



Floodline Delineation: The Proposed Housing Development, Farm 1388, Kuils River

**City of Cape Town Municipality, Western Cape
Province, South Africa**

9/26/2025

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Declaration	<p>The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.</p>

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1 Introduction

1.1 Background

The Biodiversity Company was appointed to conduct a Floodline Delineation for proposed housing development, located on Farm 1388, Kuils River, Western Cape Province (Figure 1-1).

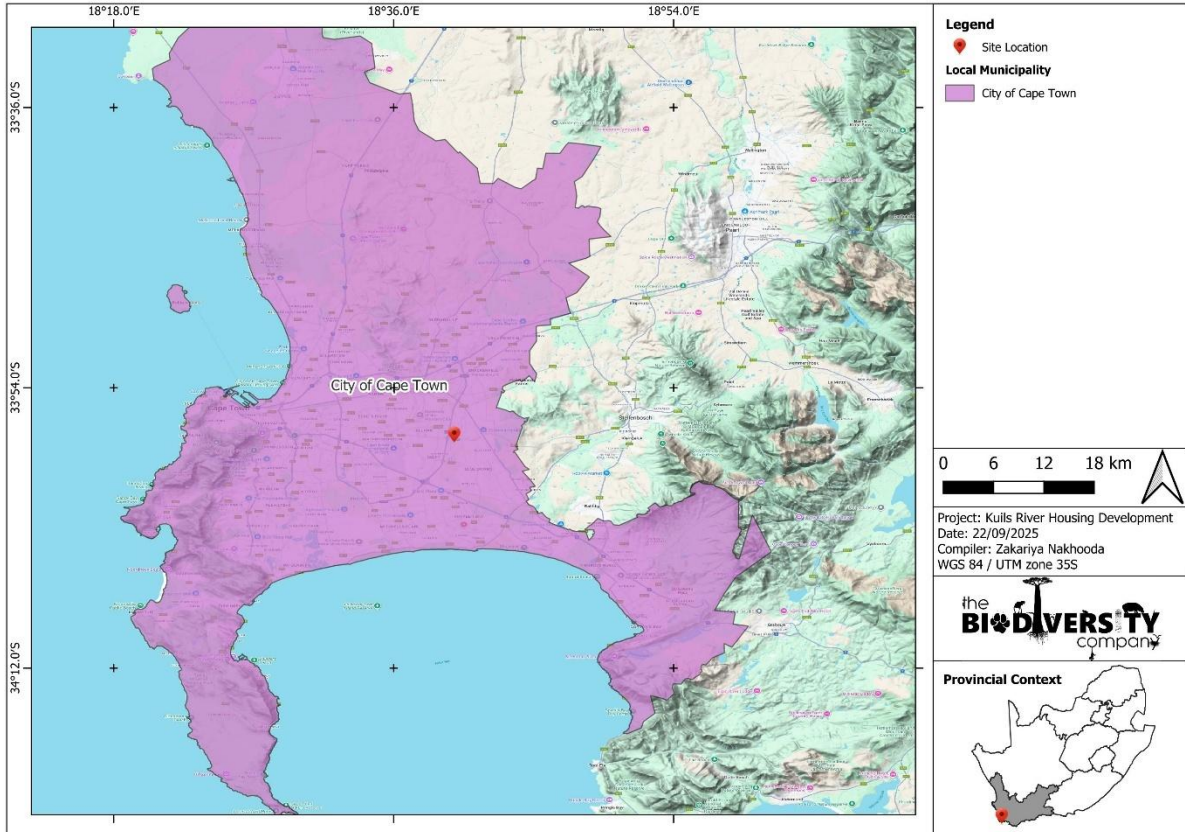


Figure 1-1 Regional Setting of the Proposed Development

1.2 Project Description

The following information is as provided by Sillito (2025):

The proposed residential development on Farm 1388 is strategically positioned along the western bank of the Kuils River (Figure 1-2), north of Wesbank and east of Belhar in Cape Town, Western Cape. The project aims to create a well-integrated residential community, offering 436 Single Residential (SR1) erven, two General Residential sites spanning 0.63 hectares (with an estimated yield of 50 units), and a 0.58-hectare General Business site to support local commercial needs. The development will feature a thoughtfully designed layout that ensures efficient service delivery, incorporating roads, stormwater drainage, water supply, and sanitation systems to meet the needs of future residents.

