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FITZGIBBON URBAN DEVELOPMENT AREA E2 FLOOD IMPACT ASSESSMENT AND STORMWATER MANAGEMENT PLAN

Urban Land Development Authority
15 January 2010

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REPORT TITLE: Fitzgibbon Urban Development Area E1 Flood Impact Assessment and Stormwater management Plan

CLIENT: Urban Land Development Authority

REPORT NUMBER: 0541-02-D

Revision Number	Report Date	Report Author	Reviewer
0	15 January 2010	JO	DN

For and on behalf of
WRM Water & Environment Pty Ltd

David Newton
Director

TABLE OF CONTENTS

APPENDIX D

32

TYPICAL BIO-RETENTION POD CROSS-SECTION

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 GENERAL

The Urban Land Development Authority (ULDA) is currently preparing a development application for the proposed next stage of development, referred to as Area E2, within the Fitzgibbon Urban Development Area (UDA). This report, prepared by WRM Water and Environment, presents the results of hydrologic and hydraulic modelling studies undertaken to assess the impacts of the proposed development on flood behaviour and stormwater runoff.

1.2 SITE DESCRIPTION

The proposed Area E2 development is located within the Department of Communities land and ULDA land to the north-west of Area E1 and stages 1 to 4 of the Fitzgibbon Chase development as shown in Figure 1.1. Appendix A shows the proposed lot layout for the Area E development. The Area E2 development covers an area of about 9.89 ha (excluding the bus way corridor) and consists of 90 urban residential allotments (5.30 ha), park/open space (0.60 ha), and new road reserves (3.99 ha).

1.3 ADOPTED ASSESSMENT CRITERIA AND DESIGN OBJECTIVES

1.3.1 Flooding

The impacts of full development of the UDA and development of stages 1 to 4 of the Fitzgibbon Chase only were investigated in detail in a previous study (WRMa, 2009) which developed a TUFLOW two-dimensional hydraulic model of the entire UDA. That study proposed a suite of flood mitigation infrastructure options to ensure no adverse impact on flood levels on adjoining or downstream properties. Since the completion of the full development study, the following development features have been investigated using the TUFLOW model:

- Relocation of a footbridge crossing along Fitzgibbon Drain (WRMb, 2009); and
- The Area E1 development (WRMc, 2009).

The flood impacts of the proposed Area E2 development on design flood levels was assessed for the 100 year Average Recurrence Interval (Q100) event using the TUFLOW hydraulic model incorporating the above development features. The Q100 water level impact of the development was assessed along Cabbage Tree Creek, Fitzgibbon Drain and Carseldine Drain across the UDA site. Note that the future Roghan Road crossing of Carseldine Drain, to the north of the E2 development, was not included as part of the Area E2 development.

The modelled peak water levels including stages 1 to 4 of the Fitzgibbon Chase, Area E1 and Area E2 developments were compared with existing (pre Fitzgibbon UDA development) conditions to ensure the development resulted in no adverse flood impacts on adjoining properties.

1.3.2 Stormwater

Development within the Fitzgibbon UDA will be designed to meet current best practice design objectives for Water Sensitive Urban Design (WSUD), including management of stormwater quantity and quality, as well as source substitution for non-potable water supply.

Current WSUD design objectives for stormwater management are provided in the South East Queensland Regional Plan Implementation Guideline No. 7: Water Sensitive Urban Design (DIP 2008). The design objectives include:

- A stormwater quality management design objective. This objective requires the following reductions in total load of key stormwater pollutants discharging from the site, compared to untreated stormwater runoff:
  - 80% reduction in total suspended solids,
  - 60% reduction in total phosphorus,
  - 45% reduction in total nitrogen, and
  - 90% reduction in gross pollutants.
- A frequent-flow management design objective. This objective requires the first 15 mm of runoff from impervious surfaces (for sites with > 40% imperviousness) to be captured and managed to minimise the impacts on downstream ecosystems associated with the increased frequency of runoff from impervious surfaces.
- A waterway stability management design objective. The objective aims to protect downstream waterways from increases in in-stream erosion by ensuring that the peak 1 year ARI stormwater discharge from the site to the receiving waterway is not increased by the proposed development.

A MUSIC model has been developed to ensure that load reduction targets for the development can be achieved.

Stormwater treatment measures (STMs) for the development have been proposed to achieve these management design objectives including rainwater tanks, sediment traps, trash racks, grass swales, bio-retention cells, detention basins, and flow dissipaters. Stormwater harvesting alternatives for the development are being investigated as part of a separate study.

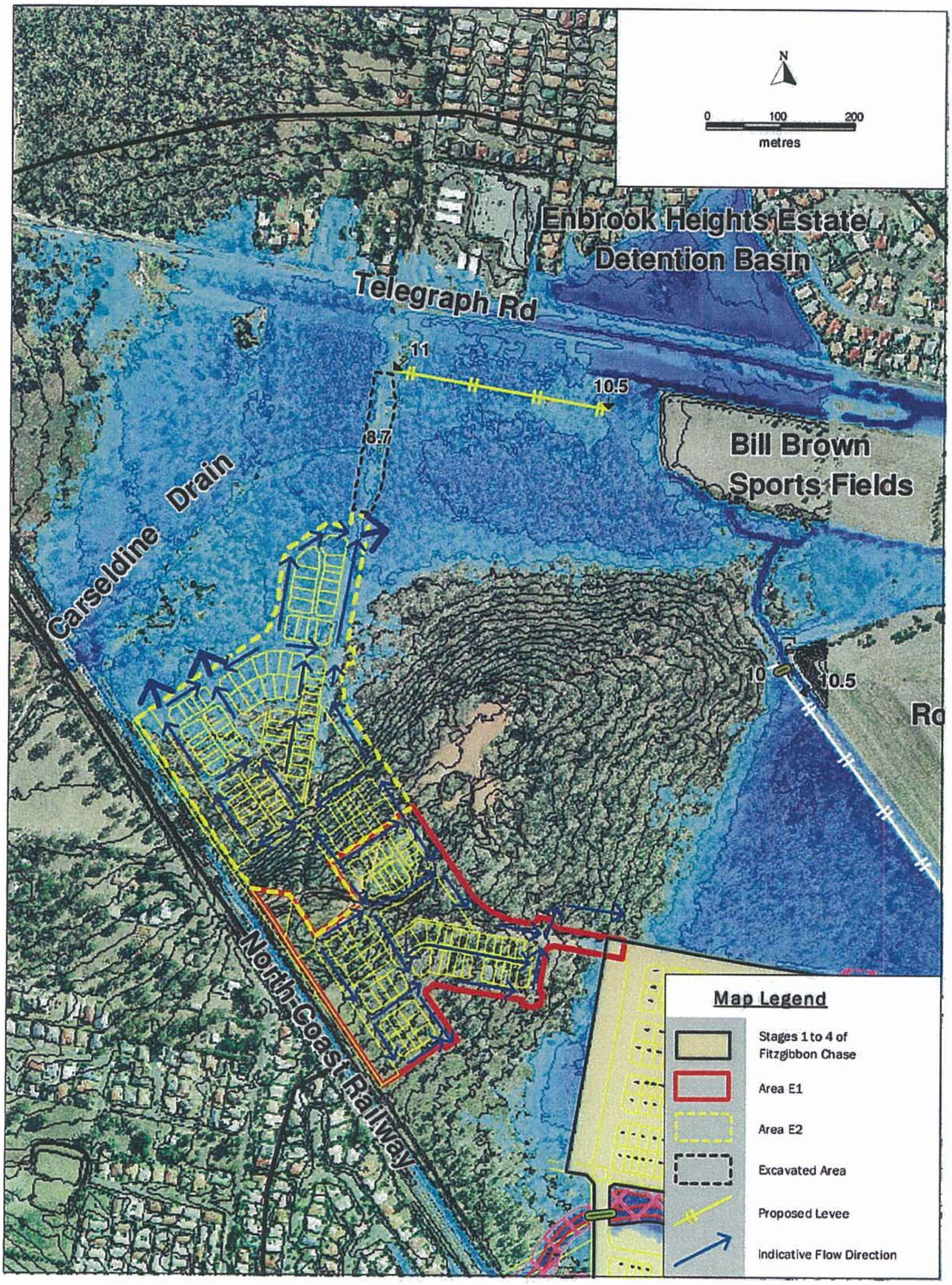


Figure 1.1 Area E Locality Map and TUFLOW model configuration

2 FLOOD IMPACT ASSESSMENT

2.1 METHODOLOGY

The impacts of the proposed Area E2 development were assessed using the hydrologic and hydraulic models originally developed for the assessment of flood impacts for stages 1 to 4 of Fitzgibbon Chase and the overall development of the UDA. Full details of the development and calibration of the models are documented in the following report:
Flood and Stormwater Management Studies for the Fitzgibbon Development Scheme, Ref. 0541-01-G [Rev 1] dated 24 July 2009.

For the assessment of flood impacts due to Area E2 development it was assumed that stages 1 to 4 and Area E1 of the Fitzgibbon Chase and the Roghan Road landfill detention basin (DB1) were constructed prior to construction of Area E2. A proposed footbridge crossing of Fitzgibbon Drain was also added to the model (WRMb, 2009)

The model was run for the 100 year ARI flood event for five storm durations including the 60, 90, 120, 180, and 270 minute duration storms to the determine the impact of stages 1 to 4 of Fitzgibbon Chase plus Area E compared with existing conditions (pre Fitzgibbon UDA) on peak flood levels at 37 reporting locations within the study area. The reporting locations are shown in Figure 2.1.

2.2 MODEL CHANGES

The TUFLOW model including stages 1 to 4 and Area E1 of the Fitzgibbon Chase development (WRMc, 2009) was modified to include the proposed Area E2 development. The following changes were made to the model within the Area E2 footprint:

- The Manning's 'n' was modified from 0.035 for open areas and 0.10 for vegetated areas to 0.025 to reflect the improved drainage efficiency within the developed area;
- The initial and continuing losses were modified from 15 mm and 2.5 mm/hr, respectively to 6.6 mm and 1.0 mm/hr. This corresponds to a change in imperviousness from 0% to 60%.
- The existing landform was modified to include the expected fill extent based on preliminary advice from the project civil engineers (drawing no SK48 rev P3, Precinct four - Fill and Excavation Plan Sheet 1 to 3; dated October and November 2009).

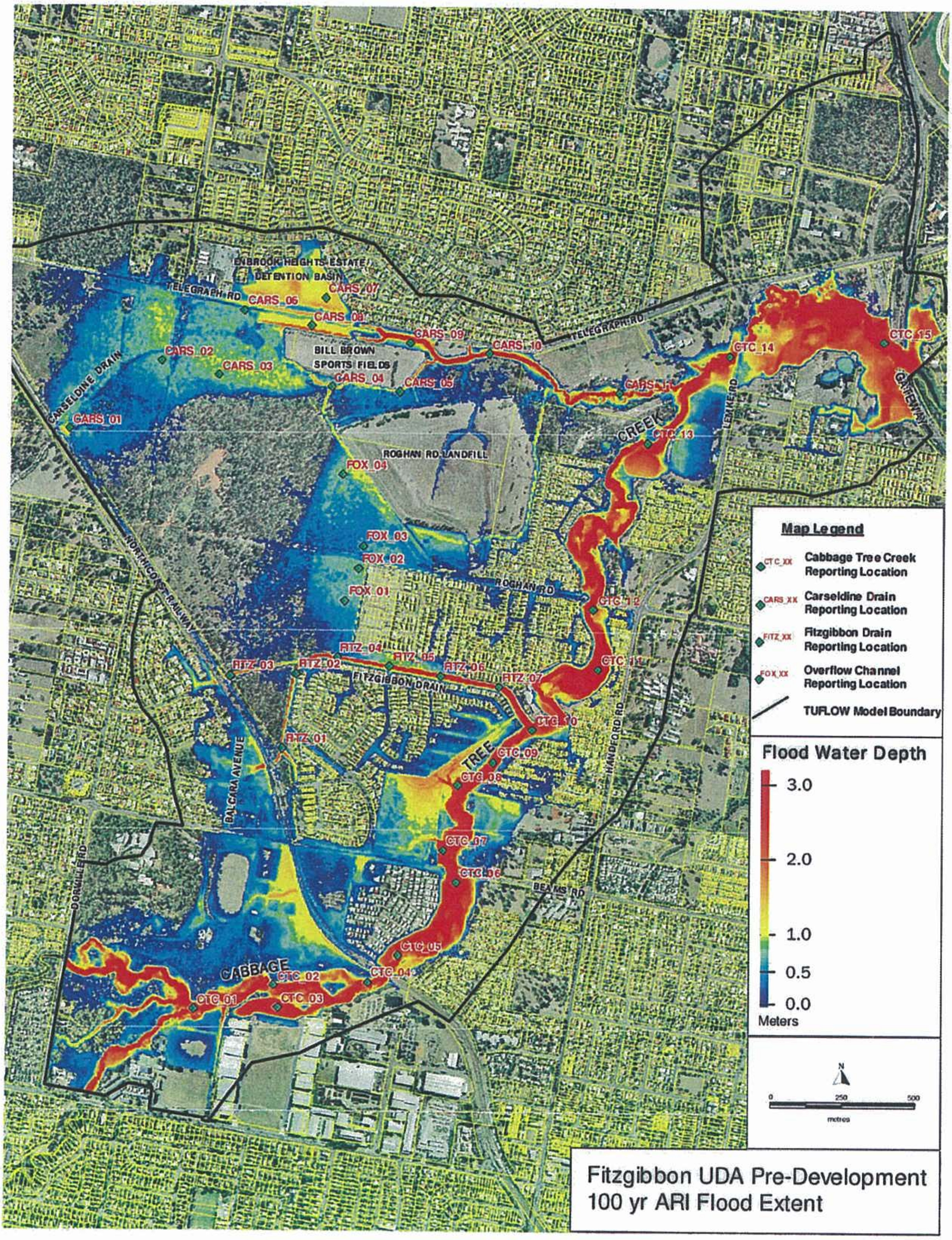


Figure 2.1 Pre-Development 100 year ARI Flood Extent and Reporting Locations, Fitzgibbon UDA site (from WRM,2009a)

The following flood mitigation measures are also proposed as part of the Area E2 development (see Figure 1.1):

- Temporary excavation of an existing informal bund down to the surrounding ground level of about 8.7 m AHD along part of the Roghan Road easement between Area E2 and Telegraph Road; and
- The construction of a levee (Le_3 from report no. 0541-01-G [Rev1]) along the powerlink easement boundary between the Roghan Road easement and the Bill Brown sports fields. Note that this levee is located wholly within the Department of Communities land.

The proposed excavation sufficiently improves drainage along Carseldine Drain to ameliorate the impacts of filling associated with the Area E2 development. The proposed levee prevents any additional water from flowing towards Telegraph Road.

2.3 100 YEAR ARI WATER AND VELOCITY LEVEL IMPACTS

Table 2.1 shows the 100 year ARI flood level impacts of the proposed Area E2 development at 37 reporting locations within the TUFLOW model study area (see Figure 2.1).

The results of the flood modelling show that development of Area E2 does not increase 100 year ARI water levels compared with predevelopment conditions except at reporting locations CARS_03, CARS_04, and CARS_05, where the proposed levee increases water levels along Carseldine Drain between the Bill Brown Sports Field and the Roghan Road Land Fill by up to 0.19 m compared with pre-development conditions. Water levels adjacent to Telegraph Road along the northern side of the proposed levee and the Bill Brown Sports field are reduced by up to 0.09 m.

The peak flood velocities will increase by up to 0.3 m/s and absolute velocities will be up to 0.8 m/s along Carseldine Drain between CARS_03 and CARS_05. The wide flow width and flat slope of the drainage path ensures that the increases in velocity do not impact significantly on the erosion potential along this reach of Carseldine Drain.

