired or replaced to the specifications outlined in Tables B.2 and Table B.3 of the BPEM (EPA Victoria, 2015).

8.6 Control of dust

Contingency measures shall be implemented if at any time dust levels exceed acceptable criteria (based on observations made on-site or measurements from calibrated instruments). Where unacceptable dust levels are considered to have been generated, dust shall be suppressed by one or more of the following:

- Immediately stopping work until dust returns to an acceptable level.
- Water sprays applied by water cart.
- Use of proprietary products.
- Sheeting (or similar) laid over and secured to cover localised exposed areas.
- Changing protocols i.e. avoid work on windy days.

8.7 Groundwater contingency measures

8.7.1 Contingency response

If groundwater monitoring results demonstrate an increasing trend (i.e. two or more consecutive sampling events exceed baseline (pre-development) CoPC concentrations (taking into account seasonal variation)) and/ or if CoPC other than those identified in the baseline contaminant profile are detected, then contingency measures are required to be implemented.

It is anticipated that contingency measures will be implemented in a staged approach to fully characterise the potential risk as follows:

1. Undertake additional groundwater sampling i.e. repeat sampling event to verify analytical results. If elevated concentrations are confirmed and the aquifer chemistry has altered, then the monitoring program should convert to quarterly sampling events.

2. Should additional monitoring data indicate that groundwater contamination concentrations are not within the range of historic and baseline concentrations, consideration should be given to undertake a risk assessment utilising the existing dataset. If the risk outcome is below acceptable levels then no further action is required and groundwater monitoring should revert to the original six monthly schedule.
3. If the risk assessment outcome indicates that risk has increased to above acceptable levels, then additional contingency measures (e.g. management and/ or remedial works) may be required – refer to Section 8.7.2). The level of action will be commensurate to the identified risk to potential receptors.
4. Following implementation of relevant management action, review the measures set out in this SMP for appropriateness and requirements for amendment such as revision of periodic monitoring (e.g. additional/higher frequency monitoring, installation and monitoring of wells on/off-site).

8.7.2 Additional contingency measures

Contingency measures will be implemented during development activities when an exceedance of a trigger is identified, and groundwater monitoring indicates that implemented management measures are not successfully mitigating impacts on groundwater quality and/or the management objectives are not being achieved.

Additional contingency measures may include the following:

- Ground truth the results of groundwater sampling/ impact to validate findings of the assessment and/or determine/identify the source of impact and whether it has been caused by development activities. Where cause is identified during ground truthing and can be rectified, undertake action immediately. For actions which require alternate resources, schedule works to be undertaken as soon as possible.
- Groundwater remedial technologies that may be suitable for the site if the need for groundwater remediation is identified are listed below:
  - **Passive remediation:** Source zone removal together with monitored natural attenuation (MNA) is the most common form of passive groundwater remediation where contamination is point-source related.
  - **Active remediation:** Practicable measures to remove, treat or dispose impacts attributed to development works.

An assessment of the feasibility of abovementioned remedial technologies in mitigating risks in groundwater will be required prior to implementation of remediation at the site. It is noted that often it is a combination of passive and active groundwater approaches that are required to fully restore groundwater quality at a site over the long term (where associated with development works).

8.8 Notification procedures

Stakeholder notification for incidents, exceedances and other matters will be undertaken directly by the Contractor. Where relevant, stakeholders will be provided with information relating to circumstances that constitute a material change to site conditions, such as (but not limited to):

- Potential human health risks and impacts to the environment and environmental values, including adverse effects to receptors and where contamination migrating outside of the Site boundary is identified.
- Short-term nuisances (if present), such as noise, odours and dust, potentially generated during the installation of pile infrastructure.

- As part of the notification procedure, the following (at a minimum) shall be undertaken:
- Stakeholder engagement in evaluating contingency response actions and evaluation further actions, such as further work required and revisions to the SMP.
- Reporting the Site to DWER if a material change in site risk profile occurs.

9. Reporting requirements

All reporting of site management shall be prepared with reference to *Assessment and Management of Contaminated Sites* (DER, 2014) and *ASC NEPM* guidelines. A report shall be prepared following the completion of each phase of monitoring (i.e. during and post-construction). Reporting requirements are summarised below.

9.1 Prior to construction

The selection and design of landfill gas/vapour mitigation measures shall be documented as identified in NSW EPA (2019). This shall include (but not be limited to):

- Design report/design basis report.
- Plans and specifications for the physical measures to be constructed or installed.
- A CQA plan for all landfill gas and vapour mitigation measures to be installed and a program to confirm that the measures are constructed in accordance with the design. This shall be prepared and implemented in accordance with the requirements set out in NSW EPA (2019) Appendix A7.
- CQA plan for construction of the engineered landfill cap and for water management measures.
- Appropriate monitoring protocols and assessment criteria for the relevant aspects of mitigation measures that are designed are identified by the Contractor for incorporation into the relevant CQA plan (and OSMP as relevant for ongoing management).
- An outline of the ongoing management measures required, and how these will be implemented and enforced.

The above shall be prepared in a suitable format to facilitate review and approval of the landfill gas/vapour mitigation measures by the appointed Contaminated Sites Auditor prior to implementation of construction. Further guidance on appropriate reporting of selection and design of landfill gas/vapour mitigation measures is provided in British Standard 8485;2015+A1:2019 (BSI 2019 – in particular, Section 8.3).