Located within a growing urban corridor, the development aligns with regional planning objectives by expanding housing availability while integrating sustainable infrastructure solutions. The site benefits from proximity to existing municipal services; however, upgrades and extensions will be necessary to accommodate the proposed density. Primary access to the development will be established through a south-westward extension of Reuter Street, with Old Nooiensfontein Road serving as a secondary entry point.



Figure 1-2 Locality Setting of the Proposed Development

Farm 1388 is bordered by an existing residential area to the north and the Kuils River to the east, with the Betel Primary School centrally located within the site, effectively dividing it into two sections. Of the total site area, 12.15 hectares are allocated for housing development. The terrain is relatively flat, with a gentle west-to-east slope toward the river. Currently, the site is largely

undeveloped, featuring grass, scattered trees, and small wetland/marshy areas in the lower-lying eastern portion. Basic municipal infrastructure exists to support the Betel Primary School, including temporary roads, sewer, water, and stormwater services.

Sanitation infrastructure includes a 200mm sewer line running along the northeastern boundary, flowing southeast toward the Nooiensfontein Pump Station. A temporary 160mm sewer line serves the school, connecting to a 200mm collector at Old Nooiensfontein Drive. Wastewater from the development will fall within the Bellville Wastewater Treatment Works (WWTW) catchment, which has sufficient treatment capacity. Regarding water supply, limited-service information is available, with a 160mm reticulation line at Dorothy Street and a 110mm line at Bhokwe Road, both northwest of the site. Larger distribution mains, including a 700mm and 800mm main along Stellenbosch Arterial and a 450mm main along the R300 highway, are located farther away. The existing stormwater network consists of a 525mm pipeline along the northeastern section, discharging into a 600mm pipeline that flows into the Kuils River, supplemented by a 375mm pipe network servicing the school.

Access to the site is currently restricted to Old Nooiensfontein Road, which connects to Betel Primary School Road via a low bridge crossing over the Kuils River. However, this segment of Old Nooiensfontein Road requires realignment to fall within the designated road reserve. Additionally, Betel Primary School Road, currently serving as temporary access, will be demolished, and a new access route for the school will be incorporated into the proposed road network. As per the Traffic Impact Assessment (TIA), the primary access point for the development will be via Reuter Street's south-westward extension, with Old Nooiensfontein Road acting as a secondary access route.

1.3 Scope of Work

The aim of this study is to determine the 1:100-year floodline extent for the watercourses located within the vicinity of the proposed site. The analysis focuses on the current land use at the study area. The analysis relies on existing 5 m topographical data of South Africa.

To conduct the floodline delineation study for the non-perennial watercourse on the site, the following tasks were completed:

- Catchment Delineation;
- Design Flood Peak Calculations: Calculations were performed to determine the anticipated flood peak magnitudes for the chosen flood return periods;
- Hydraulic Modelling: Hydraulic models were constructed to simulate the flow behaviour of the identified watercourses during the designated flood events; and
- Graphical Representation: The outcomes of the hydraulic models were translated into visual representations that depict the extents of the 1:100-year floodline.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable:

- It is assumed that all information received from the client is relevant and correct;
- No detailed/high resolution contour data (<1 m) was available for the modelling of the catchment areas and watercourse channels considered in this assessment. Readily available 5 m contour data developed by the Department of Rural Development and Land Reform was utilised;
- The results of this study were largely based on the outcomes of a standardised hydrological assessment and historic information of the catchment;
- The floodline presented should only be used for indicative and environmental planning purposes, and not for detailed engineering designs, unless signed off by a suitably qualified and registered engineer;
- The floodline areas modelled in this assessment should be interpreted with caution; given the overall low resolution elevation data utilised; and
- Data presented in the hydrological model attempts to represent current catchment conditions, for which Google Earth satellite imagery was utilised.

2 Catchment Hydrological Characteristics

2.1 Quaternary Catchment Details

The site falls within the Quaternary Catchment G22E within the Breede - Olifants Water Management Area (WMA). The typical climatic conditions associated with rainfall and runoff volumes for the quaternary catchment are presented in Table 2-1 and Figure 2-1.