Table 2.1 Area E2 Development Conditions TUFLOW Model 100 yr ARI Flood Levels and 100 yr ARI Flood Level Impacts

Reporting Location	Peak Flood Level (m AHD)		100 yr ARI Water Level Impacts (m)
	Pre-Fitzgibbon UDA	Fitzgibbon Chase Stages 1 to 4 and E1 and E2 Development Conditions	
CARS_01	11.65	11.65	0.00
CARS_02	9.55	9.55	0.00
CARS_03	9.24	9.43	0.19
CARS_04	9.08	9.19	0.11
CARS_05	8.58	8.66	0.08
CARS_06	9.19	9.10	-0.09
CARS_07	9.15	9.09	-0.06
CARS_08	9.15	9.08	-0.07
CARS_09	8.01	8.00	-0.01
CARS_10	7.47	7.47	0.00
CARS_11	5.96	5.95	-0.01
CTC_01	15.48	15.48	0.00
CTC_02	14.47	14.47	0.00
CTC_03	14.37	14.37	0.00
CTC_04	13.71	13.71	0.00
CTC_05	12.65	12.65	0.00
CTC_06	12.50	12.50	0.00
CTC_07	12.38	12.37	-0.01
CTC_08	12.11	12.10	-0.01
CTC_09	11.56	11.55	-0.01
CTC_10	10.31	10.30	-0.01
CTC_11	9.26	9.25	-0.01
CTC_12	8.69	8.69	0.00
CTC_13	5.95	5.94	-0.01
CTC_14	4.69	4.69	0.00
CTC_15	3.90	3.87	-0.03
FITZ_01	11.77	11.73	-0.04
FITZ_02	10.62	10.56	-0.06
FITZ_03	11.90	10.89	-1.01
FITZ_04	10.47	10.46	-0.01
FITZ_05	10.46	10.45	-0.01
FITZ_06	10.46	10.44	-0.02
FITZ_07	10.44	10.43	-0.01
FOX_01	9.78	10.36	0.58
FOX_02	9.76	10.33	0.57
FOX_03	9.71	10.25	0.54
FOX_04	9.70	10.25	0.55

* The 100 year ARI water levels in this table must not be used to determine development fill levels.

3 STORMWATER MANAGEMENT

3.1 OVERVIEW

The stormwater management plan for the site includes the following:

- An outline of the design objectives for the proposed stormwater treatment system;
- Descriptions and preliminary sizing of the Stormwater Treatment Measures (STMs) proposed for the operational phase of the development;
- Quantitative modelling to demonstrate that the treatment system will meet relevant performance criteria for stormwater quality management and frequent flow management;
- Description of erosion control management measures for waterway stability management.

The proposed stormwater management strategy includes the use of road-side bio-retention pods within the road reserve that will replace conventional gully pits. Runoff from allotments (including roof, overflows from rainwater tanks, and ground), road, and footpaths will drain overland for collection and treatment within the bio-retention pods. Stormwater will be conveyed to underground stormwater pipes within the bio-retention pods either through the filter media and sub-surface drainage or the overflow riser pipe.

The 'MUSIC' model for urban stormwater improvement conceptualisation (CRCCH, 2005) was used to assess the un-mitigated and mitigated runoff quality from the developed area on the site, and determine the performance of the proposed stormwater treatment system.

3.2 PROPOSED STORMWATER TREATMENT TRAIN

Figure 3.1 shows indicative stormwater catchments for the development site. These catchments are indicative only and are based on the most current available layout. The exact catchment boundaries and location of STMs will be determined during detailed design. The following water sensitive urban design principles will be included in the proposed development:

- Road side bio-retention pods will be constructed within road reserve. The pods will treat road, roof, and lot runoff from the development site;
- Appendix D shows a typical cross section of the bio-retention pods. Bio-filtration of stormwater flows will be treated through the following layers:
  - A 150mm deep drainage layer with particles between 10 and 15mm in diameter in the base of the basin. Slotted 90 mm PVC pipe at 1.5 m spacing (max) will be layed within this layer and connected to the underground pipe network.
  - A 150mm deep sand transition layer placed over the drainage layer.

- A 500mm deep growing medium of sandy loam placed over the transition layer.
- Small flows entering the basin will percolate into the gravel/sand layer, with sediment and nutrients being removed in the process. It was assumed that the underlying soil is impermeable when undertaking the water quality modelling.
- Once flows exceed the hydraulic capacity of the bio-filtration layer, flows will fill the basin and discharge (via a riser pipe at an extended detention depth of 0.2 m above the filter media surface) to the underground pipe network to the discharge location at the downstream boundary of the developed area.

- A sediment forebay installed upstream of all bio-retention pods will remove coarse particles prior to discharge to the bio-retention pods.
- Where possible, runoff from impermeable surfaces should be directed to adjacent gardens and grassed areas (e.g. driveways, footpaths, small car parks, paved area, car wash areas).
- Runoff from Roghan Road will be treated within bio-retention pods located in the centre median strip, similar to the current design in stages 1 to 4 of Fitzgibbon Chase.

Note that treatment measures for the south-eastern portion of super lot 1003 were accounted for as part of the Area E1 application.

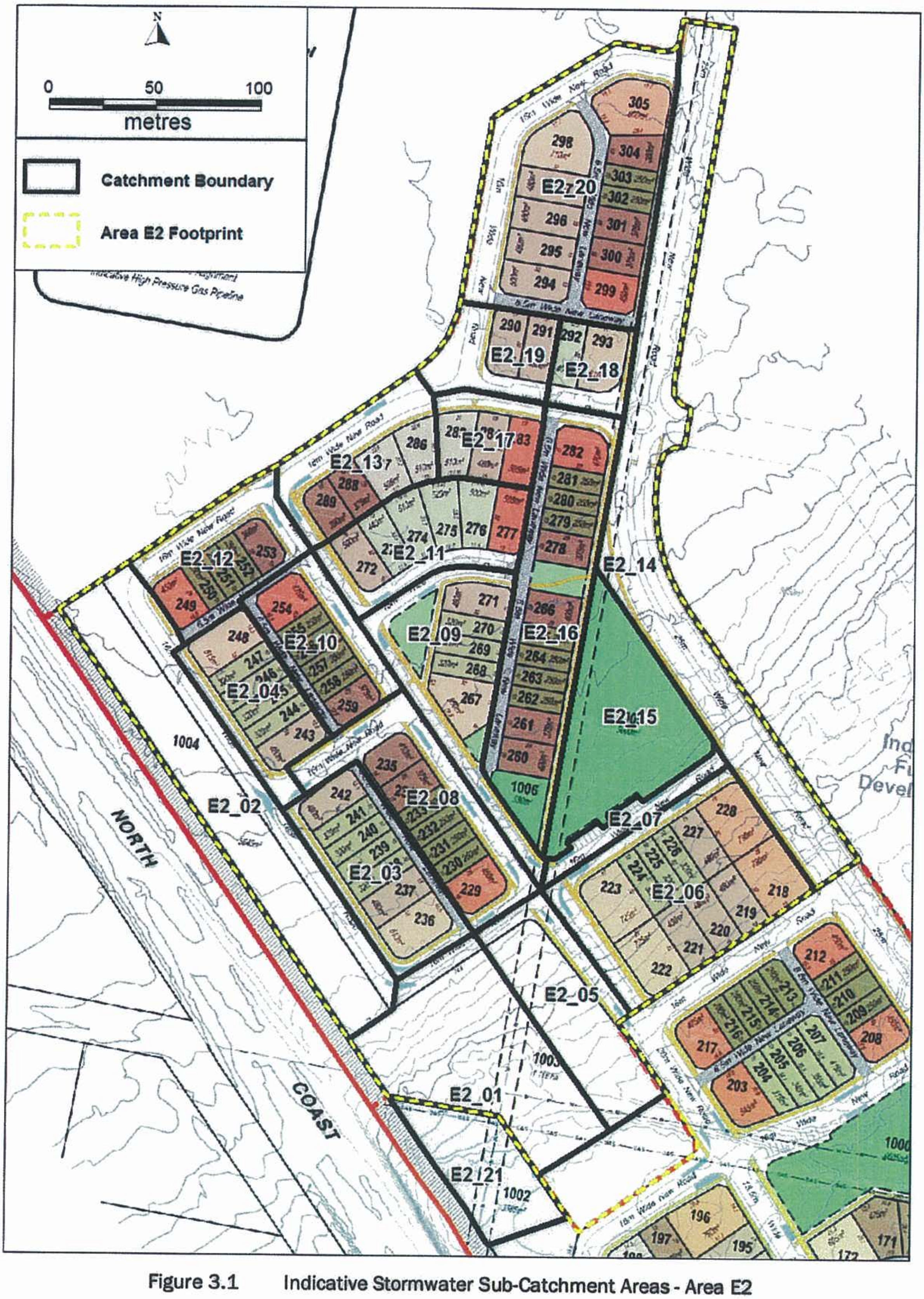


Figure 3.1 Indicative Stormwater Sub-Catchment Areas - Area E2

3.2.1 Rainwater Tanks and Stormwater Harvesting

Requirements for source substitution are provided in the South East Queensland Water Strategy (QWC 2008) which requires all new dwellings to provide 70,000 L per year from alternative (non-grid) water sources. This can be achieved either by installing lot-based rainwater tanks, regional rainwater tanks, or other stormwater harvesting methods. If large scale stormwater harvesting is implemented on the site, individual lot rainwater tanks will not be required. Stormwater management of the site for this study was assessed with and without individual lot rainwater tanks. Additional bio-retention area was used to compensate for the case without rainwater tanks.

For the case with rainwater tanks, all dwellings will collect runoff from roofs. Detached dwellings will have a minimum total rainwater tank capacity of 5 kL. Each attached dwelling will have a minimum total rainwater tank capacity of 3 kL provided either as individual tanks for each dwelling, a single tank of equivalent volume for each building complex, or a regional tank of equivalent volume connected to multiple complexes. A demand of 0.326 kL per day per dwelling was assumed from each tank for modelling purposes. Possible water uses include non-potable indoor use such as toilet flushing and laundry, as well as outdoor use such as irrigation and car washing.

3.3 WATER QUALITY MANAGEMENT DESIGN OBJECTIVES

3.3.1 Construction Phase

Table 3.1 shows pollutants identified by BCC (2003) as being generated during a development's construction. Measures will be taken during the construction phase to manage each of these pollutants. An erosion and sediment control plan will be developed as part of the operational works approval.

Table 3.1 Pollutants Typically Generated During the Construction Phase

Pollutant	Sources
Litter	Paper, construction packaging, food packaging, cement bags, off-cuts
Sediment	Unprotected exposed soils and stockpiles during earthworks and building
Hydrocarbons	Fuel and oil spills, leaks from construction equipment
Toxic Materials	Cement slurry, asphalt prime, solvents, cleaning agents, wash waters (eg from tile works)
pH Altering Substances	Acid sulfate soils, cement slurry and wash waters

3.3.2 Operational Phase

Table 3.2 presents the site runoff load based design objectives for the operational phase of the development.

Table 3.2 Operational Phase Site Runoff Performance Criteria

Parameter	Percent Reduction (%)
Suspended Solids	80
Total Nitrogen	45
Total Phosphorous	60
Gross Pollutants	90

The percent reductions given in Table 3.2 are the target reductions for comparing mitigated site conditions with unmitigated site conditions. The treatment train selected for the proposed development will ensure design objectives are met for all pollutants.

3.4 MUSIC MODELLING

3.4.1 Methodology

Assessment of mitigated post-development site runoff water quality was undertaken using the 'MUSIC' water quality model (CRCCH, 2005). Suspended solids, total nitrogen and total phosphorus concentrations were estimated with the Brisbane City Council (BCC) MUSIC model runoff generation parameters. Baseflow and stormflow concentration parameters were adopted from BCC (2003) and IEAust (2006).

Two separate analyses were undertaken to ensure that the proposed development met the water quality objectives. First, the MUSIC model was used to calculate the bio-retention area required for one hectare of each land use category (i.e. road, roof, and lot) to meet the stormwater quality management design objectives. The bio-retention area was then factored based on the actual area of each land use category within each of the 21 sub-catchments across the development. A check against detailed MUSIC models of two individual sub-catchments indicated that the simplified method based on factory areas provided a similar result.

MUSIC models were then prepared for the entire Area E2 site with and without rainwater tanks. The MUSIC model was used to check that the total bio-retention areas calculated using the unit area (first) method ensured water quality objectives were met for the downstream receiving waters. Adopted MUSIC parameters are provided in Appendix B.

3.4.2 Source Node Parameters

Tables B1 and B2, Appendix B, show the adopted MUSIC source node rainfall-runoff and pollutant concentration parameters, respectively. These parameters are either default model parameters (CRCCH, 2005) or were sourced from BCC (2003) and GCCC (2006). Table 7 in GCCC (2006) provides mean stormwater flow pollutant concentrations for roof, road and other impervious/pervious areas within a residential area. Mean base flow pollutant concentrations and standard deviations given for residential use areas (BCC, 2003) were applied to road areas.

Routing was not used in any drainage links.

3.4.3 Unit Area MUSIC Model Configuration

Figure C1, Appendix C shows the MUSIC model configuration used to assess the unit area mitigated post-development site runoff quality. A bio-retention pod node, two tank nodes, and one GPT node were added to the model. These nodes represent the treatment nodes that will treat runoff from the development site. The proposed GPTs, in the form of a sediment forebay installed on the inlets into the bio-retention area were modelled as a single GPT node.

When determining the bio-retention area required for roof with rainwater tanks it was assumed that half of the residential roof areas are connected to tanks. The remaining roof area bypasses the rainwater tanks to the GPT and bio-retention pod.

- Table 3.3 shows the properties adopted for modelling the sediment forebay area.
- Table 3.4 presents the properties adopted for modelling of rainwater tanks. A capacity of 5 kL and 3 kL was adopted for each single dwelling and multiple dwelling lot, respectively.
- Table 3.5 shows the properties adopted for modelling the bio-retention pod. The bio-retention component will be planted with a selection of native shrubs and grass.

Table 3.3 Sediment Fore-bay Properties

Pollutant	Input (mg/L)	Output (mg/L)
Total Suspended Solids	1000	500
Total Phosphorous	5	4
Total Nitrogen	50	50
Gross Pollutants	15	7.5

Table 3.4 Rainwater Tank Properties per hectare of roof area

Inlet Properties	3 kL Tank	5 kL Tank
Low Flow By-Pass (m^3/s)	0	0
High Flow By-Pass (m^3/s)	100	100
Storage Properties		
Volume below overflow pipe (kL)	3	5
Depth above overflow (m)	0.2	0.2
Number of tanks	67	50
Total volume of rainwater tanks (kL)	200	250
Surface Area (m^2)	100	125
Outlet Properties		
Overflow Pipe Diameter (mm)	50	50
Reuse-Properties		
Daily Demand (kL/day)	21.73[a]	16.30[b]

[a] Based on 67 dwellings per hectare
[b] Based on 50 dwellings per hectare

Table 3.5 Bio-Retention Basin Properties

Inlet Properties	
Low Flow By-Pass (m^3/s)	0
High Flow By-Pass (m^3/s)	100
Storage Properties	
Extended Detention Depth (m)	0.20
Extended Detention Surface Area (m^2)	- [a]
Seepage Loss (mm/hr)	0
Infiltration Properties	
Filter Area (m^2)	- [a]
Filter Depth (m)	0.5
Filter Median Particle Diameter (mm)	0.45
Saturated Hydraulic Conductivity (mm/hr)	180
Depth Below Underdrain Pipe (% of Filter Depth)	0
Outlet Properties	
Overflow Weir Width (m)	2

[a] See Table 3.6

3.4.4 Unit Area MUSIC Model Results

Table 3.6 shows the required bio-retention area per hectare for each land use category. Table 3.6 also shows the mean annual pollutant percent reductions for suspended solids, total nitrogen, total phosphorous and litter based on the adopted treatment train.

Table 3.6 Required Bio-Retention Area for each Land Use Category and Percent Load Reductions determined by the MUSIC model

Land Use Category		Roof (without tanks)	Roof (with tanks)	Lot	Park[a]	Road
% Impervious		100	100	50	0	60
Bio-Retention Area (m^2/ha)		213	28	183	-	183
Extended Detention Area (m^2/ha)		213	28	183	-	183
Water Quality Annual Load Reduction (%)	Suspended Solids (Target 80%)	88.1	78.9	89.2	-	89.5
	Phosphorous (Target 60%)	68.6	60.6	70.2	-	70.9
	Nitrogen (Target 45%)	45.1	45.1	45.0	-	45.0
	Gross Pollutants (Target 90%)	100	100	100	-	100

[a] Park area not included in bio-retention area calculations

Table 3.7 shows the catchment areas for each land use category, percent impervious, and required bio-retention area with and without lot based rainwater tanks. Note that the actual bio-retention area that will be required for each sub-catchment will be affected by the details of the adopted stormwater drainage system and will need to be confirmed during detailed design. The total required bio-retention area for the site is 1206 m^2 (1.2 % of total development area) and 1806 m^2 (1.8 % of total development area) for the Area E2 development with and without rainwater tanks, respectively. Note that with the use of lot based rainwater tanks, a reduction of 33 % of the required bio-retention area can be achieved compared with no rainwater tanks.

