69 Woodhill Avenue
Overland Flow Assessment

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ETS

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Final

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1. Introduction

O2 Environment + Engineering were commissioned by ETS to prepare an Overland Flow Assessment in response to the Brisbane City Council (BCC) Information Request (IR) issued on the 17 October 2014. The IR has been issued in response to the Reconfiguration of a Lot and Material Change of Use Preliminary Approval (Application reference A003954604).

1.1. Site Locality

The 607m² site is situated at 69 Woodhill Avenue, Coorparoo and is properly described as Lot 2 on RP40615. The site is bounded by Woodhill Avenue to the north, Derby Street to the south and existing residential dwellings to the east and west. The site locality is included as **Figure 1**.

Figure 1 – Site Locality (Source: Nearmap)

1.2. Objective

The principal objective of this study is to demonstrate the proposed development will not increase the flood levels on neighbouring properties and that the proposed dwellings provide immunity to the 2% AEP event (50 year ARI event). The findings of this assessment are based on data obtained from a number of sources, as summarised in the following sections.

Detailed 2D modelling has been undertaken to confirm the above objectives.

2. Site Characteristics

2.1. Location

2.2. Flood Data

Results of the current flood modelling undertaken by the Brisbane City Council (Brisbane City Council Floodwise Property Report (BCC 2014a)) indicates that a portion of the subject site is situated within an overland flow. The Brisbane City Council flood awareness map (BBC 2014b) shows the indicative overland flow path, as contained in **Figure 2**.

Figure 2 - Flood Awareness Map for Woodhill Avenue (Source: BCC http://floodinformation.brisbane.qld.gov.au/fio/)

2.3. Topography and Existing Land Use

The site currently contains a timber dwelling and falls from north-western corner to the south-eastern corner at a grade of approximately 6%. The highest point on the site is located in the north-western corner at RL 11.94m AHD while the lowest point is located in the south-eastern corner at RL 9.03m AHD.

2.4. Drainage

Stormwater originating within the site will discharge to the kerb and channel in Derby Street. The nearest stormwater infrastructure is an existing gully pit, located approximately 5m east of the site boundary. This gully pit is connected to twin 1125mmx1800mm box culverts.

Please refer to **Appendix A** for details in relation to the existing stormwater network, sourced from Brisbane City Council eBimaps (BCC 2014c).

2.5. Development Layout

The proposed development consists of a 1 into 3 lot subdivision and 3 new small lot dwelling houses, with the existing house to remain on the northern lot fronting Woodhill Avenue and the proposed construction of two townhouses that will front Derby Street.

Please refer to **Appendix B** for Proposed Development Layout.

3. Hydrology

3.1. Methodology

The XP-SWMM runoff-routing model been has used to estimate design flood discharges within the study area. The model represents the sub-catchments as a network of nodes linked to either the 1D pipe drainage network of the 2D DTM geometric base. Each node is defined by its pervious (undeveloped) and impervious (developed), fraction impervious and average catchment slope. The net rainfall is routed through the network after appropriate losses (initial and continuing) and roughness factors are applied, resulting in a surface runoff hydrograph for each sub-catchment.

The XP-SWMM model was used to estimate the 2% AEP (50 year ARI) event discharges.

A Rational Method assessment was undertaken and used to compare the pre and post development design discharges for each sub-catchment.

3.2. Hydrologic Model

3.2.1. Configuration

Figure 2 illustrates the extent of the XP-SWMM model. Nine sub catchments were used to represent runoff from the contributing catchments that influence the flooding regime of the site. The sub-catchments have been delineated to accurately represent the inflow locations and their impact on the proposed development layout.

Figure 3 - XP-SWMM Hydrologic Model Extent

3.2.2. Hydrologic Routing

Hydrologic modelling has been undertaken using the Laurenson Runoff Routing Method. The Laurenson method requires the catchment to be divided into a pervious (undeveloped) and an impervious (developed) portion. A fraction impervious of 0% has been applied to the undeveloped portion and 100% to the developed portion.

3.2.3. Manning's Roughness

Manning's roughness (n) values have been applied to represent the undeveloped and developed portions of the catchment. XP-SWMM allows a range to be applied to represent the varied degree of roughness that could be expected within the catchment. The following values have been applied:

- Developed catchment n = 0.014; and
- Undeveloped catchment n = 0.045.