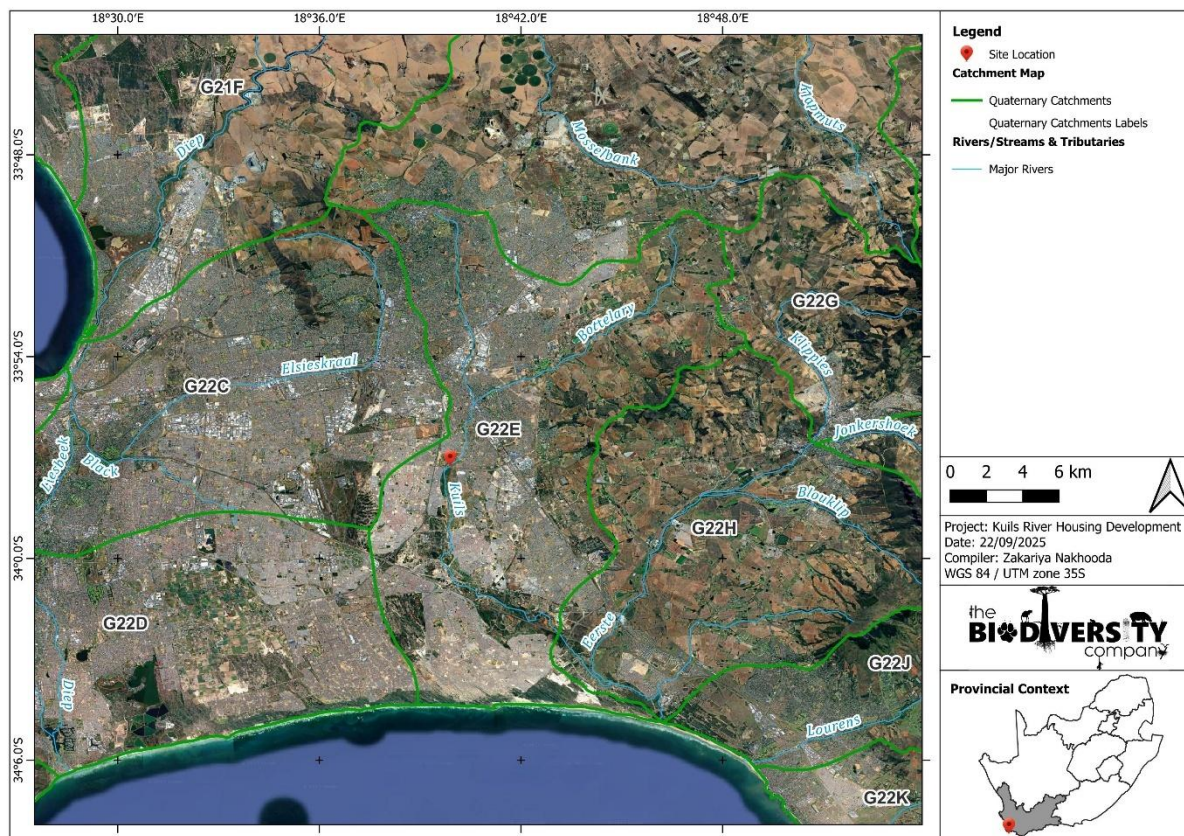


Figure 2-1 Site Hydrological Setting

Table 2-1 Quaternary Catchment Information (WRC, 2012)

Quaternary Catchment	QC Area (km ²)	MAP (mm)	MAE (mm)	MAR (mcm1)
G22E	271	563	1 410	20.25

Quaternary Catchment G22E has a Mean Annual Precipitation (MAP) of 563 mm. The monthly rainfall averages for G22E are presented in Table 2-2. The site falls within the G2B rainfall zone and the 23C evaporation zone with a Mean Annual Evaporation (MAE) of 1 410 mm. Monthly evaporation averages for G22E are presented in Table 2-3. The naturalised Mean Annual Runoff (MAR) for the catchment is 20.25 x 10⁶ m³.

Table 2-2 Monthly Rainfall Averages (WRC, 2012)

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
17	19	21	62	100	128	118	101	61	42	26	20

¹ Million Cubic Metres

Table 2-3 Monthly Evaporation Averages (WRC, 2012)

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
33	38	42	122	197	253	234	199	121	84	52	40

A comparison between the mean monthly rainfall and evaporation is presented in Figure 2-2. The overall trends indicate greater evaporation than rainfall for all months of the year.