Table 3.7 Area E2 Development Sub-Catchment areas, Impervious Fraction, and Required Bio-Retention Area - with and without rainwater tanks

Subcatchment		Number of dwellings	Roof Area (m²)	Ground Area (m²)	Park Area (m²)[b]	Road Area (m²)	Impervious Fraction	Required Bio-retention Area (m²)	
ID	Area (m²)							With Rainwater Tanks	Without Rainwater Tanks
E2_01[a]	6394	15	3000	2960	0	434	0.74	71	126
E2_02[a]	8617	18	3600	2045	0	2972	0.74	102	168
E2_03	4150	10	1800	1050	0	1300	0.75	48	81
E2_04	3168	9	1600	575	0	993	0.78	33	63
E2_05[a]	4070	10	2000	1245	0	825	0.77	43	80
E2_06	7544	25	4100	1810	0	1634	0.79	75	150
E2_07	1053	0	0	0	0	1053	0.60	19	19
E2_08	4760	9	1650	595	0	2515	0.73	62	92
E2_09	4786	8	1400	690	463	2233	0.64	57	83
E2_10	3216	8	1450	400	0	1366	0.77	36	63
E2_11	3963	8	1450	1525	0	988	0.71	50	77
E2_12	3420	7	1250	310	0	1860	0.74	43	66
E2_13	3589	4	800	980	0	1809	0.66	53	68
E2_14	10520	0	0	0	0	10520	0.60	193	193
E2_15	5000	0	0	0	5000	0	0.00	0	0
E2_16	6930	14	2650	1120	530	2630	0.69	76	125
E2_17	2005	5	850	645	0	510	0.74	24	39
E2_18	1506	5	800	210	0	496	0.80	15	30
E2_19	2211	2	400	580	0	1231	0.65	34	42
E2_20	9778	21	3600	1930	0	4248	0.73	123	190
E2_21	2665	0	0	2665	0	0	0.50	49	49
TOTAL	99345	178	32400	21335	5993	39617	0.67	1206	1806

[a] Super Lot. Number of lots, and roof area indicative only
[b] Park area is not included in calculation of bio-retention area

3.4.5 Total Area E2 post development MUSIC Model Configuration

Figure C2 and Figure C3, Appendix C show the MUSIC model configuration used to assess the Area E2 mitigated post-development site runoff quality from the entire E2 site with and without rainwater tanks. The area of the source nodes for roof, lot, road, and park were changed to 3.24 ha, 2.13 ha, 3.96, and 0.60 ha respectively.

- Table 3.3 shows the properties adopted for modelling the sediment forebay area.
- Table 3.8 presents the properties adopted for modelling of rainwater tanks. A capacity of 3 kL and 5 kL was adopted for each single dwelling and multiple dwelling lot, respectively.
- Table 3.9 shows the properties adopted for modelling the bio-retention pods.

3.4.6 Area E2 post development MUSIC Model Results

Table 3.10 shows the mean annual pollutant loads for suspended solids, total nitrogen, total phosphorous and litter for Area E2 post-development conditions with rainwater tanks. Table 3.11 shows the results with rainwater tanks. WQOs are met for all modelled water quality parameters.

Table 3.8 Rainwater Tank Properties

Inlet Properties	3 kL Tank	5 kL Tank
Low Flow By-Pass (m^3/s)	0	0
High Flow By-Pass (m^3/s)	100	100
Storage Properties		
Volume below overflow pipe (kL)	3	5
Depth above overflow (m)	0.20	0.2
Number of tanks	64	71 + 43[a]
Total volume of rainwater tanks (kL)	192	570
Surface Area (m^2)	96	285
Outlet Properties		
Overflow Pipe Diameter (mm)	50	50
Reuse-Properties		
Daily Demand (kL/day)	20.9	37.2

[a] Estimated number of allotments on Super Lot development

Table 3.9 Bio-Retention Basin Properties

Inlet Properties	With Tanks	Without Tanks
Low Flow By-Pass (m^3/s)	0	0
High Flow By-Pass (m^3/s)	100	100
Storage Properties		
Extended Detention Depth (m)	0.20	0.20
Extended Detention Surface Area (m^2)	1206	1806
Seepage Loss (mm/hr)	0	0
Infiltration Properties		
Filter Area (m^2)	1206	1806
Filter Depth (m)	0.5	0.5
Filter Median Particle Diameter (mm)	0.45	0.45
Saturated Hydraulic Conductivity (mm/hr)	180	180
Depth Below Underdrain Pipe (% of Filter Depth)	0	0
Outlet Properties		
Overflow Weir Width (m)	2	2

Table 3.10 Mean Annual Pollutant Loads, Post-Development Mitigated (with tanks) Conditions

Pollutant	Annual Pollutant Load (kg/year)		Percent Reduction (%)	WQO Percent Reduction (%)
	Source Node	Mitigated (with tanks)		
Suspended Solids	15600	2330	85.0	80
Total Phosphorous	30	9.78	67.4	60
Total Nitrogen	160	82.9	48.1	45
Litter	1940	0	100	90

Table 3.11 Mean Annual Pollutant Loads, Post-Development Mitigated (without tanks) Conditions

Pollutant	Annual Pollutant Load (kg/year)		Percent Reduction (%)	WQO Percent Reduction (%)
	Source Node	Mitigated (without tanks)		
Suspended Solids	15600	1930	87.6	80
Total Phosphorous	30	9.15	69.5	60
Total Nitrogen	160	87.1	45.7	45
Litter	1940	0	100	90

3.5 FREQUENT FLOW MANAGEMENT

The frequent-flow management design objective requires the first 15 mm of runoff from impervious surfaces be captured and managed to minimise the impacts on downstream ecosystems associated with the increased frequency of runoff from impervious surfaces. Rainwater tanks and bio-retention basins are used to achieve this requirement. Also, frequent flows will be captured by existing wetland areas. The MUSIC model was used to determine the total amount of runoff captured in these STMs.

Table 3.12 shows the estimated total volume of runoff from the development, the estimated volume of runoff that accounts for the first 15 mm of rainfall per day on impervious surfaces, and the volume of water captured within the bio-retention pods with and without rainwater tanks on the development. The results show that about 50 % of runoff from the developed site occurs on days with less than 15 mm of runoff. The volume of runoff captured and infiltrated or evaporated from the bio-retention pods is about 75 % of runoff, indicating that the proposed stormwater management system will comply with the frequent flow management system. Note that the volume of water stored in the rainwater tanks is ignored.

Table 3.12 Frequent Flow Management Results

Scenario	Volume of Runoff from source nodes (excluding runoff captured by rainwater tanks) (ML/yr)	Volume of Runoff Accounting for first 15 mm/day of Rainfall on impervious surfaces (ML/yr)	Volume of Runoff captured/evaporated in bio-retention pods (ML/yr)
With rainwater Tanks	66	34	50
Without rainwater Tanks	77	39	54

3.6 WATERWAY STABILITY MANAGEMENT

Waterway stability management aims to protect downstream waterways from increases in in-stream erosion by ensuring that the peak 1 year ARI stormwater discharge from the site to the receiving waterway is not increased by the proposed development. Limiting the peak flows up to the 1 year ARI discharge from the site will be achieved using rainwater tanks and bio-retention pods. Additional erosion protection and flow dissipation device(s) will be required on the proposed pipe outlet(s) from the development site to ensure no local erosion at the stormwater outlets.

4 SUMMARY OF FINDINGS

The Urban Land Development Authority (ULDA) is currently preparing a development application for the proposed next stage of development, referred to as Area E2, within the Fitzgibbon Urban Development Area (UDA). This report, prepared by WRM Water and Environment, presents the results of hydrologic and hydraulic modelling studies undertaken to assess the impacts of the proposed development on flood behaviour and stormwater runoff.

The TUFLOW model developed in a previous study (WRMc, 2009) was used to assess the impact of the development on flood levels within the vicinity of the UDA. The following flood mitigation measures are proposed:

- Temporary excavation of an existing informal bund down to the surrounding ground level of about 8.7 m AHD along part of the Roghan Road easement between Area E2 and Telegraph Road; and
- The construction of a levee (Le_3 from report no. 0541-01-G [Rev1]) along the powerlink easement boundary between the Roghan Road easement and the Bill Brown sports fields. Note that this levee is located wholly within the Department of Communities land.

The results of the flood modelling show that development of Area E2 does not increase 100 year ARI water levels compared with predevelopment conditions except at reporting locations CARS_03, CARS_04, and CARS_05, where the proposed levee increases water levels along Carseldine Drain between the Bill Brown Sports Field and the Roghan Road Land Fill by up to 0.19 m compared with pre-development conditions. No existing development will be affected by these increased water levels. Water levels adjacent to Telegraph Road along the northern side of the proposed levee and the Bill Brown Sports field are reduced by up to 0.09 m.

A number of stormwater treatment devices (STMs) within the development have been proposed to achieve the stormwater management design objectives. The proposed measures include sediment traps, bio-retention pods, detention basins, and flow dissipaters. Two stormwater management options were investigated, one with and the other without rainwater tanks. The required total bio-retention area for these two cases is 1206 m^2 (1.2 % of development area) and 1806 m^2 (1.8 % of development area) respectively.

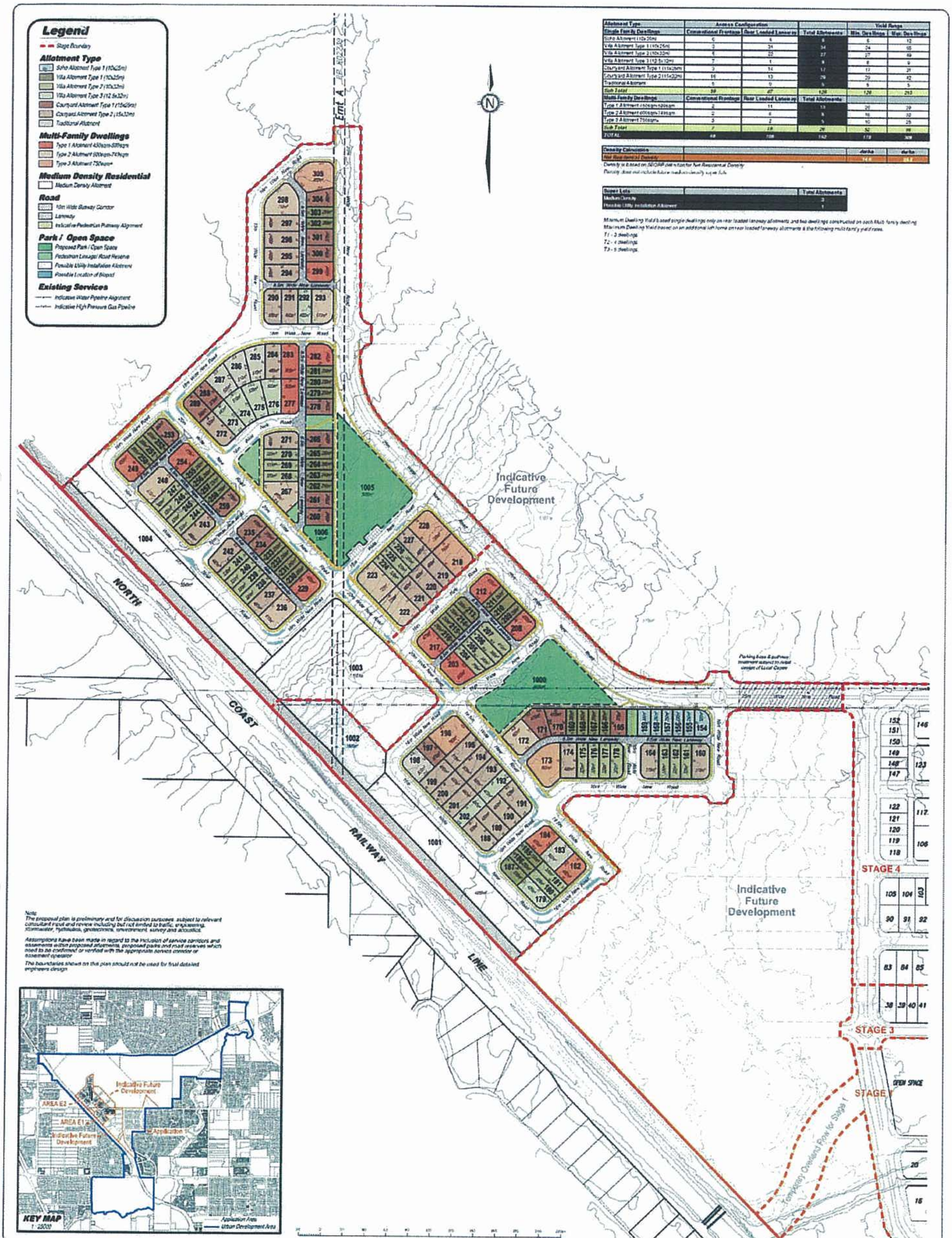
The proposed STMs ensure that the development meets the design objectives for stormwater quality management, frequent flow management, and water stability management.

5 REFERENCES

BCC (2003)	*Guidelines for Pollutant Export Modelling in Brisbane, Version 7 [Rev 2]*, Waterways Program, Urban Management Division, Brisbane City Council, Brisbane, 11 December 2003
BCC (2000)	*Guideline on Identifying and Applying Water Quality Objectives in Brisbane City*, Version 1, Waterways Program, Urban Management Division, Brisbane City Council, Brisbane, March 2000
CRCCH (2005)	*MUSIC (Model for Urban Stormwater Improvement Conceptualisation)*, CRC for Catchment Hydrology, Australia
GCCC (2006)	*GCCC MUSIC Modelling Guidelines 2006 – Version 1*, Gold Coast City Council, Australia
ICC (2007)	*Planning Scheme Policy 3 – General Works, Part 2 – Stormwater Drainage*, Ipswich City Council, Australia
IEAust (2006)	*Draft Australian Runoff Quality Guidelines*, Institution of Engineers, Australia
WRMa (2009)	*Flood and Stormwater Management Studies for the Fitzgibbon Development Scheme*, Ref. 0541-01-G [Rev 1] dated 24 July 2009
WRMb (2009)	*Fitzgibbon Chase - Relocation of Footbridge*, Ref. 0541-01-Q dated 2 September 2009
WRMc (2009)	*Fitzgibbon Urban Development Area E1 Flood Impact Assessment and Stormwater Management Plan*, Ref. 0541-02-B [Rev 1] dated 25 November 2009

APPENDIX A

PROPOSED LOT LAYOUT



Allotment Type	Access Configuration			Yield Range	
Single Family Dwellings	Conventional Frontage	Rear Loaded Laneway	Total Allotments	Min. Dwellings	Max. Dwellings
Soho Allotment (10x25m)	6	6	[illegible]	6	12
Villa Allotment Type 1 (10x25m)	3	31	34	24	65
Villa Allotment Type 2 (10x32m)	5	22	27	27	49
Villa Allotment Type 3 (12.5x32m)	7	1	8	8	9
Courtyard Allotment Type 1 (15x25m)	3	14	17	17	31
Courtyard Allotment Type 2 (15x32m)	16	13	29	29	42
Traditional Allotment	5	0	5	5	5
Sub Total	39	87	126	126	213
Multi-Family Dwellings	Conventional Frontage	Rear Loaded Laneway	Total Allotments		
Type 1 Allotment 450sqm-520sqm	2	11	13	26	39
Type 2 Allotment 600sqm-749sqm	2	6	8	16	32
Type 3 Allotment 750sqm+	3	2	5	10	25
Sub Total	7	19	26	52	96
TOTAL	46	106	152	178	309

Density Calculation		dw/ha	dw/ha
Net Residential Density		[illegible]	[illegible]

Density is based on SEQRP definition for Net Residential Density
Density does not include future medium density super lots

Super Lots		Total Allotments
Medium Density		2
Possible Utility Installation Allotment		1

Level Datum		Date	11 November 2009
Origin		Surveyed	
		Comp By.	WW/KCH
		DWG Name.	22743-108-PROP
Scale	1 : 1500 @ A1	Local Authority	URBAN LAND DEVELOPMENT AUTHORITY
		Job Reference	22743-000

CLIENT
Urban Land Development Authority

ALLOTMENT LAYOUT - AREA E
253 TELEGRAPH ROAD, FITZGIBBON
LOT 10 & 11 ON SP223412

PROJECT
PROPOSED SUBDIVISION

Plan Reference
22743 - 108 C

CONICS

CONICS (BRISBANE) PTY LTD
743 ANN STREET
PO BOX 1559,
FORTITUDE VALLEY QLD 4006.
email: conics@conics.com.au
web: www.conics.com.au

APPENDIX B

MUSIC PARAMETERS

Table B1 Adopted MUSIC Runoff Generation Parameters

Parameter	Urban Residential	Commercial	Industrial	Rural Residential	Forested
Field Capacity (mm)	200	80	80	80	80
Infiltration Capacity Coefficient a	50	200	200	200	200
Infiltration Capacity Coefficient b	1	1	1	1	1
Rainfall Threshold (mm)	1	1	1	1	1
Soil Capacity (mm)*	400!	120$^{\alpha}$	120$^{\alpha}$	120$^{\alpha}$	120$^{\alpha}$
Initial Storage (%)*	10	25	25	25	25
Daily Recharge Rate (%)	25	25	25	25	25
Daily Drainage Rate (%)	5	5	5	5	5
Initial Depth (mm)	50	50	50	50	50

Notes: * Single pervious soil store adopted
$^{\alpha}$ Shallow Soil Store
! Deep Soil Store