3.2.4. Rainfall Losses

Initial Loss (IL) and Continuing Losses (CL) have been applied to the modelling, and again these values have been varied for the developed (impervious) and developed (pervious) portions of the catchment. The following loss rates have been adopted:

- Developed catchment IL = 1mm CL = 0mm/hr; and
- Undeveloped catchment IL = 15mm CL = 2.5mm/hr.

3.2.5. Existing Conditions Parameters

Table 1 summarises the XP-SWMM parameters adopted for the existing catchment conditions. The catchment slopes were estimated from 1m contours for the external catchments and the Woodhill Avenue catchment. A copy of the catchment plan is included as **Appendix C**.

Table 1 – XP-SWMM Model Parameters, Existing Conditions

Sub-catchment	Area (ha)	Impervious (%)	Slope (%)
Woodhill	37.75	70	2
Ext 1	122.50	60	1
Ext 2	1.13	70	2
Ext 3	0.87	80	2
Ext 4	0.53	70	1
Ext 5	1.06	85	3
Ext 6	4.69	60	2
Ext 7	10.36	70	2
Ext 8	0.57	10	1

3.2.6. Development Conditions Parameters

The increase in fraction impervious as a result of the proposed development is insignificant and does not result in any change to the assumed 70% fraction impervious for the Woodhill Avenue catchment. Therefore, the fraction impervious for the fully developed scenario remains unchanged from that applied to the existing scenario assessment.

3.3. Rational Method Comparison

The Rational Method was used to compare the XP-SWMM estimates of design discharges for the existing and developed conditions at legal points of discharge for each catchment.

Based on QUDM (2013) guidelines, The C10 values for external catchment and Woodhill catchment conditions vary from 0.84 to 0.87 based on the density of residential lots.

Error! Reference source not found. summarises the comparison of Rational Method and XP-SWMM peak discharges for each catchment. Note that the existing storages within the catchment have been ignored for this analysis.

Table 2 - Comparison of Rational Method and XP-SWMM Model Discharges for 2% AEP (50 year ARI) Event

Catchment	Rational Method	XP-SWMM
Woodhill	17.49	20.08
Ext 1	44.16	55.26
Ext 2	0.62	0.68
Ext 3	0.51	0.56
Ext 4	0.26	0.31
Ext 5	0.68	0.73
Ext 6	2.04	2.40
Ext 7	4.33	5.66
Ext 8	0.20	0.19

4. Overland Flow Assessment

4.1. Objectives

In accordance with Brisbane City Council's City Plan 2014 (BCC, 2014), the objective of this overland flow assessment is to demonstrate the that proposed development will;

- Minimise the risk to people from flood hazard;
- Not reduce the ability of evacuation resources including emergency services to access and evacuate the site in a flood emergency, with consideration to the scale of the development;
- Minimise impacts on property from flooding;
- Minimise disruption to residents, business or site operations and recovery time due to flooding;
- Minimise the need to rebuild structures after a flood event greater than the defined flood event.

XP-SWMM has been used for this analysis. XP-SWMM is an industry standard two-dimensional river analysis model used to estimate flood characteristics such as flood level, velocity and flood depth and the impacts the proposed development has on the surrounding properties.

One scenario has been run through XP-SWMM:

- **Local Overland Flow**: This type of flooding is caused by excess run-off during high rainfall events. The water may rise quickly and move with speed but will recede quickly. When assessing for overland flow, BCC (2014) states that the maximum storm event to consider is the 50-year ARI storm event (2% AEP).

4.2. Model Set Up

4.2.1. General – XP-SWMM

The unsteady state, 2D/1D hydrodynamic model XP-SWMM (incorporating TUFLOW as the model engine) was used to analyse the flood behaviour of the study area. The model output is fully compatible with MapInfo and TUFLOW, and can also be used with waterRIDE.

The XP-SWMM model represents the DTM of the study area as a series of grid points (2D cells). This allows flow in excess of channel capacity or pipe network to break out and continue along the floodplain, as the topography dictates. The hydraulic structures, including culverts, weirs and sub-surface pipe networks have been represented as 1D elements which are dynamically linked to the 2D elements. The XP-SWMM model computes the capacity of the 1D element and once exceeded, the surcharged flow is transferred to the 2D model.