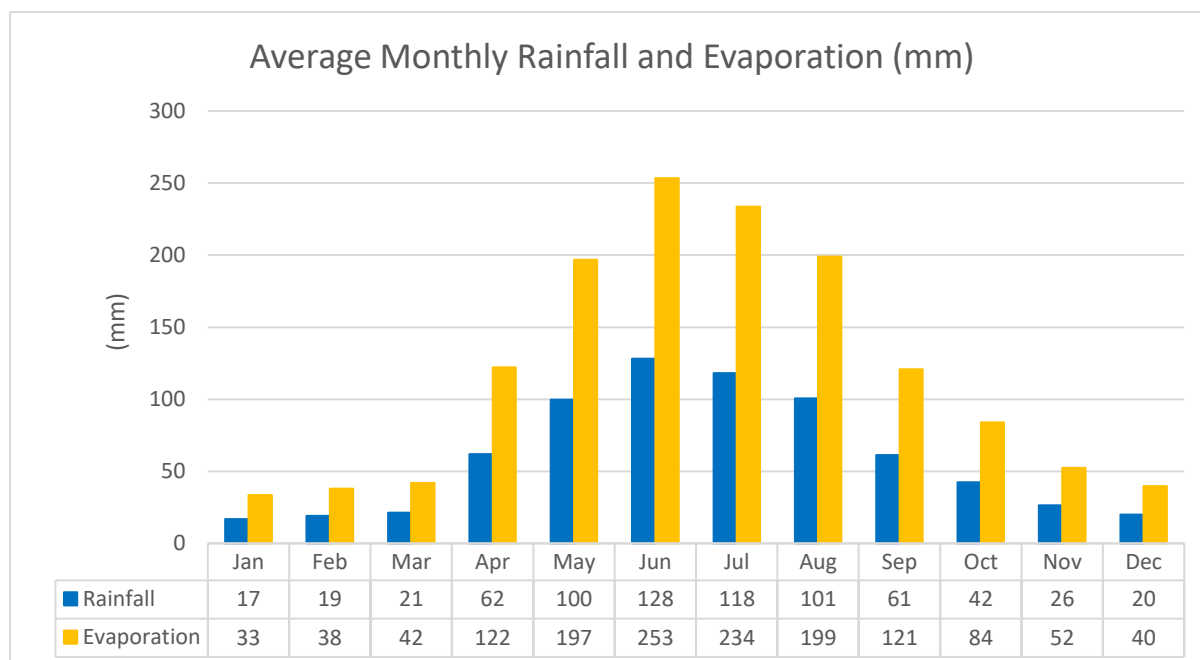


Figure 2-2 Average Monthly Rainfall and Evaporation for QC G22E

2.2 Site Specific Design Rainfall

Design rainfall is a probabilistic representation of rainfall intensity (depth of rainfall over a time period) at a certain location for a given duration and average recurrence interval. The design rainfall depths for the centroid of the site were extracted using the Design Rainfall Estimation software for South Africa (Smithers and Schulze, 2002). The rainfall data utilised to determine the design rainfall depths was extracted from the Rainfall Utility Tool (Table 2-4).

Table 2-4 Rainfall Station Utilised to Determine Design Rainfall Depths

Name	ID	Distance to Site (km)	Record (years)	Altitude (mamsl)	MAP (mm)
Kuilsriver	0021326_W	2.5	35	52	566
Long Acres	0021357_W	2.5	22	70	566
Bellville (Bos)	0021235_W	5.1	51	62	476
Eersterivier (Bos)	0021330_W	7.4	81	24	522
Bellville	0021204_W	7.6	45	73	518
Durbanville (Pol)	0021260_W	12.7	93	152	602

The output rainfall at each site includes a ninety percent upper, standard and lower bounds for all design rainfall values. For this assessment, the ninety percent upper value (bold value in Table 2-5) was used

in the modelling to determine the indicative floodline. The rationale for the use of the upper bound is as follows:

- To consider any potential increases in the rainfall that may occur due to effects of climate change; and
- The type of infrastructure.

The 24hr design rainfall depths for the different return periods are illustrated in Table 2-5 and the value used is highlighted in **bold**.