Source: BCC (2003)

Table B2 Adopted MUSIC Base and Stormflow Concentration Parameters

Land Use Type for MUSIC Source Nodes [1]	Parameter	Total Suspended Solids (Log_{10} mg/L)		Total Phosphorus (Log_{10} mg/L)		Total Nitrogen (Log_{10} mg/L)	
		Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
Residential Roof [2]	Mean	1.0	1.3	-0.97	-0.89	0.2	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.2	0.26
Residential Lots[2]	Mean	1.0	2.18	-0.97	-0.47	0.2	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.2	0.26
Residential Road[2]	Mean	1.0	2.43	-0.97	-0.3	0.2	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.2	0.26

Notes: Source: 1 BCC (2003)
2 Mean Stormflow concentrations sourced from GCCC (2006) all other concentrations from BCC (2003)

APPENDIX C

MUSIC MODEL

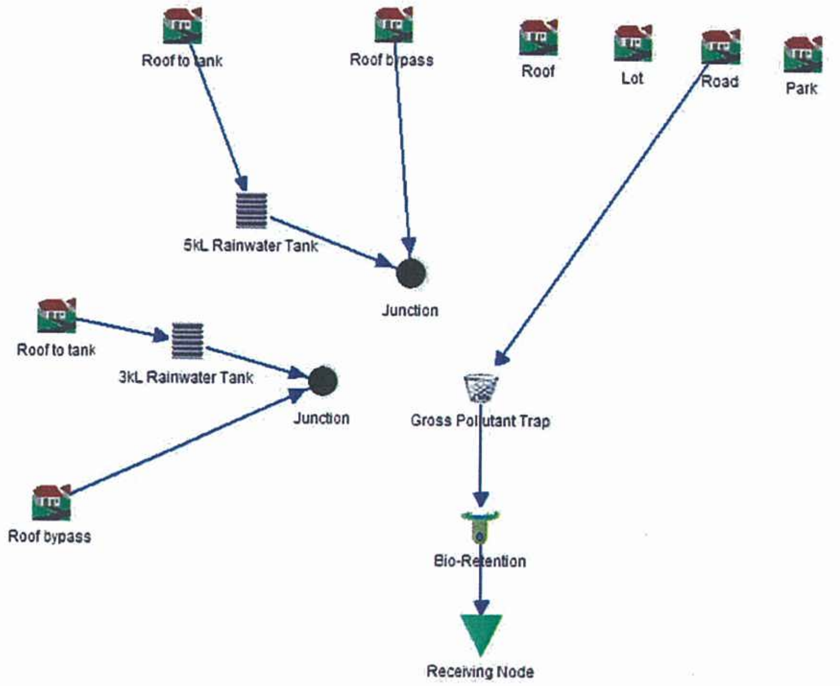


Figure C1 Unit Area MUSIC Model (with Road Source Node Connected)

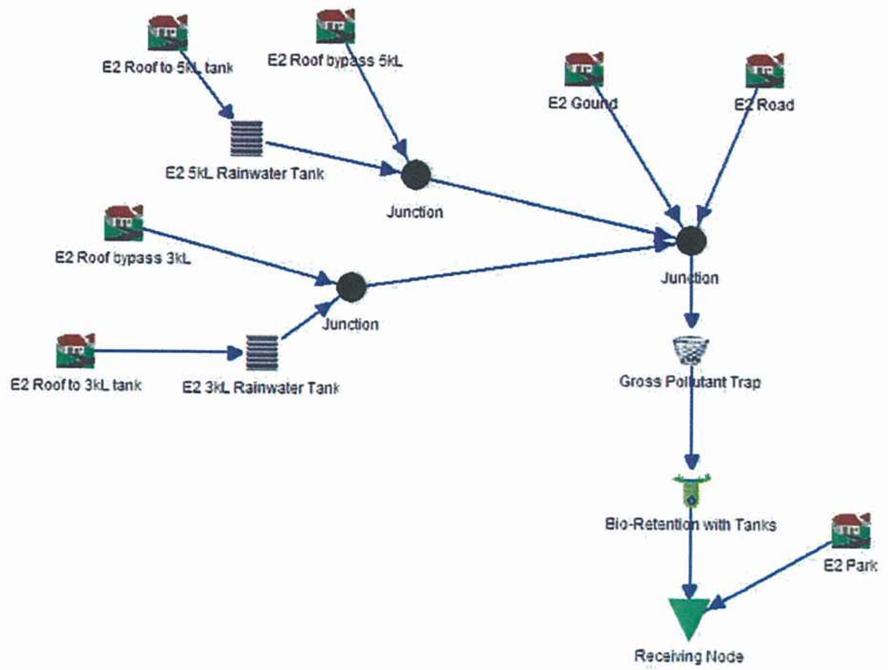


Figure C2 Area E2 Proposed Development MUSIC Model (with rainwater tanks)

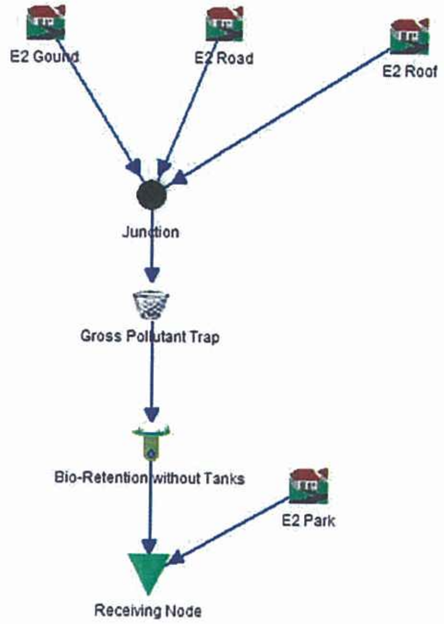
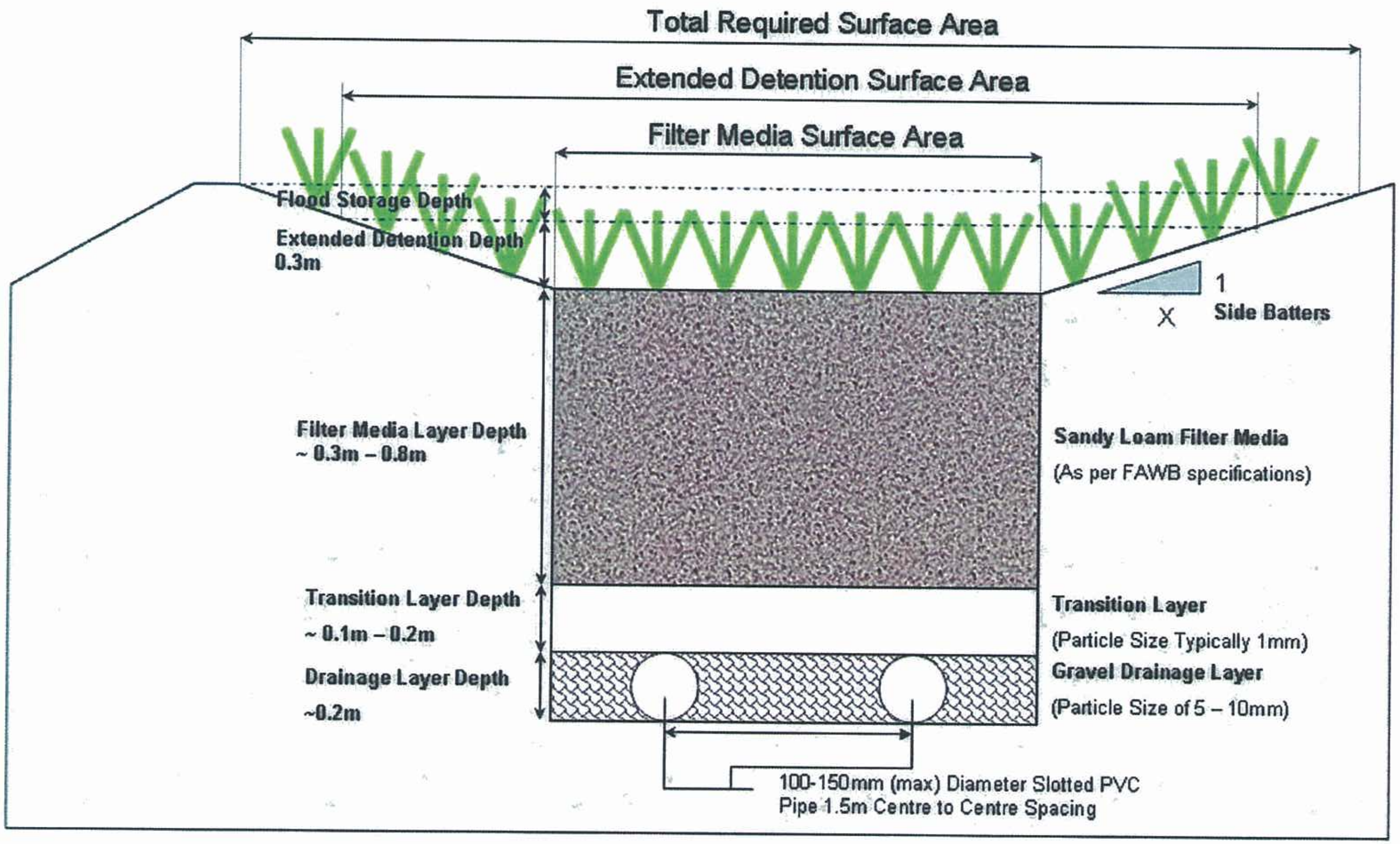


Figure C3 **Area E2 Proposed Development MUSIC Model (without rainwater tanks)**

APPENDIX D

TYPICAL BIO-RETENTION POD CROSS-SECTION


Total Required Surface Area
Extended Detention Surface Area
Filter Media Surface Area
Flood Storage Depth
Extended Detention Depth
0.3m
1
X
Side Batters
Filter Media Layer Depth
~ 0.3m – 0.8m
Sandy Loam Filter Media
(As per FAWB specifications)
Transition Layer Depth
~ 0.1m – 0.2m
Drainage Layer Depth
~0.2m
Transition Layer
(Particle Size Typically 1mm)
Gravel Drainage Layer
(Particle Size of 5 – 10mm)
100-150mm (max) Diameter Slotted PVC
Pipe 1.5m Centre to Centre Spacing

0541-02-I
15 April 2010

wrm
water + environment

WRM Water & Environment Pty Ltd
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www.wrmwater.com.au

Ian Purssey
ULDA
PO Box 3643
South Brisbane BC QLD 4101

PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 29/10/10

Dear Ian,

SUBJECT: ULDA FITZGIBBON DEVELOPMENT – REVIEW OF BULK EARTHWORKS FOR AREAS C, E, F & G

As requested by Bruce McArthur from ETS we have reviewed the following design drawings for bulk earthworks in Areas C, E, F and G for the Fitzgibbon development:

ULDEFG C200 P2 – 22/3/2010
ULDEFG C201 P2 – 22/3/2010
ULDEFG C202 P2 – 22/3/2010

We have assumed that the required minimum fill level is based on the Brisbane City Council requirement for residential allotments to be a minimum of 300 mm above the 100 year ARI (Q100) design flood level. We have also assumed that potential flood mitigation works for Cabbage Tree Creek that would reduce flood levels on the site (though included in planning investigations for the UDA) may not be constructed.

Subject to the comments provided below, which may require some minor adjustment to fill levels, the proposed filling is generally compliant with the results of flood investigations undertaken to date for the UDA:

- C200 P2 - The minimum fill level at the southeast corner of the filled area shown on this plan should be 11.45 mAHD at the upstream end of the adjacent channel, and 11.40 mAHD at the downstream end of the channel.
- C200 P2 – We note that the design of the waterway culvert crossing adjacent to the southeast corner of the filled area (box culverts at Ch 590 on dwg. ULDSFG C304 D) indicates that the overflow point for flows exceeding the culvert capacity, with a minimum elevation of about 11 mAHD, is located about 50 m to the north of the culvert. The design of the final landform should ensure that overflows from the waterway, due to events greater than Q100 or substantial culvert blockage, can access this low point with minimal impact on residential allotments.
- C201 P2 – The minimum fill level at the northern limit of the filled area shown on this plan (near the future Roghan Road culvert crossing) should be 10.95 mAHD. The minimum fill level at the western corner of the filled area, adjacent to the Carseldine Drain open space reserve, should be 11.25 mAHD.
- C202 P2 – The minimum fill level for the fill pads shown on this plan should be 10.95 mAHD, increasing to 11.25 mAHD at the upstream (western) end of the site.

Please do not hesitate to contact me if you require further information.

For and on behalf of
WRM Water & Environment Pty Ltd

David Newton
Principal Engineer
RPEQ # 5386

Urban Utilities

ASSESSMENT of the PROPOSED WATER SERVICING PLAN of the

FITZGIBBON URBAN DEVELOPMENT AREA - AREAS B, C, E1, E2, F & G

Document Date: 17 March 2010

Revision History

Rev No	Author	Branch	Approved for Issue			
			Position	Name	Signature	Date
0	Arash Alizadeh	Asset Management	Manager - Infrastructure Planning	Andy Krumins		Feb 26, 2010
1	Arash Alizadeh	Asset Management	Manager - Infrastructure Planning	Andy Krumins		Mar 17, 2010

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Queensland Urban Utilities (QUU) was commissioned by the Urban Land Development Authority (ULDA) to assess the required water mains for development of areas B, C, E1, E2, F and G of the Fitzgibbon Urban Development Area (UDA).

The Fitzgibbon UDA covers 295 hectares of land in the northern suburbs of Fitzgibbon, Carseldine, Bald Hills, Taigum and Deagon. The area is located approximately 12 km from the Brisbane Central Business District. (see Figure 1-1)

Areas B, C, E1, E2, F and G of the Fitzgibbon UDA are proposed to contain about 310 low, low-medium and medium residential allotments. The area is located south of Telegraph Rd, north of the railway and west of stages 1-4 which are currently being constructed (see figure 1-2).

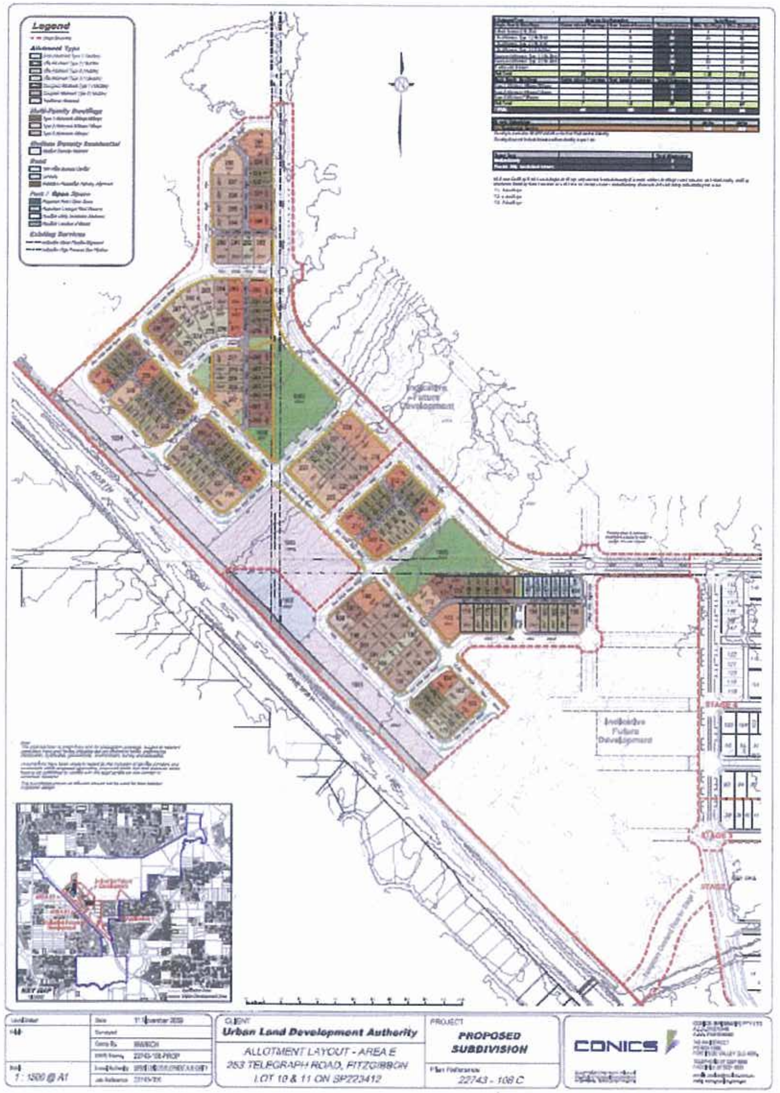
The study area is within the Bracken Ridge Water Supply Area (WSA) and is supplied by gravity from Bracken Ridge reservoir (50.4 mAHD Minimum Operating Level) (see Figure 1-3).