9.2 Reporting during construction phase

9.2.1 Interim reporting

During construction phase, a monthly report shall be prepared. Each report shall contain the following:

- Scope of work completed.
- Verification of compliance with the requirements of the CQA plans and the SAQP.
- Conclusions and recommendations (where relevant) for further action.

Following the completion of each round of monitoring, the field results will be provided to the Principal within 5 days of completion of fieldwork.

9.2.2 CQA reporting

CQA reporting shall be prepared by the appropriate party (expected to be an appropriately qualified and experienced independent consultant) in accordance with:

- Guidelines set out in NSW EPA (2019: in particular, Appendix A7) for gas and vapour mitigation measures.
- Guidelines set out in EAP Victoria (2015) for cap and water management measures.

9.3 Prior to operational use

9.3.1 Site remediation validation reporting

As required by the CQA plan, an Environmental Closure report shall be prepared at the completion of the construction phase, to document the management action undertaken at the Site in accordance with the measures and monitoring identified in this document, and to support Auditor endorsement of the works undertaken at the Site to seek reclassification with respect to the Act.

CQA reporting shall also be provided to the Auditor for review and endorsement (refer to NSW EPA (2019: Appendix A7).

Closure reporting for ASS shall also be undertaken to comply with DWER requirements (DER, 2015b); to be provided as an appendix to the report.

9.3.2 Ongoing Site Management Plan (OSMP)

- An ongoing site management plan (OSMP) will be prepared to facilitate management of residual risks for ongoing operation of the Site as a new station. The OSMP will utilise appropriate measures to eliminate risks (or otherwise control activities) where a residual risk of exposure to contamination may still occur without such ongoing management (e.g. maintenance workers undertaking future excavations in an uncontrolled manner).

Aspects of the OSMP concerning landfill gases and vapours will be prepared with reference to relevant guidance provided in NSW EPA (2019: refer to Appendix 8).

The OSMP shall be prepared and provided to the Auditor for review and endorsement prior to operational use of the new station development (refer to NSW EPA (2019: Appendix A7).

9.3.3 Mandatory auditor's report

The Auditor is required to prepare three MARs for the Site. One MAR accompanied the *Bridge Modifications SMP* (GHD 2020b); a second MAR is required to accompany the final management plans for the station development, prior to ground disturbing activities. A third MAR is required once the station construction is complete and an OSMP has been prepared and endorsed by the Auditor.

9.4 Operational use

The Principal shall conduct a periodic review of the OSMP to incorporate any changes to the site conditions or regulations. The intervals for such periodic review will be confirmed in the OSMP. Additional reviews shall also be implemented in the event of a change to the station development features (such as but not limited to: site features/layout/operations).

10. References

British Standard 8576 (BSI 2013) *Guidance on Investigation for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)*, British Standards Institution 2013.

British Standard 8485;2015+A1:2019 (BSI 2019) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. British Standards Institution 2019.

Construction Industry Research and Information Association (CIRIA: 2007) *Assessing risks posed by hazardous ground gases to buildings C665*.

Contaminated Sites Act (CS Act: 2003) Western Australia.

Department of Water and Environment Regulation (2019) *Landfill Waste Classification and Waste Definitions 1996 (as amended 2019)*

Department of Environment Regulation (2014) *Contaminated Sites Guidelines: Assessment and management of contaminated sites*.

Department of Environment Regulation (2015a) *Identification and investigation of acid sulfate soils and acidic landscapes*

Department of Environment Regulation (2015b) *Treatment and management of soil and water in acid sulfate soil landscapes*

Department of Health (DoH; 2009) *Environmental Health Guide: Hydrogen Sulphide and Public Health, Department of Health*, Perth, October 2009.

Environmental Protection Agency (EPA) Victoria (2018) *Landfill Gas Fugitive Emissions Monitoring Guidelines, Publication 1684,* February 2018.

EPA Victoria (2015) *Best Practice Environmental Management (BPEM) – Siting, Design, Operation and Rehabilitation of Landfills, Publication 788.3,* August 2015

GHD (2016) *Preliminary Site Investigation: Ranford Road Landfill.*

GHD (2017) *Sampling and Analysis Quality Plan (SAQP) for Detailed Site Investigation: Ranford Road Metronet.*

GHD (2019a) *Ranford Road Metronet - Additional Groundwater Data – Review*.

GHD (2019b) *Ranford Road Metronet - Landfill Gas Modelling*.

GHD (2020a) *Ranford Road Metronet – Addendum gas monitoring report*.

GHD (2020b) *TCL: Bridge Modifications SMP*

GHD (2020c) *Ranford Road Metronet – Additional Groundwater Review* – Summary Letter

GHD (2020d) *Ranford Road Metronet - Detailed Site Investigation*

Government of Western Australia (2017) *Environmental Protection (Noise) Regulations 1997*, January 2017.

Golder (2018) *PTA Metronet – Thornlie to Cockburn Link Preliminary Acid Sulfate Soil Investigation*

Golder (2019) *METRONET – Thornlie to Cockburn Geotechnical and Environmental Investigations*

Heads of the Environmental Protection Authorities (EPA) Australia and New Zealand (HEPA) (2020) *PFAS National Environmental Management Plan* (NEMP) *Version 2.0, 2020*.