Table 2-5 Design Rainfall Depths

Recurrence Interval (years)	1:2-year	1:5-year	1:10-year	1:20-year	1:50-year	1:100-year
Rainfall depth (mm)	40.9	54.9	65.1	75.7	90.6	102.8

2.3 Topography and Drainage

The study area is located along the west coast of South Africa and can be characterised as having mountainous terrain towards the east, changing to a plateau as the terrain moves to the south towards the Atlantic Ocean. A Digital Elevation Model (DEM) for the study area has been developed utilising readily available 5 m contour data developed by the Department of Rural Development and Land Reform (Figure 2-3).

The Kuils River is the only watercourse which is located adjacent to the site (Figure 2-3 and Figure 1-2).

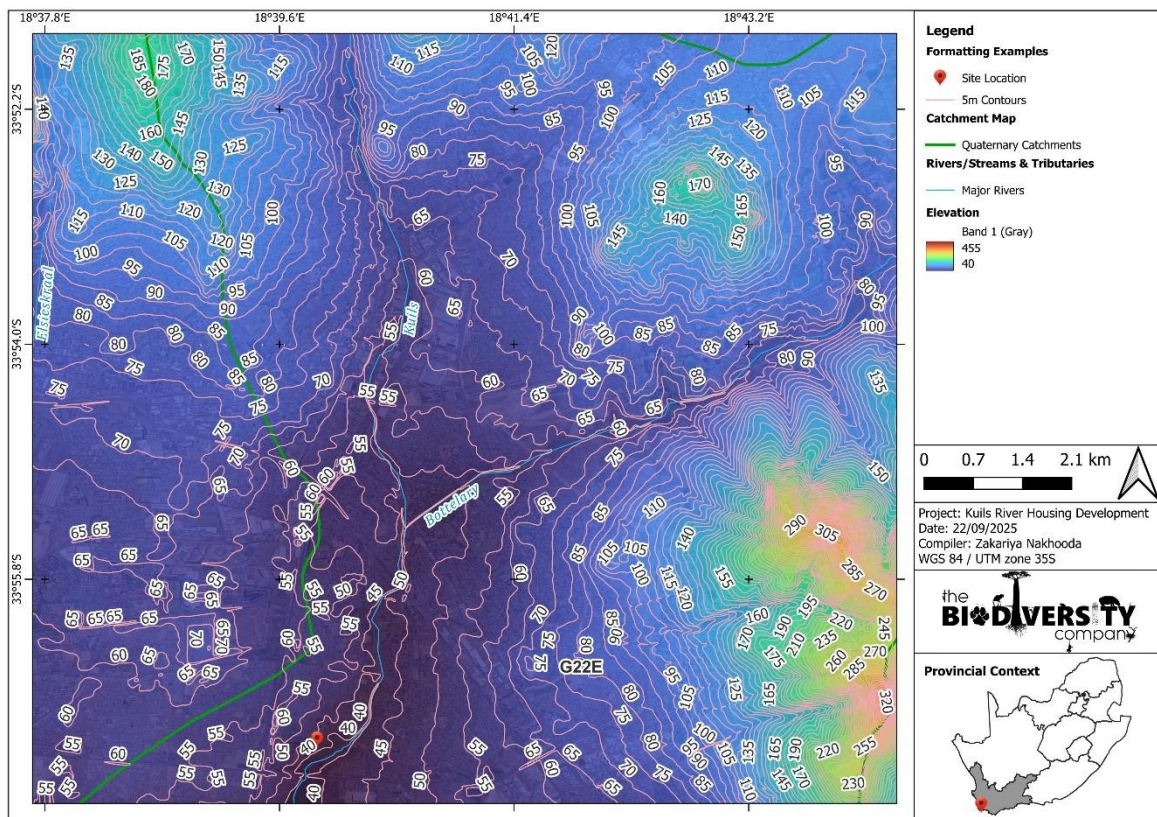


Figure 2-3 DEM of the Study Area

2.4 Land Cover and Soils

The dominant landcover within the study area is representative agricultural activities (predominantly sugarcane plantations) as identified from Google Earth imagery (accessed on the 25th August 2025).

Soils are a key natural regulator of catchment hydrological response due the capacity that soils have for absorbing, retaining, and releasing water (Schulze, 1989). The Soil Conservation Services (SCS) hydrological soil classes of the catchment are presented in Table 2-6 (as defined by Schmidt & Schulze, 1987 and indicated in SANRAL, 2013) and illustrated in Figure 2-4.