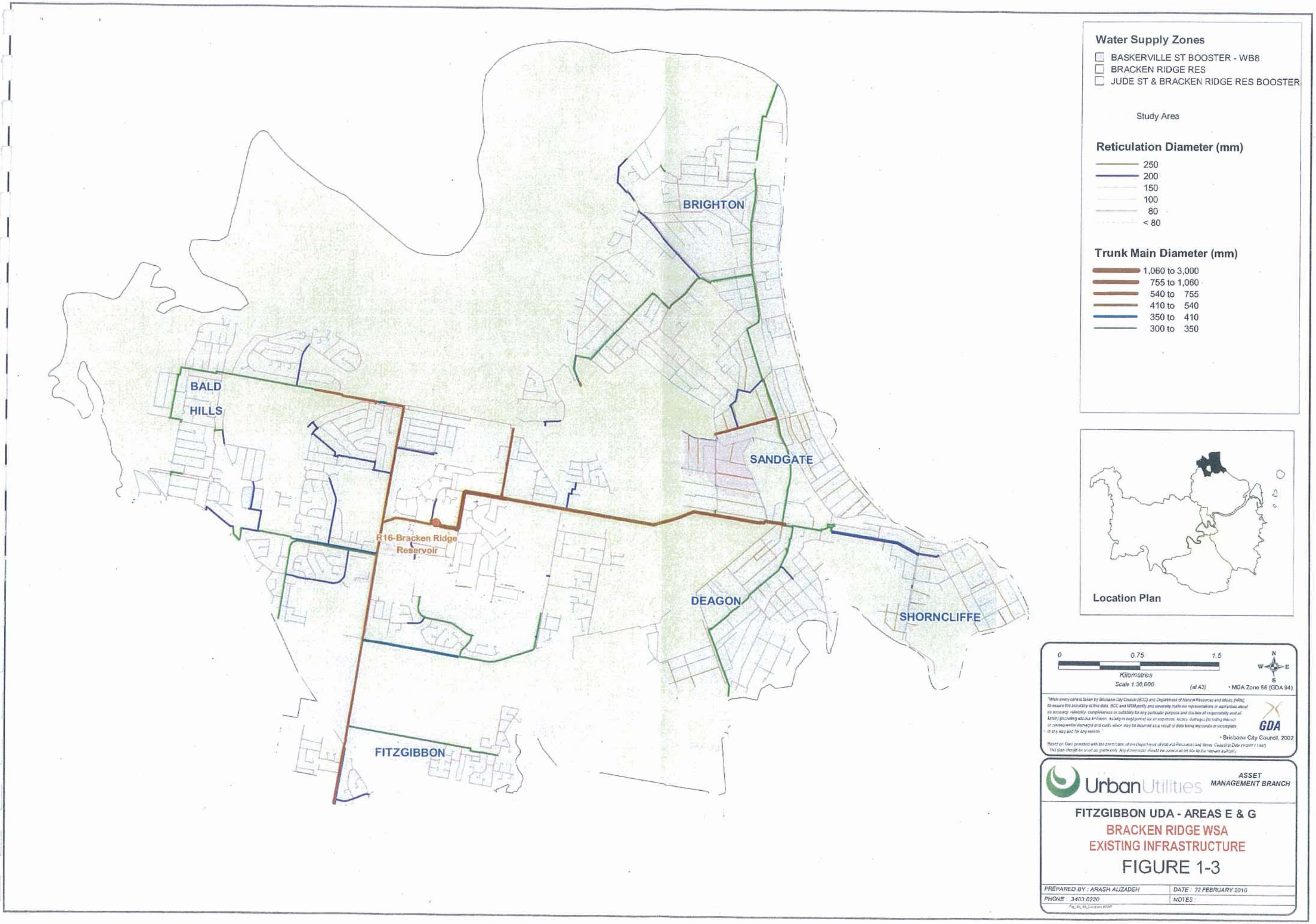
This document has been prepared to assess the required water mains to meet Brisbane City Council (BCC) design standards to:

- Achieve minimum pressures;
- Achieve required fire-flow capacities;
- Ensure reliability of supply to the proposed development.

Figure 1-1 Fitzgibbon UDA

Figure 1-2 Study Area





Urban Utilities ASSET MANAGEMENT BRANCH

FITZGIBBON UDA - AREAS E & G

BRACKEN RIDGE WSA

EXISTING INFRASTRUCTURE

FIGURE 1-3

PREPARED BY : ARASH ALIZADEH	DATE : 22 FEBRUARY 2010
PHONE : 3403 0220	NOTES :

2 POPULATION AND DEMAND

Number and types of allotments for the study area were provided by the ULDA and are shown in Figure 2-1.

The majority of allotments are of Low Density residential (LDR) and Low-Medium Density Residential (LMR) categories with three larger allotments (Super Lots) along the railway line categorised as Medium Density Residential (MR).

Equivalent Persons (EP) were calculated from the allotment data by equating one LDR and LMR dwelling to 2.5 EP, and one MR dwelling to 1.7 EP. (see Table 2-1)

Table 2-1 Study Area Equivalent Persons Calculation

Allotment Type	City Plan Category	No. of Allotments	Yield Range		EP per Dwellings	Total Max EP
			Min Dwellings	Max Dwellings		
Single Family Dwellings	LDR	126	126	213	2.5	533
Multi-Family Dwellings	LMR	26	178	309	2.5	773
					Total EP	1,305
Allotment Type	**City Plan Category**	**No. of Allotments**	**Total Area (ha)**	**Dwellings per ha**	**Total No. of Dwellings**	**EP per Dwellings**
Super Lots	MR	3	21.76	66	1,436	1.7
					Total EP	2,441

Per capita demands were calculated based on an Average Day Demand (AD) of 268L/person/d, a Peak Day (PD) to Average Day factor of 1.7 and a Peak Hour Demand (PH) factor of 1.89. Non Revenue Water of 46L/EP/day was also added to the calculated demand. This equated to a Peak Hour Demand of 0.011L/s/EP. Table 2-2 shows the study area's demand calculation.

Allotment Type	Access Configuration			Yield Range	
Single Family Dwellings	**Conventional Frontage**	**Rear Loaded Laneway**	**Total Allotments**	**Min. Dwellings**	**Max. Dwellings**
Soho Allotment (10x25m)	0	6	6	6	12
Villa Allotment Type 1 (10x25m)	3	31	34	34	65
Villa Allotment Type 2 (10x32m)	5	22	27	27	49
Villa Allotment Type 3 (12.5x32m)	7	1	8	8	9
Courtyard Allotment Type 1 (15x25m)	3	14	17	17	31
Courtyard Allotment Type 2 (15x32m)	16	13	29	29	42
Traditional Allotment	5	0	5	5	5
Sub Total	*39*	*87*	*126*	*126*	*213*
Multi-Family Dwellings	**Conventional Frontage**	**Rear Loaded Laneway**	**Total Allotments**		
Type 1 Allotment 450sqm-599sqm	2	11	13	26	39
Type 2 Allotment 600sqm-749sqm	2	6	8	16	32
Type 3 Allotment 750sqm+	3	2	5	10	25
Sub Total	*7*	*19*	*26*	*52*	*96*
TOTAL	***46***	***106***	***152***	***178***	***309***

Density Calculation		dw/ha	dw/ha
Net Residential Density		*14.6*	*25.3*

Density is based on SEQRP definition for Net Residential Density

Density does not include future medium density super lots

Super Lots		Total Allotments
Medium Density		3
Possible Utility Installation Allotment		1

Minimum Dwelling Yield based single dwellings only on rear loaded laneway allotments and two dwellings constructed on each Multi-family dwelling

Maximum Dwelling Yield based on an additional loft home on rear loaded laneway allotments & the following mulit-family yield rates:

T1 - 3 dwellings

T2 - 4 dwellings

T3 - 5 dwellings

Figure 2-1 Number and Types of Allotments in Study Area

Table 2-2 Study Area Demand Calculation

City Plan Category	Total EP	AD (L/EP/d)	PD/AD	PD (L/EP/d)	MH/PD	MH (L/EP/d)	MH (L/EP/s)	MH Inc. NRW (L/EP/s)	MH (L/EP/s)
LDR/LMR	1,305	268	1.70	456	1.89	861	0.010	0.011	13.76
MR	2,441	268	1.70	456	1.89	861	0.010	0.011	25.75

In hydraulic modeling and for LDR and LMR allotments, EP loads were distributed uniformly across the existing parcels within the study area. For the Super Lots, the EP demand for each parcel was applied to the nearest junction in the model.

3 HYDRAULIC ANALYSIS

Hydraulic analysis of the proposed water reticulation mains was undertaken using hydraulic analysis software. The following scenario runs were undertaken:

1. Peak Hour pressures
2. Fire Flow

3.1 PEAK HOUR SCENARIO

System performance was assessed under PH demands with Bracken Ridge reservoir at Minimum Operating Level (MOL). The adequacy of proposed water service mains was checked to ensure a minimum service pressure of 210kPa (21m) is maintained at the water meters.

3.2 FIRE FLOW SCENARIO

System requirements were identified to supply fire fighting flows of 25 (from two hydrants) and 45 L/s (from up to three hydrants) for low and high risk areas respectively. Assessment of fire flow capacity was made with a concurrent background demand equivalent to 2/3 of PH demand with a minimum allowable residual pressure of 100kPa (10m) at the hydrants.

3.3 RELIABILITY OF SUPPLY

The network configuration was reviewed to ensure that a reliable supply to the development would be available into the future. Potential connection to the adjacent Aspley WSA and also the number of cross connections between the reticulation and trunk mains were considered to provide an adequate reliability of supply.

4 PROPOSED AND REVIEWED WATER RETICULATION MAINS

The augmentations proposed by ULDA are shown in SK06 - SK10. The plan comprises a DN225 backbone supply that runs parallel to the existing DN410 along the future extension of Roghan Rd and connects to the existing DN300 in Roghan Rd. The proposed water reticulation mains are mostly sized as DN150.

Supplementary information provided by ULDA in the course of reviewing the draft version of the study is also listed below:

- Major parts of the study area are subject to bulk fill. In worst case the fill depth in the vicinity of the existing DN410 trunk main can add as much as 1.7m extra soil depth.
- Some sections of the proposed plan have already been constructed (see sketch SK06) in smaller size than proposed by QUU in previous advice[1].
- It was proposed to lay reticulation mains in the future busway to connect to as existing main in Lavender Pl.

The proposed plan and the background information were reviewed by QUU and recommendations were identified as follows:

- Contingency of Supply: Due to the development being situated on a trunk main branch from Bracken Ridge reservoir, and given the size of the development, it is necessary to ensure that a contingent supply from adjacent Aspley WSA can be delivered in case of failure/maintenance of the trunk mains. Two options were identified either can address the above issue:
    - Option 1: To upsize the proposed DN150 water main supplying Area B to DN250 (Line 4, see Figure 4-1) and to connect it to existing DN225 in Aspley WSA via Carselgrove

[1] "Assessment of the Proposed Water Servicing Plan of the Fitzgibbon Urban Development Area – Areas B, C, E1, E2, F & G – Draft" - Dated 26 February 2010

  Ave. It is also proposed to upsize the section further north (line 3, see Figure 4-1) from DN150 to DN200.

  - Option 2: To install a standard 200mm BCC flow meter / PRV pit, with internal pipework as an offtake from the existing DN300 in Roghan Rd (see Figure 4-2). It is recommended to initially install pipe shorts instead of the PRV and flow meter. This will allow relatively easy installation of a PRV and flow meter, if required. It is also required to insert a new valve into the existing DN410 (see Figure 4-2) to isolate the trunk main from Bracken Ridge in case it has to be shutdown.

- Fire Flow Provision: The reticulation has been sized on the basis of providing minimum flows of 45 L/s. However it is suggested the ULDA engage with the fire authority to ascertain the overall level of fire protection required.
- Water main sizing: Opportunities were identified to downsize some of the proposed main sizes from DN150 to DN100 whilst meeting the Peak Hour and Fire Flow requirements. There may be opportunities to downsize the reticulation mains in area G; however it can not be determined until a detailed layout of the development of the surrounding area is known.
- Future busway: It is recommended not to lay any future reticulation mains in the busway as it is not in compliance with the BCC Standards which implies: "water mains shall be located to allow easy access for repairs and maintenance".
- Bulk Fill: It is recommended to lay the proposed water reticulation mains until after the bulk fill within the area is completed, if possible. This is to avoid issues of access the water mains in case of maintenance or repair. With regards to the existing water mains such as the DN410 trunk main between Norris Rd and Dorville Rd, the issue is currently being discussed between the BCC and the

ULDA representatives to ensure the necessary actions will be taken to protect the assets.

- The proposed DN225 (line 1) is upsized to DN250 as DN225 is not a standard size for BCC's new water mains.
- Two connection points between the proposed Line 3 and the existing DN410 were identified to ensure robust supply to the proposed development.
- The proposed main sizes are expressed as Nominal Bore. The material and class of pipe will need to be selected during design to give hydraulic equivalence.

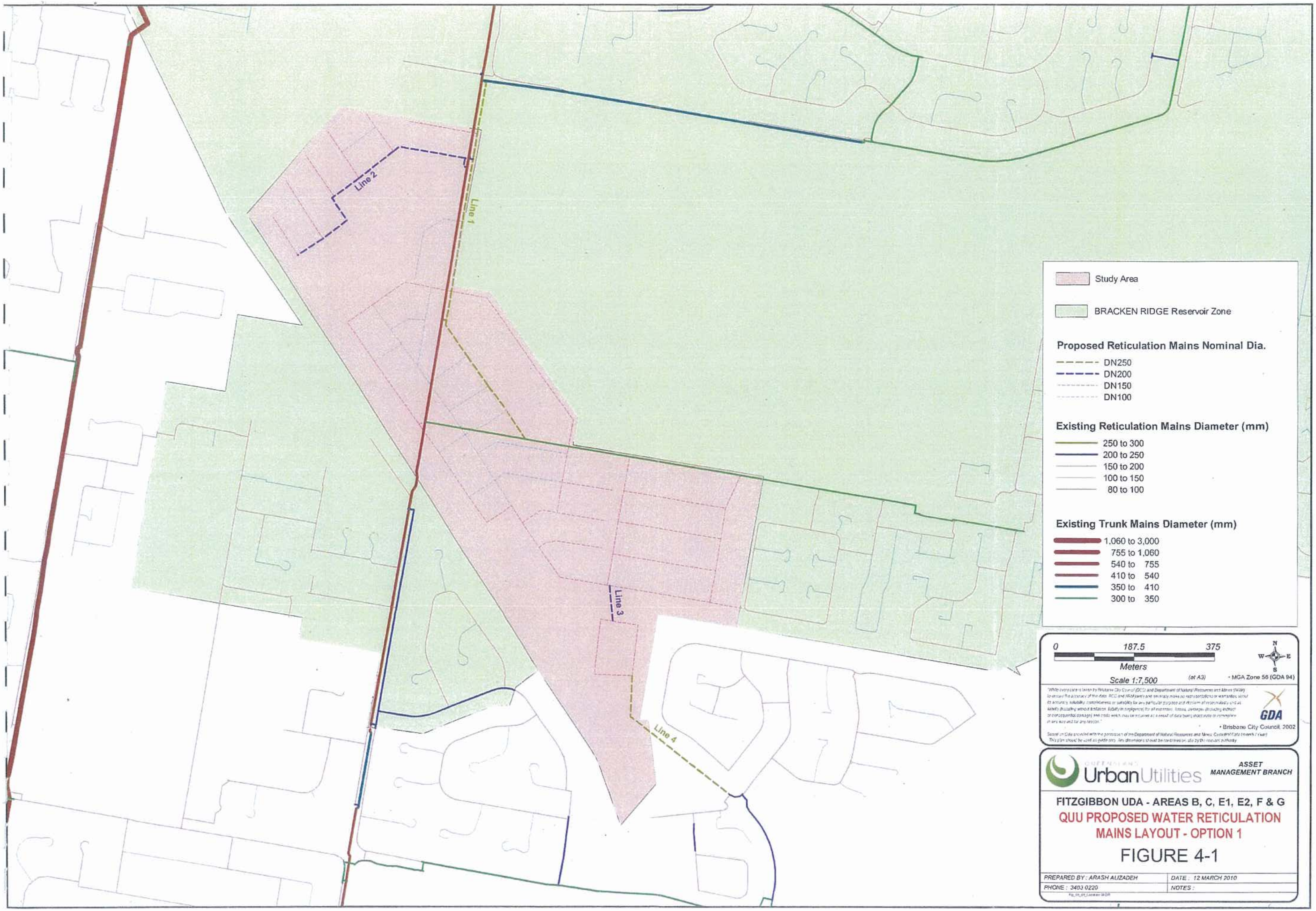
5 CONCLUSION

The proposed two options for water main network are shown in figures 4-1 and 4-2 for Areas B, C, E1, E2, F and G of the Fitzgibbon UDA.