Representation of buildings has been undertaken by making the buildings inactive flow areas. Thus the flood levels on each property have been estimated by calculating the depth outside the building. Flood levels, discharge and velocity can be extracted from the model as functions of time at required locations

The XP-SWMM model was established to estimate the peak water levels and flood depths across the subject site. In reference to **Figure 3**, the following is of note;

- The active area of the model is represented by the red polygon,
- The upstream flow boundaries of the model are represented by the cyan lines:
    - The Woodhill Avenue catchment inflow is located in the overland flow path approximately 100m upstream of the subject site, and

    - The inflow hydrograph for the remainder of the catchment are applied downstream of Leicester Street, in the open space/drainage reserve,
- The downstream boundary of the model is located at the Bowries Flat wetlands, as represented by the green line. The details of the wetland and associated drainage infrastructure have not been included as part of the modelling undertaken for this assessment,
- The digital terrain model was created from a combination of LIDAR data (DNRM 2014) and detailed site survey;
- The following manning's n values have been adopted ;
    - Urban/Grass – 0.035
    - Vegetation - sparse – 0.05
    - Vegetation - medium – 0.058
    - Vegetation - heavy – 0.065
    - Road – 0.015
    - Drainage channel – 0.014, and
- The dwellings have been modelled as inactive areas.

Figure 4 - Model Extent and Boundary Locations

4.3. Existing Scenario Results

The Brisbane City Council flood awareness map, previously provided as **Figure 2**, shows an overland flow path overland passes over the south eastern corner of the subject site. The results of the modelling for the existing scenario show the critical storm duration for the site is associated with the 25 minute storm event. Results of the 2D modelling undertaken provide similar results to the mapping of the BCC, as illustrated in **Figure 5** and **Figure 6** for peak water level and maximum depth respectively.

Figure 5 - Existing Scenario Peak Water Level - 25 Minute 2% AEP Storm Event

Figure 6 – Existing Scenario Maximum Depth - 25 Minute 2% AEP Storm Event

4.4. Developed Scenario Results

4.4.1. Design Considerations

To ensure the filling associated with the proposed dwellings does not adversely impact the neighbouring properties, the floor level for the garage has been lowered to 9.76m AHD. In addition, the driveway is designed a slope of 1:6 from the garage, grading in to intersect with the existing natural surface before grading back to Derby Street. This ensures the overland flowpath is not impeded and allows runoff to continue to flow over the corner of the property in a similar manner to the existing scenario.

4.4.2. Developed Scenario Flood Levels

The results of the modelling for the critical storm duration (again the 25 minute storm event) are provided as **Figure 7** and **Figure 8** for peak water level and maximum depth respectively.

4.5. Flood Impact Assessment

To assess the impact of the proposed dwellings on neighbouring properties, the flood afflux has been determined by subtracting the peak water levels associated with the developed scenario from those of the existing scenario. The results of this afflux assessment are provided as **Figure 9**.

The results of the assessment demonstrate only very minor variations in peak water level for the neighbouring properties, with an increase of 10mm observed in the road reserve and on the footpath at the property immediately downstream of the subject site (i.e. 71 Woodhill Avenue). Affluxes of up to 50mm are generally considered as being acceptable when undertaking 2D modelling due to limitations associated with the modelling process. Therefore, the 10mm afflux observed here is considered to be a non-worsening impact for the proposed development.

Figure 7 - Developed Scenario Peak Water Level - 25 Minute 2% AEP Storm Event

Figure 8 – Developed Scenario Maximum Depth - 25 Minute 2% AEP Storm Event

Figure 9 – Afflux Assessment - 25 Minute 2% AEP Storm Event

5. Finished Floor Levels

Table 9.4.9.3.B—Categories of flood planning levels of the Brisbane City Plan 2014 requires that habitable floors for a Category A dwelling is the 2% AEP event, plus 500mm. Therefore, based on the results of this assessment (refer to peak water levels included as **Figure 7**), the minimum habitable floor level for the proposed dwellings must be 9.55m AHD + 0.5m = **10.05m AHD**.

6. Summary

O2 Environment + Engineering were commissioned by ETS to prepare an Overland Flow Assessment for the proposed Reconfiguration of Lot at 69 Woodhill Avenue, Coorparoo.

This assessment demonstrates the proposed dwellings do not cause adverse flood impacts for neighbouring properties and that the proposed dwellings are capable of achieving flood immunity to the 2% AEP event. The minimum habitable floor level is 10.05m AHD.

To achieve this result, the garage floor level has been lowered to 9.76m AHD and the driveway graded at 1:6 from the garage to meet with the existing surface level. This ensures the overland flowpath can be maintained and results in no actionable damage to the property at 71 Woodhill Avenue.