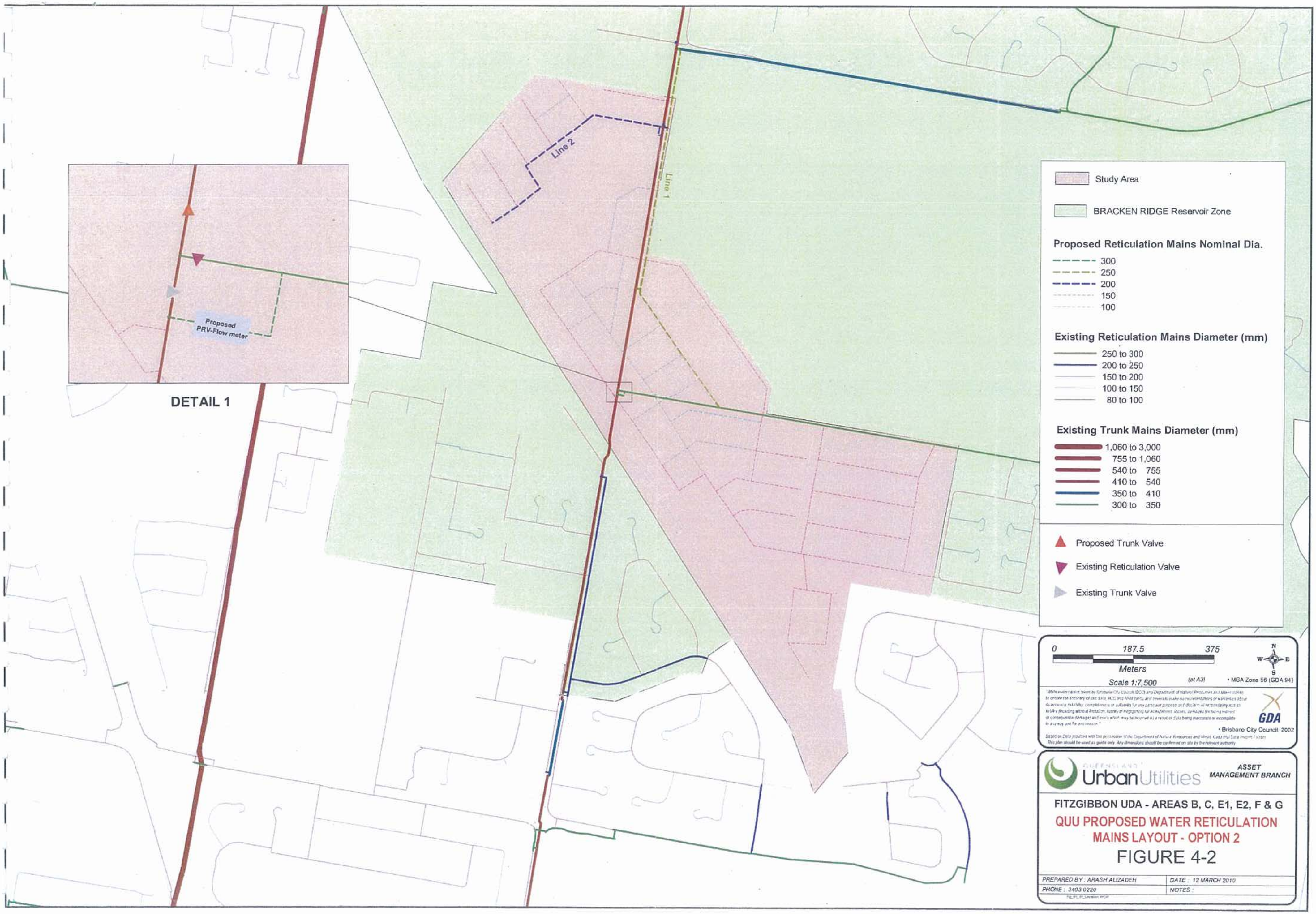
References

Queensland Urban Utilities. Bracken Ridge WSA Master Planning Report, July 2009.

Urban Land Development Authority. Fitzgibbon Urban Development Area Development Scheme. July 2009.


Line 1
Line 2
Line 3
Line 4
Study Area
BRACKEN RIDGE Reservoir Zone
Proposed Reticulation Mains Nominal Dia.
DN250
DN200
DN150
DN100
Existing Reticulation Mains Diameter (mm)
250 to 300
200 to 250
150 to 200
100 to 150
80 to 100
Existing Trunk Mains Diameter (mm)
1,060 to 3,000
755 to 1,060
540 to 755
410 to 540
350 to 410
300 to 350
0
187.5
375
Meters
Scale 1:7,500
(at A3)
• MGA Zone 56 (GDA 94)
N
W
E
S
GDA
• Brisbane City Council, 2002
Urban Utilities
ASSET MANAGEMENT BRANCH
FITZGIBBON UDA - AREAS B, C, E1, E2, F & G
QUU PROPOSED WATER RETICULATION MAINS LAYOUT - OPTION 1
FIGURE 4-1
PREPARED BY : ARASH ALIZADEH
PHONE : 3403 0220
DATE : 12 MARCH 2010
NOTES :

16



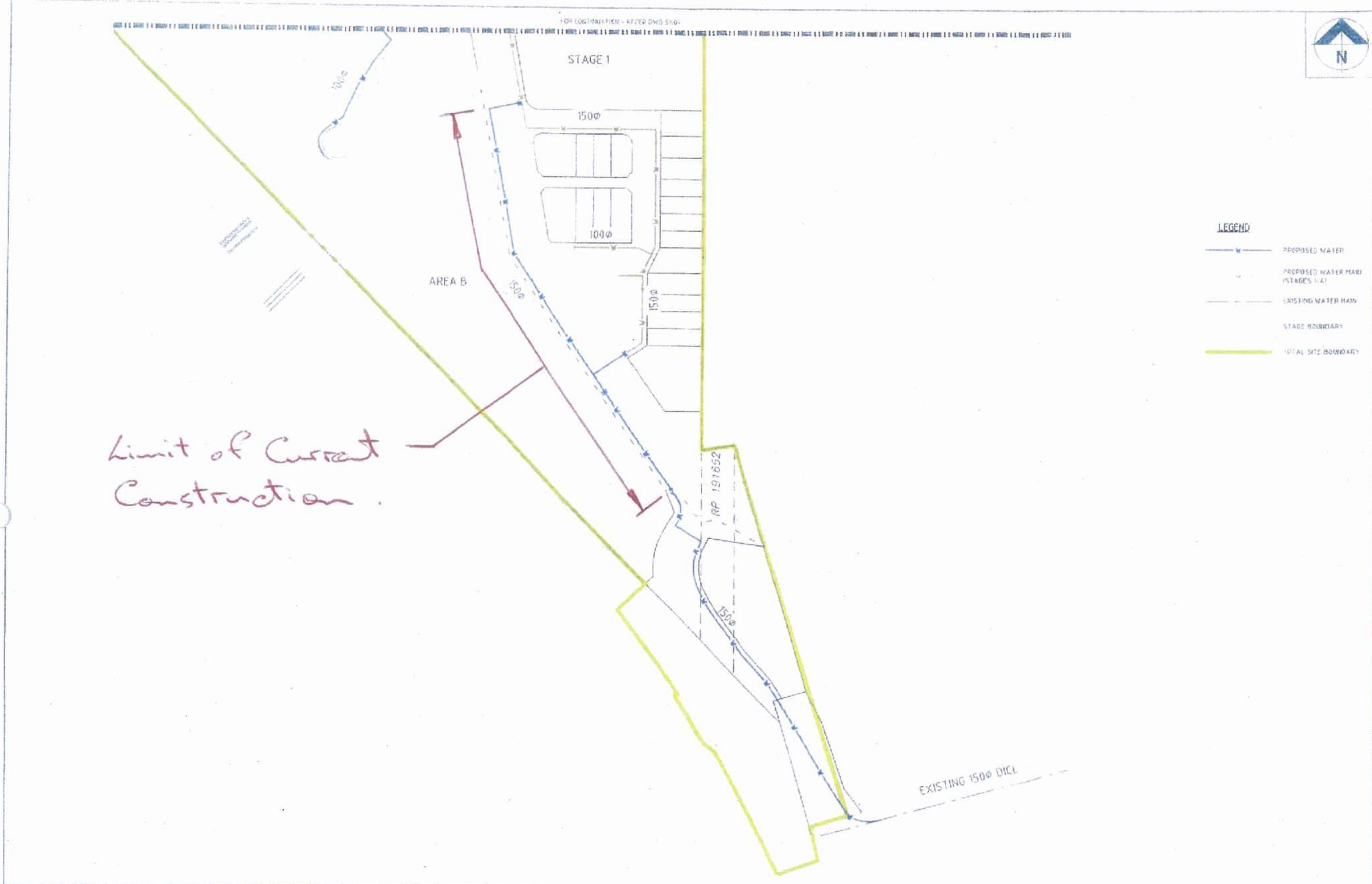
QUEENSLAND Urban Utilities ASSET MANAGEMENT BRANCH

FITZGIBBON UDA - AREAS B, C, E1, E2, F & G

QUU PROPOSED WATER RETICULATION MAINS LAYOUT - OPTION 2

FIGURE 4-2

PREPARED BY : ARASH ALIZADEH	DATE : 12 MARCH 2010
PHONE : 3403 0220	NOTES :



URBAN LAND DEVELOPMENT AUTHORITY
FITZGIBBON CHASE
153 TELEGRAPH ROAD, FITZGIBBON
WATER RETICULATION LAYOUT PLAN - SHEET 1 OF 5

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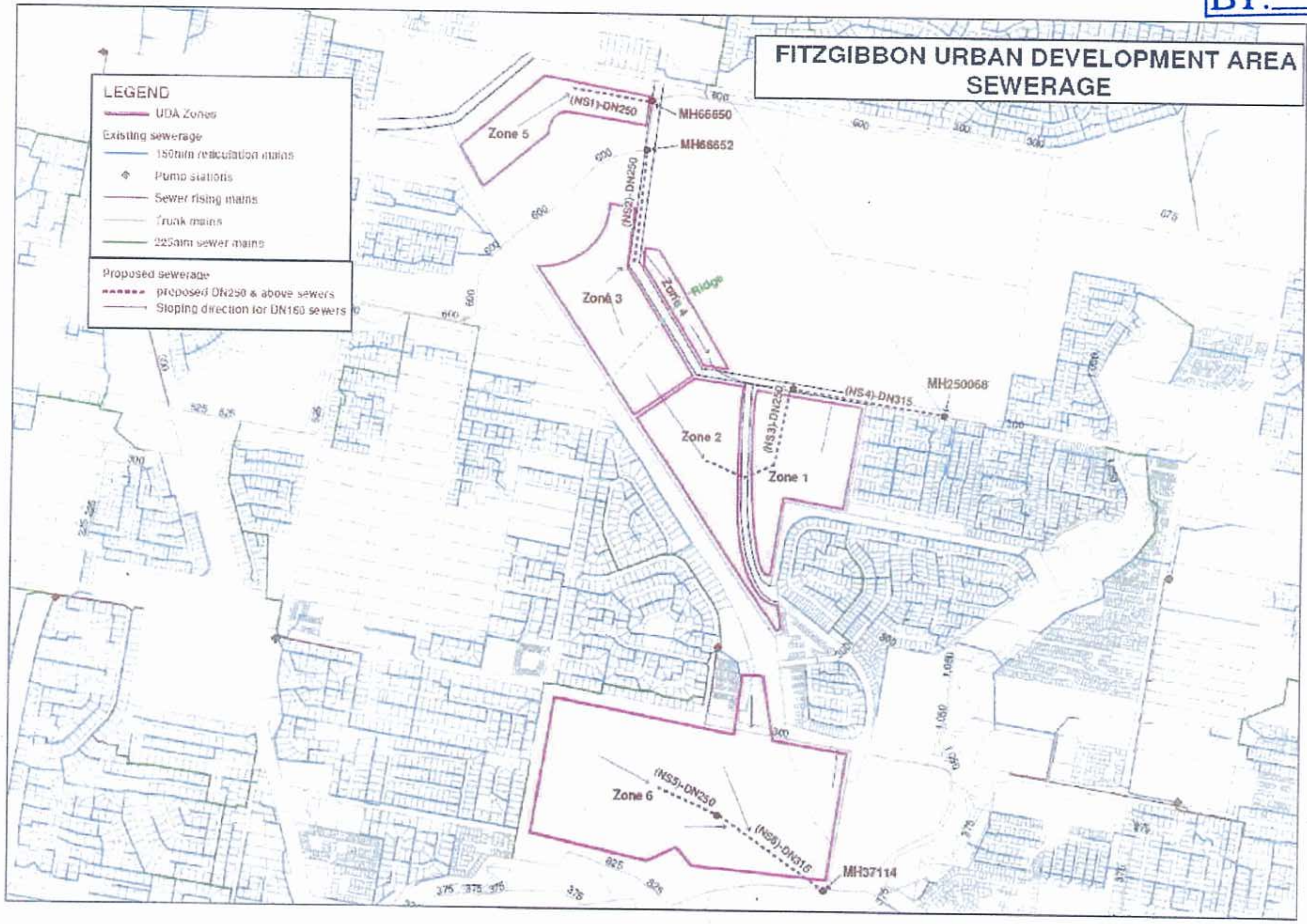
18

Figure 5- Sewer layout plan proposed in January 2009.



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Proposed Fitzgibbon Chase – *"Areas B, C, E and G"*
253 Telegraph Road, Fitzgibbon

PRELIMINARY ENVIRONMENTAL NOISE IMPACT ASSESSMENT

Prepared for:

Fitzgibbon Chase

Date Prepared:

6th November, 2009

Ttmref: 25850 R07 Fitzgibbon Chase Areas B, C, E & G RAIL.doc

TABLE OF CONTENTS

Table Index

Figure Index

1. INTRODUCTION

The following report is in response to a request by Fitzgibbon Chase to conduct a preliminary noise assessment of Areas B, C, E and G of the proposed Fitzgibbon Chase development located at 253 Telegraph Road, Fitzgibbon. This report considers rail traffic and busway noise and provides preliminary advice for consideration by the ULDA.

In undertaking this assessment attended train and bus passby measurements were conducted, and through modelling, predictions of future noise impacts were produced. Based upon the predicted noise levels, recommendations regarding acoustic treatments were specified.

2. SITE DESCRIPTION

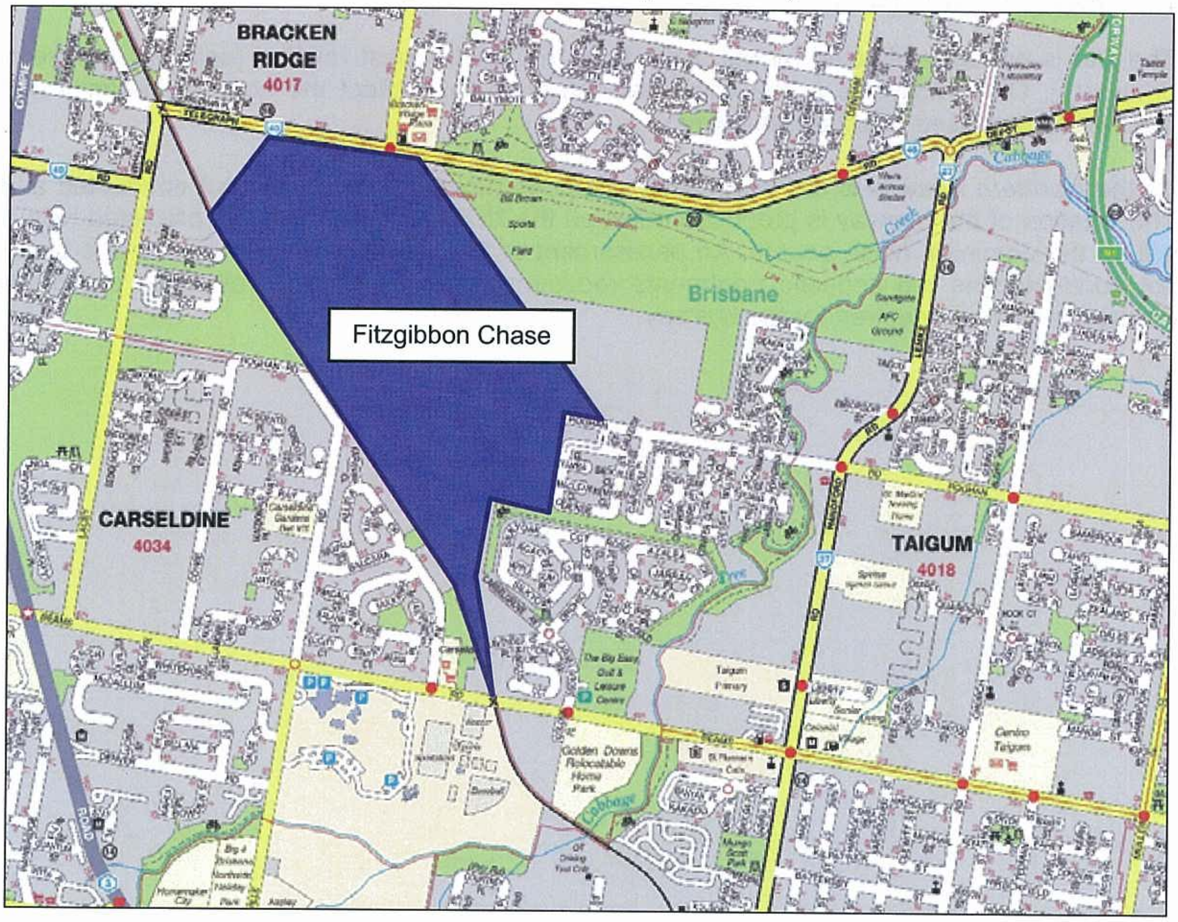
2.1 Site Location

The site is described by the following:

> *Lots 10 and 11 on SP223412,*
> *253 Telegraph Road, Fitzgibbon.*

Refer to Figure 1 for the site location.

Figure 1. Site Location (Not to Scale).



A comprehensive site survey was conducted on the 14th of August, 2009. The survey identified the following:

- The *"North Coast Rail Line"* (NCRL) is located adjacent the western boundary separating the development from park land and a mixture of single and two storey residential dwellings.
- Currently, vacant land is located adjacent the northern boundary separating the site from Telegraph Road and a mixture of single and two storey residential dwellings. Note the vacant land forms part of the *"Fitzgibbon UDA"*.
- A mixture of single and two storey residential dwellings are located east of the development.
- The *"Northern Busway"* is proposed to be located on the western boundary separating the site from the NCRL.
- Carseldine train station and a mixture of single and two storey residential dwellings are located south separating the development from Beams Road, an autoparts recycling yard and *"QUT Carseldine"*.

2.2 Proposal

Fitzgibbon Chase shall be developed in several stages. This report will focus on Areas B, C, E and G comprising a mixture of residential, retail and commercial land uses.

The proposed subdivision layouts for areas B, C and G are not available. However, refer to **Appendix A** for the proposed subdivision layout of Area E.

2.3 Acoustic Environment

The site is primarily affected by rail noise from the North Coast rail line (adjacent the western site boundary). Other activities in the area that can potentially affect the acoustic amenity of the site include the proposed *"Northern Busway"*.

As the *Northern Busway* is still in planning, attended measurements were not conducted at the site. The location of the busway is proposed between the NCRL and the site, it is predicted railway noise will be the dominant noise source. An assessment of the activities associated with the busway was not conducted as the acoustic treatments recommended to attenuate rail noise are predicted to exceed treatments required for the busway.

3. EQUIPMENT

The following equipment was used to record train passby noise levels at the site:

- RION NA-28 Sound Level Meter (SN# 01060055), and
- RION NA-74 Sound Calibrator (SN # 35073393).

The RION NA-28 sound level meter holds a current NATA Laboratory Certification, and was field calibrated before and after the monitoring session. No significant drift from the reference signal was recorded.

4. METHODOLOGY

4.1 Attended Train Noise Measurement Procedure

Attended noise measurements of train passes were conducted on the 14th and 17th of August, 2009. The RION NA-28 Sound Level Meter was positioned at two different locations as follows:

- Approximately 20metres from the nearest rail line with the microphone positioned 1.6metres above ground level (the microphone was approximately level with the rail tracks); and
- Approximately 11metres from the nearest rail line with the microphone positioned 2.2metres above ground level (the microphone was elevated approximately 0.3metres above the rail tracks).

Noise measurements were conducted as follows:

- "A" weighting;
- "Fast" response; and
- 5 minute statistical interval
- Statistics recorded: L_{Amax}, SEL\\L_{AE}, L_{AEQ}

Note: the SEL or L_{AE} is the sound exposure level. A parameter closely related to L_{Aeq} for assessment of train events that have similar characteristics but are of different duration. The L_{AE} value contains the same amount of acoustic energy over a 'normalised' one second period as the actual noise event under consideration.

Based on the measured L_{AE} level, calculations are conducted utilising the number of trains per day to determine the $L_{Aeq,24hr}$ noise impact at the proposed residential receivers.

The measurements were conducted generally in accordance with Australian Standard AS 2377:2002 *'Acoustics – Methods for the Measurement of Railbound Vehicle Noise'*.

Refer to Figure 2 for the noise monitoring locations.

Figure 2. Rail Noise Monitoring Location.

Weather conditions on the 14th and 17th of August were generally fine, slightly overcast with light winds.

5. ENVIRONMENTAL NOISE CRITERIA

The noise criteria applied to the site is generally in accordance with the *'Fitzgibbon Urban Development Area Development Scheme'* (July, 2009), where noise sensitive uses must comply with "best practice acoustic standards" and specifically the following:

- **Road Traffic Noise** for residential dwellings located adjacent roadways:
  - A maximum internal noise level of $L_{Aeq,\ 1hour}$ 35dB(A) between 10pm and 7am.
- **Rail Traffic Noise** for residential dwellings located within 100metres of a rail corridor (refer to **Appendix A** showing 100m separation line):
  - A maximum internal noise level of L_{Amax} 50dB(A) between 10pm and 7am.

In relation to rail noise, consideration should be placed on achieving a reasonable level at the outdoor recreation areas. To ensure best practice acoustic standards are achieved, it is recommended applying Queensland Transport's rail noise criteria as a guide presented in Section 5.1.

5.1 Rail Noise Criteria – Queensland Transport

The criteria typically applied by Queensland Transport to residential developments is detailed as follows:

- External design levels of $L_{Aeq,24hr}$ 65dB(A), assessed at outdoor recreation areas.
- L_{Amax} 87dB(A), assessed at outdoor recreation areas.
- Indoor design level for bedrooms and living areas of L_{Amax} 50dB(A) average maximum sound level between 10pm and 6am.

It is noted that the indoor design level is set out in Queensland Transport's 'Interest in Planning Schemes No.3'; and the external design levels are set out in the Environmental Protection (Noise) Policy 1997.

From time to time, passing trains will blow a horn to warn people of its presence. It should be noted however that Queensland Rails' "Code of Practice, Railway Noise Management" (December 1999), states the following in relation to noise impacts from horns and other safety devices:

8. "HORNS AND OTHER WARNING DEVICES"

Horns and sirens are used within QR as warning devices to protect the safety of both employees and the public. Unfortunately, noise from these devices may cause annoyance to some residents from time to time.

In general, public and employee safety must be satisfactorily protected and hence it is not appropriate to apply any particular noise criteria to these warning devices (including the QR nominated interim levels and the EPP Noise planning levels). Where specific complaints are received, however, responsible Managers will consider whether there is sufficient justification to change standing orders on the use of horns or to nominate alternative warning devices.

In considering what constitutes "sufficient justification", responsible Managers will have regard to any relevant QR Safety Management Systems.

QR shall ensure driver training will include appropriate use of horns and warning devices.

6. RESULTS AND ANALYSIS

6.1 Rail Noise – Queensland Transport

6.1.1 Measured Noise Levels

Measurements of 14 trains passing the site were recorded on the 14th and 17th of August, 2009, and are presented in Table 1.

Table 1: Measured Noise Levels from Passing Trains.

Date/Time	Train Type	Direction of Travel	Separation Distance (m)	Maximum Noise Level L_{AMAX} dB(A)	Instantaneous Noise Level SEL dB(A)	Horn Sounded?
14th August, 2009	Passenger 6	N	30	77	82	Yes
	Passenger 6	S	25	84	87	No
	Passenger 6	S	25	77	82	No
	Passenger 6	N	30	75	81	Yes
	Passenger 6	S	25	82	86	No
	Passenger 6	S	25	88	90	No
	Passenger 6	N	30	75	81	Yes
	Passenger 6	S	25	86	82	Yes
	Passenger 6	N	30	95	90	No
17th August, 2009	Tilt Train 8	N	11	85	91	No
	Passenger 6	S	26	72	79	No
	Passenger 6	S	26	71	78	No
	2 Engine, 43 Cattle Wagons	S	26	91	97	No
	1 Engine 30Freight	S	26	80	88	Yes

An increase in rail traffic does not increase the maximum L_{Amax} noise levels; however it does increase the frequency of such occurrences and will increase the $L_{Aeq,24hour}$ noise level.

It was observed during the attended measurements that during certain train passbys the horn was utilised. Note as in accordance with the assessment requirements of Queensland Transport, all measurements containing horn noise were excluded from the analysis.

6.1.2 Rail Volumes

Rail timetables provided by Queensland Rail indicate there is an average of 150 trains (135 passenger and 15 freight) passing the site every day. We were advised by QR that all services are subject to alteration, addition and cancellation which may vary the number of actual trains passing on a daily basis.

During a phone conversation with QR, TTM Consulting was advised that due to confidentiality QR was unable to provide details of any future plans to duplicate the rail lines or of the ultimate rail traffic volumes.

6.1.3 Predicted Noise Levels

The predicted maximum noise levels presented in Figures 3 – 8 are based on the following assumptions:

- In relation to the proposed lots natural surface levels were adopted as building pad levels were not provided at the time of the assessment (presented in **Appendix A** in "m AHD").
- The façade correction factor was not included in the modelling.
- 150 trains traverse the rail lines every day.
- The relative height above natural surface level for the ground floor is 1.8metres.
- The relative height of residential floors is 2.8metres.
- A 2.4metre high acoustic barrier along the full length of the western site boundary (adjacent the busway) as detailed in **Appendix C**.

Figures 3 – 8 present the modelled L_{Amax} levels of rail noise impacts at the site and assumes the construction of a 2.4metre high acoustic barrier.

Figure 3. Predicted L_{Amax} Noise Contours – Ground Floor (Not to Scale).

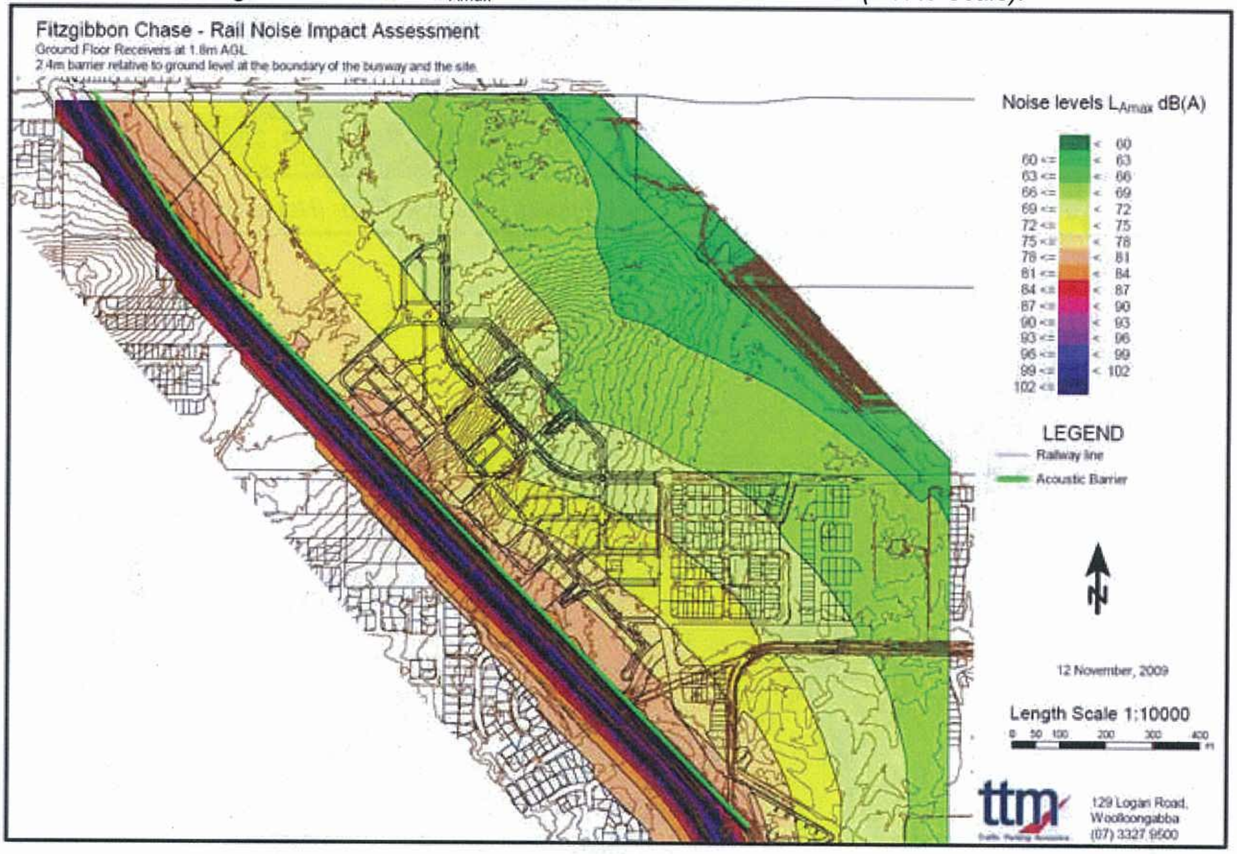


Figure 4. Predicted L_{Amax} Noise Contours – First Floor (Not to Scale).

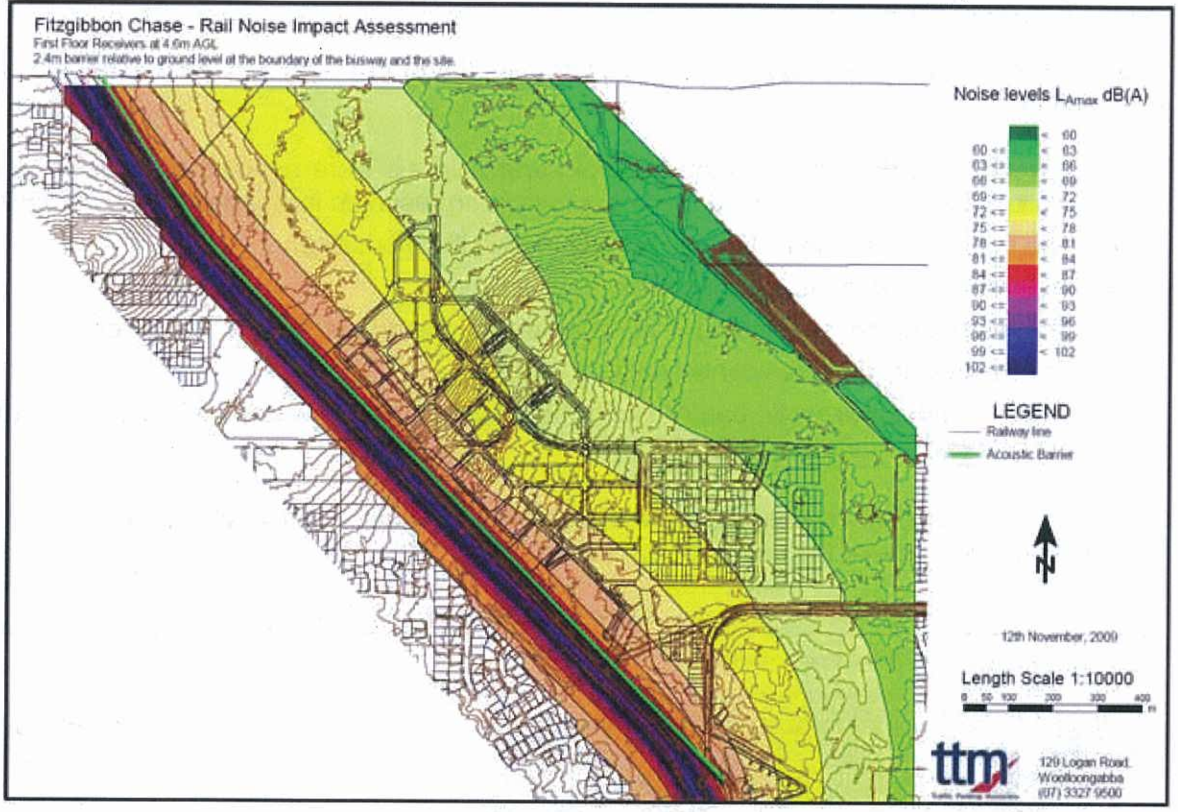


Figure 5. Predicted L_{Amax} Noise Contours – Second Floor (Not to Scale).