7. References

BCC (2014) – Brisbane City Plan 2014 - Schedule 6.11 Flood Planning Scheme Policy and Part 8.2.11 Flood Overlay Code

BCC (2014a) - Brisbane City Council Floodwise Property Report extracted August 2014

BCC (2014b) - Brisbane City Council Flood Flag Map, extracted August 2014

BCC (2014c) - Brisbane City Council eBimaps, extracted August 2014

DNRM (2014) – Department of Natural Resources and Mines LIDAR Data, extracted August 2014

QUDM (2013) - Queensland Urban Drainage Manual Third Edition, 2013

XP-SWMM (2014) – XP SOLUTIONS, 2014

8. Appendices

Appendix A Existing Drainage Infrastructure

Date : Aug 19, 2014
User : qutebm0502#885499

Scale = 1:1,000
Metres 20 40

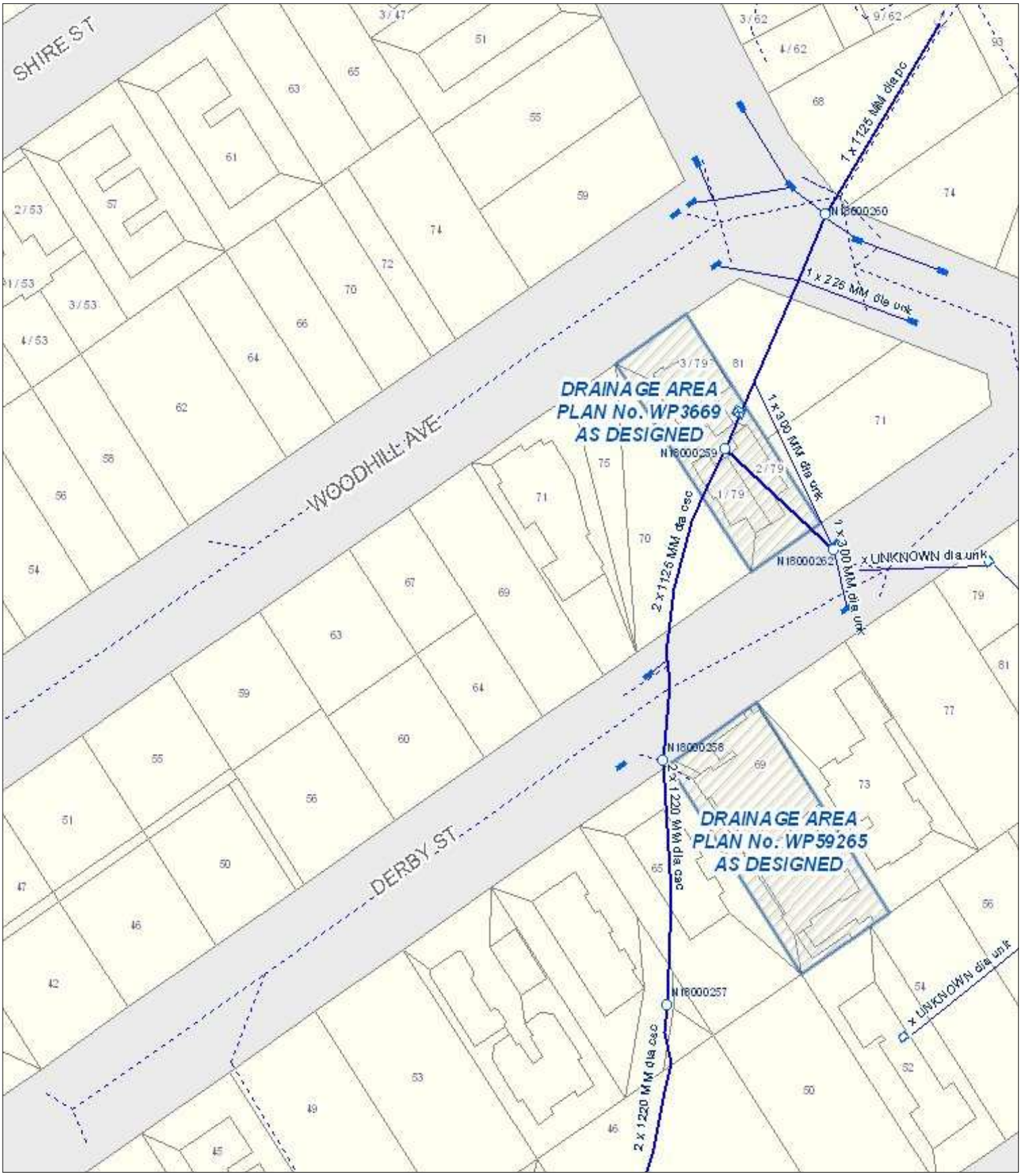
Location :

6,958,725
506,154 N 506,540
6,958,509

Disclaimer :

Caution: This map may contain the locations of abandoned underground asbestos pipes. Council gives no warranty to the completeness or accuracy of these records. Appropriate care needs to be taken in all cases.