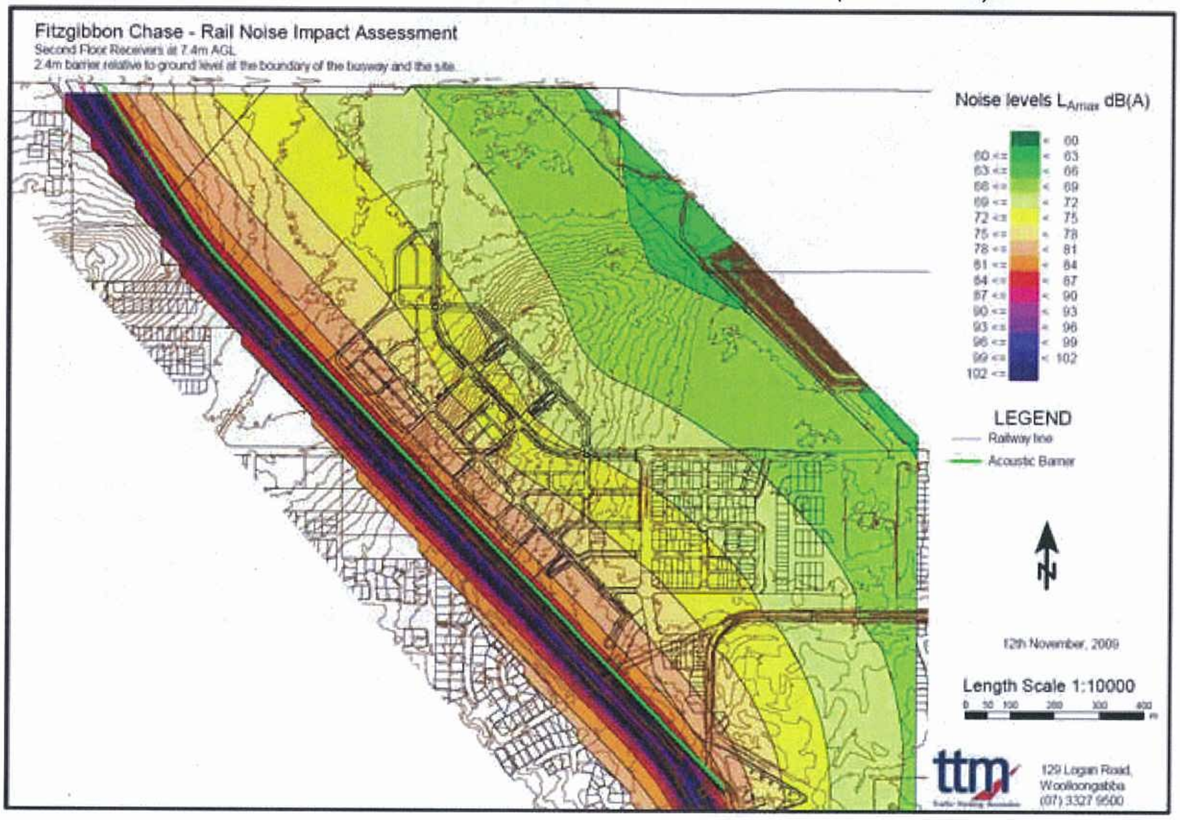


Figure 6. Predicted L_{Amax} Noise Contours – Third Floor (Not to Scale).

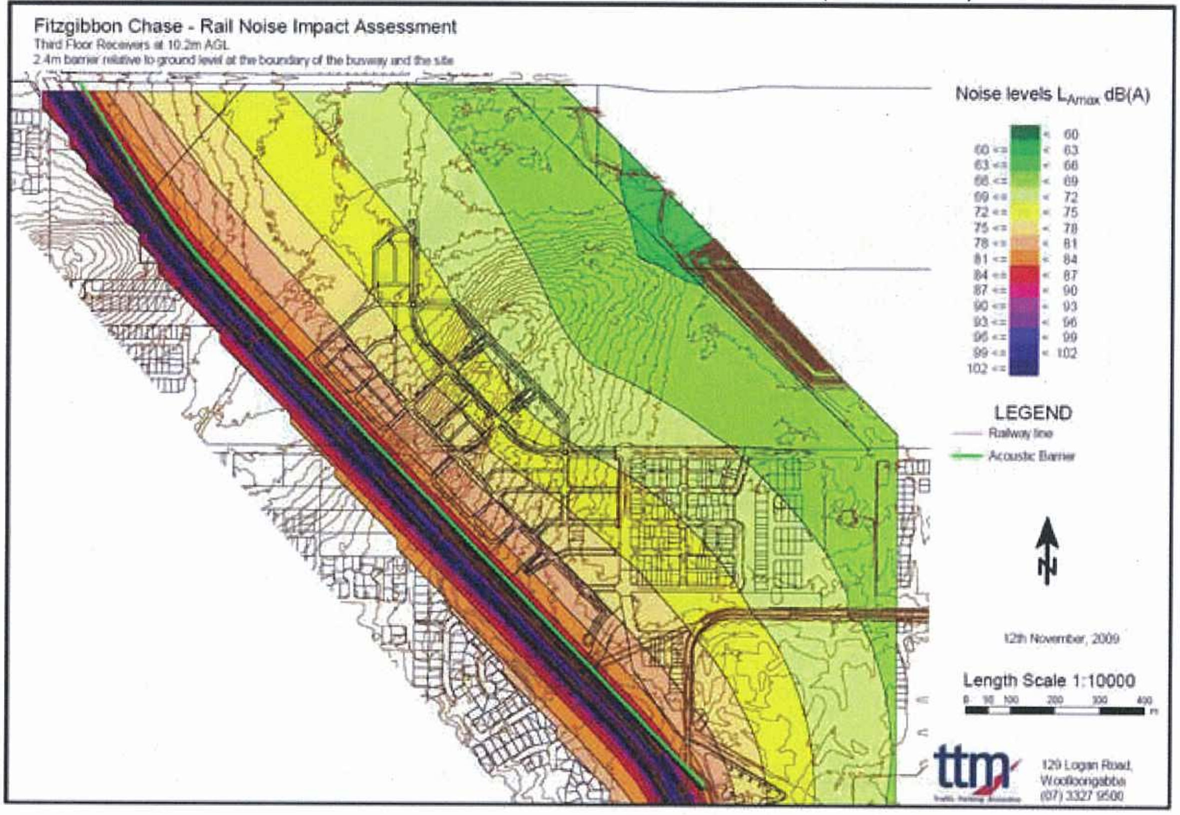


Figure 7. Predicted L_{Amax} Noise Contours – Fourth Floor (Not to Scale).

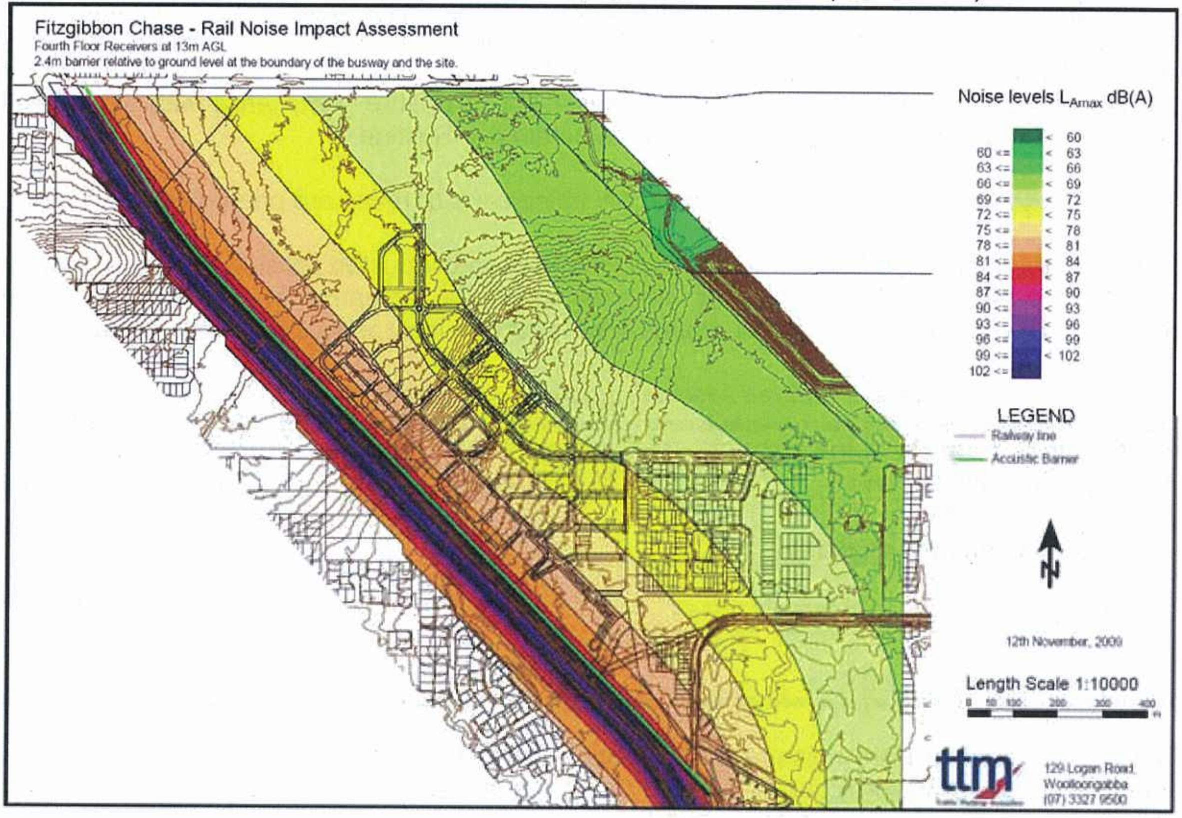
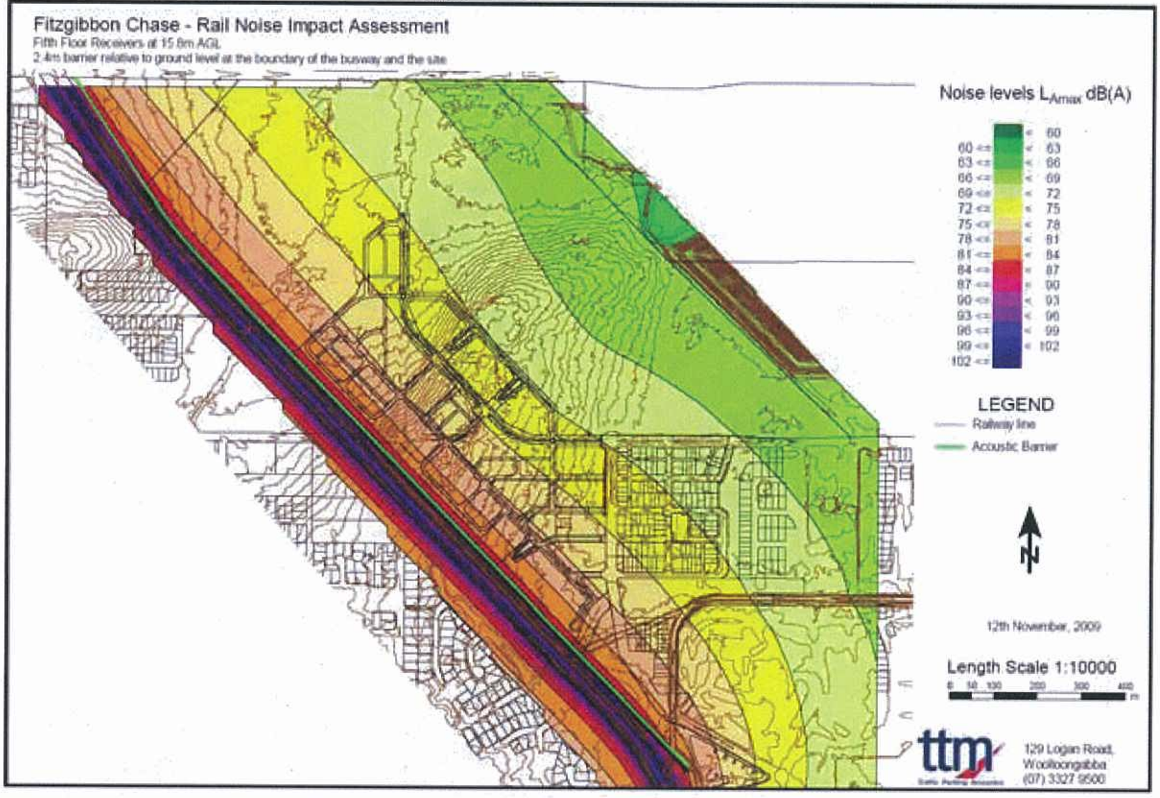


Figure 8. Predicted L_{Amax} Noise Contours – Fifth Floor (Not to Scale).



Based upon the modelled noise levels, the upper floor levels of lots 1001, 1003 and 1004 within Area E are predicted to exceed the external criteria of L_{Amax} 87dB(A) (outdoor recreation areas) and require further acoustic assessment as detailed in Section 7. Lots 179 – 198, 229 – 259, 1001, 1003 and 1004 (within Area E) and all proposed lots within areas B, C and G located within 100metres of the rail corridor and shall require further assessment to ensure compliance with the internal noise criteria on the ground and upper floor levels as detailed in Section 7.

To assist with the review process, SoundPLAN noise contour maps are presented in **Appendix B**.

Based on the measured SEL/L_{AE} level, calculations were conducted utilising the number of trains per day to determine the $L_{Aeq,24hour}$ noise impacts at private recreation areas. Table 2 presents the predicted average noise level at the ground floor level with increasing separation distance.

Table 2: Predicted Average$L_{Aeq,24hour}$ Noise Levels from Passing Trains.

Distance from Rail Line (m) (Relative Location)	**Average Noise Level dB(A) $L_{Aeq,24hr}$ (Free field)**	**Criteria dB(A) $L_{Aeq,24hour}$**	**Complies Yes/No**
25 (Measurement Location)	65		Yes
30 (Lots 1001, 1003 and 1004)	63	65	Yes
67 (Lots 236 – 249)	58		Yes

Based upon the modelled noise levels, all private recreation areas are predicted to comply with the criteria of $L_{Aeq,24hour}$ 65dB(A) due to increased separation distance from the rail line.

7. RECOMMENDATIONS AND DISCUSSION

Compliance is predicted with the ULDA assessment criteria on the condition the following treatments are implemented:

Area E:

- Construction of a 2.4metre high acoustic barrier along the site boundary as detailed in **Appendix C**.
    - Care should be taken to ensure the barriers are free of gaps or holes.
    - The acoustic barriers shall be constructed to the designated height above natural ground level at the eastern site boundary.
    - The recommended barriers may be constructed using one of the following materials (but not limited to) 19mm thick timber palings fence with 40% overlap, 9mm fibre cement or masonry.
    - Note the modelling has assumed the barrier is constructed the full length of the western boundary.
- Communal recreation areas located on lots 1001, 1003 and 1004 are predicted to exceed the criteria and require further acoustic assessment once their locations are finalised.
    - As a guide we recommend communal recreation areas are located at ground level on the eastern side of any building to maximise screening from the rail line.
- To ensure compliance with the internal criteria of L_{Amax} 50dB(A) lots 179 – 198, 229 – 259, 1001, 1003 and 1004 (located within 100metres of rail corridor) will require further acoustic assessment once detailed floor plans and elevations are available. Refer to **Appendix A** showing 100m separation line.

Building treatments shall be determined by using the calculation methods detailed in Australian Standard *AS3671:1989 'Road Traffic Noise Intrusion – Building Siting and Construction'*; to ensure compliance with the ULDA and Queensland Transport's internal noise criteria of L_{Amax} 50dB(A), once building floor plans and elevations are finalised.

Areas B, C and G:

A preliminary assessment of the acoustic treatments required for Areas B, C and G was conducted. Compliance with the ULDA assessment criteria is predicted provided the following recommendations are implemented:

- Construction of a 2.4metre high acoustic barrier along the site boundary as detailed in **Appendix C**.
    - Care should be taken to ensure the barriers are free of gaps or holes.
    - The acoustic barriers shall be constructed to the designated height above natural ground level at the eastern site boundary.
    - The recommended barriers may be constructed using one of the following materials (but not limited to) 19mm thick timber palings fence with 40% overlap, 9mm fibre cement or masonry.
    - Note the modelling has assumed the barrier is constructed the full length of the western boundary.
- All lots located within 100metres of the rail corridor require further acoustic assessment once building floor plans and elevations are finalised.

8. CONCLUSIONS

A preliminary environmental noise impact assessment was conducted of Areas B, C, E and G of the proposed Fitzgibbon Chase Development located at 253 Telegraph Road, Fitzgibbon. On the condition the recommendations presented in Section 7 are implemented, the development can be designed to comply with the relevant ULDA and Queensland Transport assessment criteria.

If you should have any further questions, please do not hesitate to contact us.

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Acoustic Consultant

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Associate Director

9. APPENDICES

APPENDIX A

Proposed Subdivision Layout