BRISBANE CITY GDA Qasco



BCC Stormwater and Cable Networks

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Metres 20 40

Date: Aug 27, 2014

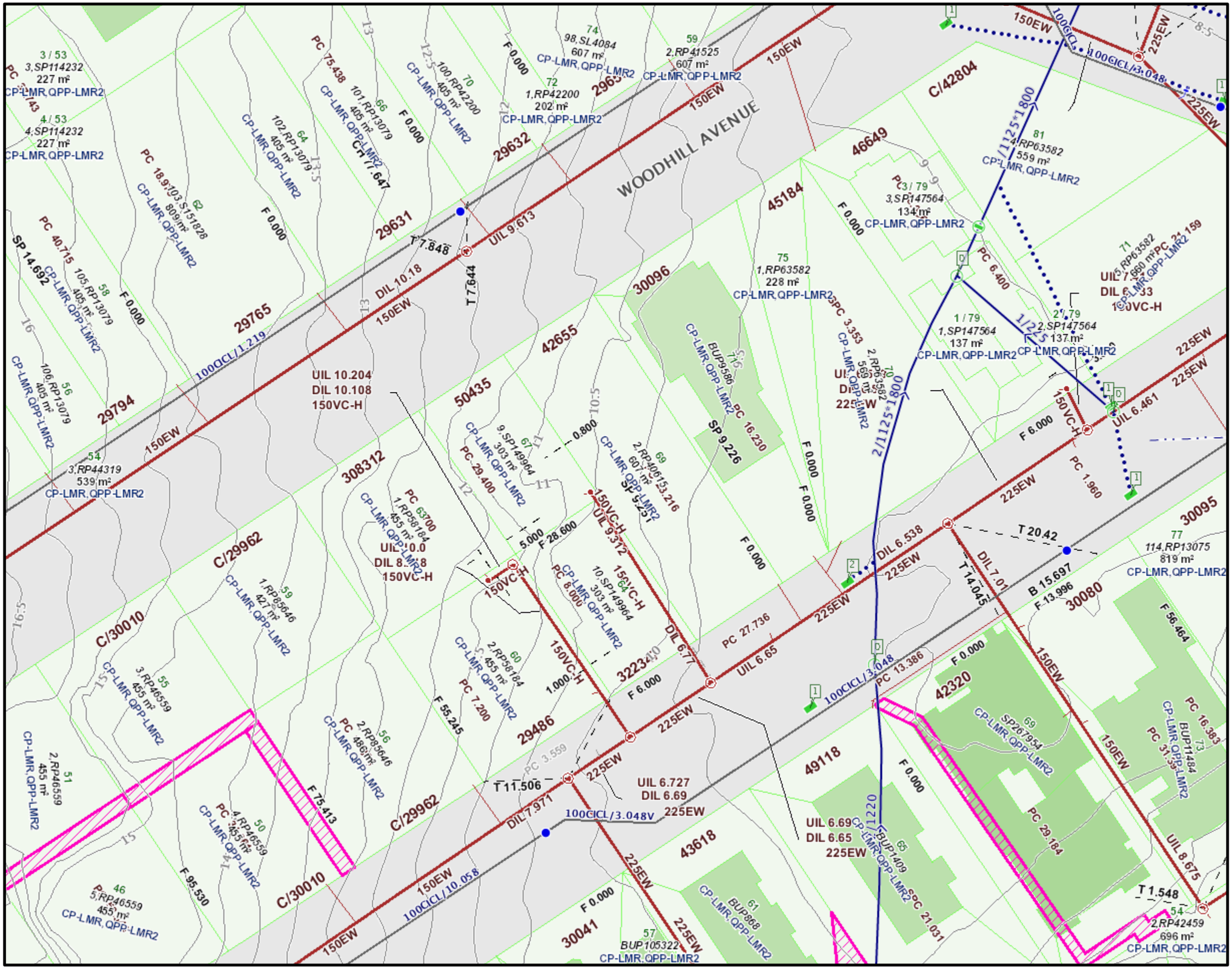
Location:

6958722

506253 N 506443

6958512

Disclaimer:



69 Woodhill Ave

All Services

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6,958,575

Disclaimer :

Date : Aug 19, 2014
User : qutebm0502#885499

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Location :

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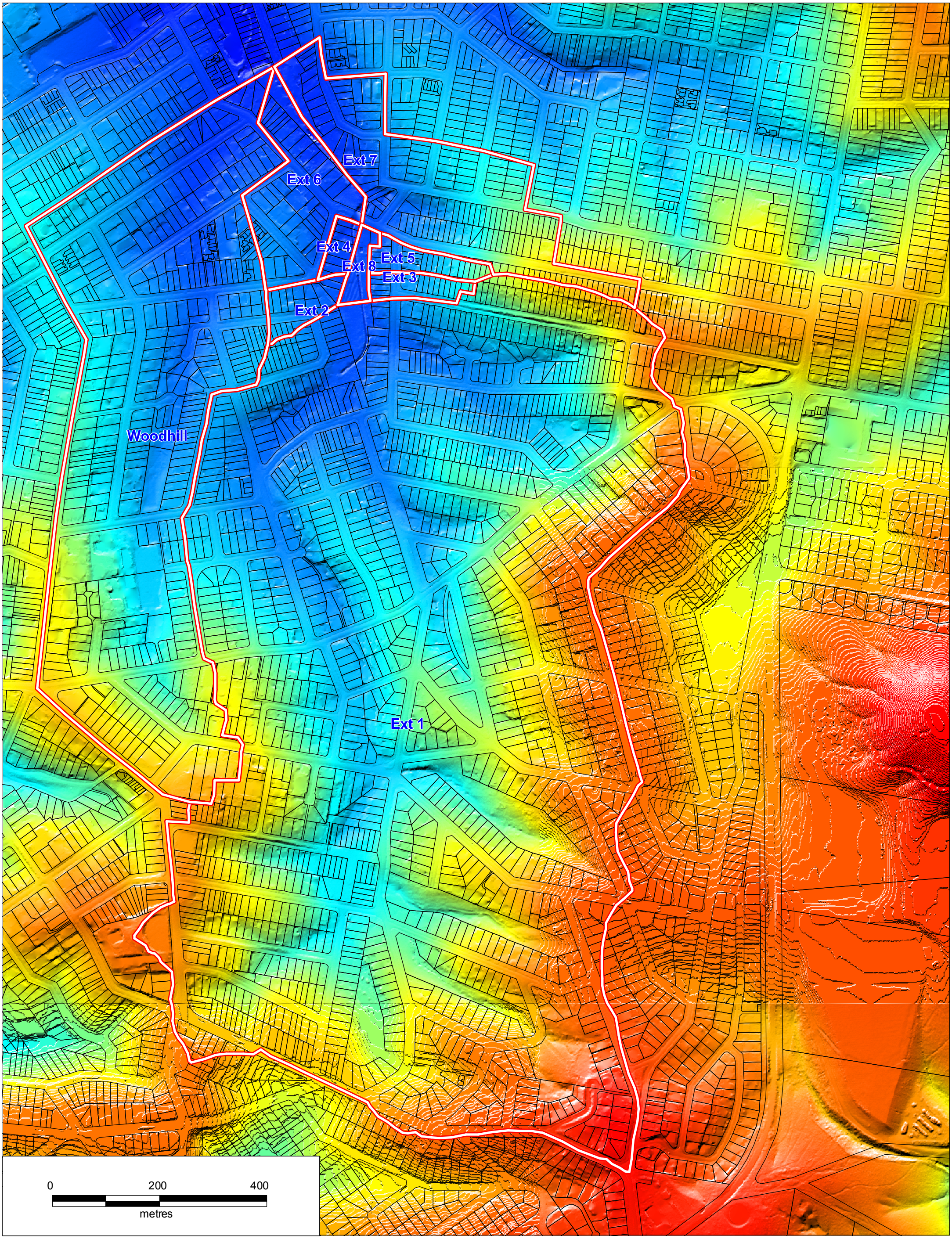
506,250 N 506,444

6,958,563

Disclaimer :

Appendix B Development Layout

Appendix C Catchment Map



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