Table 2-6 Soil Conservation Services Hydrologic Soil Class Interpretation (SANRAL, 2013)

Class	Description
Class A	Sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.
Class B	Silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly of or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
Class C	Soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
Class D	Soils are clay loam, silty clay loam, sandy clay, silty clay or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

The soils within the catchment area are largely representative of SCS Class A/B and B soils, indicating that the soil textures are sandy loams.

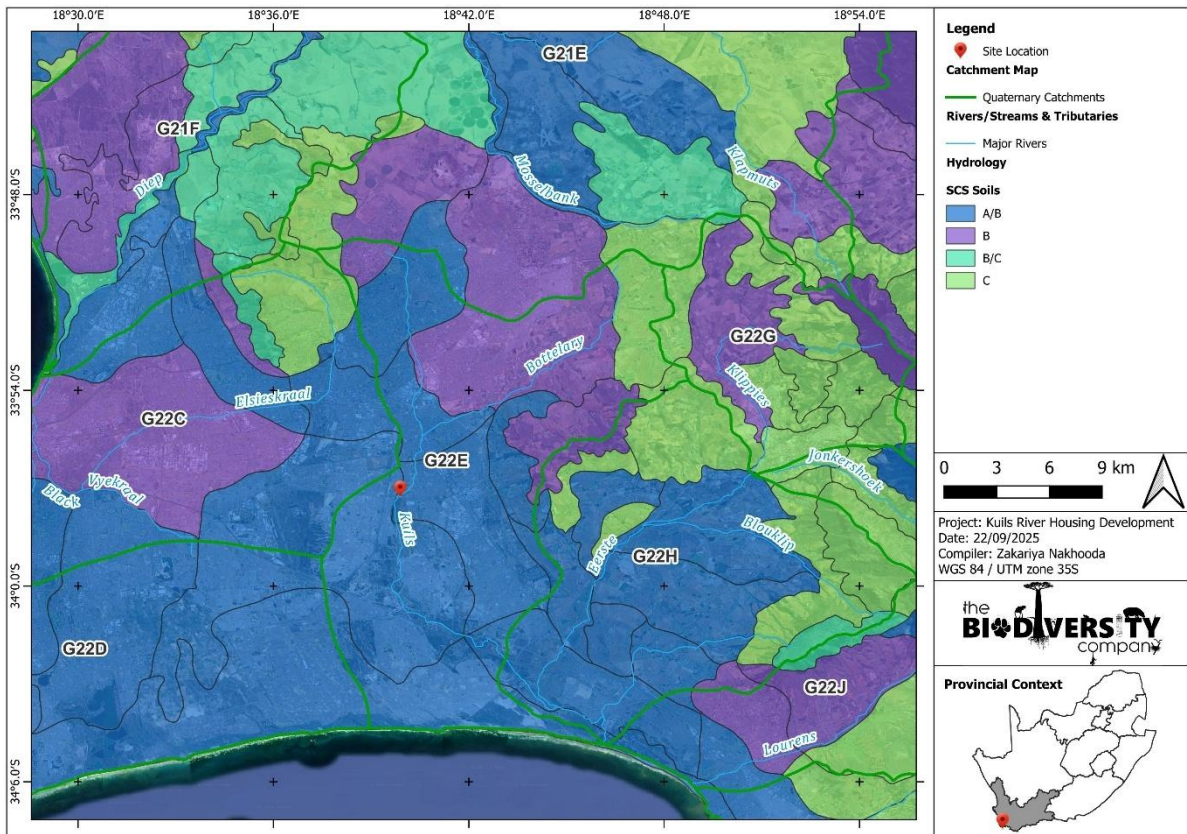


Figure 2-4 SCS Hydrological Soils Groups

3 Design Flood Peaks

3.1 Catchment Delineation

The contributing catchment to the non-perennial reach under consideration was delineated using readily available topographic data (5 m contour data). To provide a more accurate delineation, aerial imagery was utilised so that current land use and land transformation practices could be incorporated. The delineated catchment is represented in Figure 3-1. Catchment information that was used in generating the design flood estimates for the contributing catchments is summarised in Table 3-1.

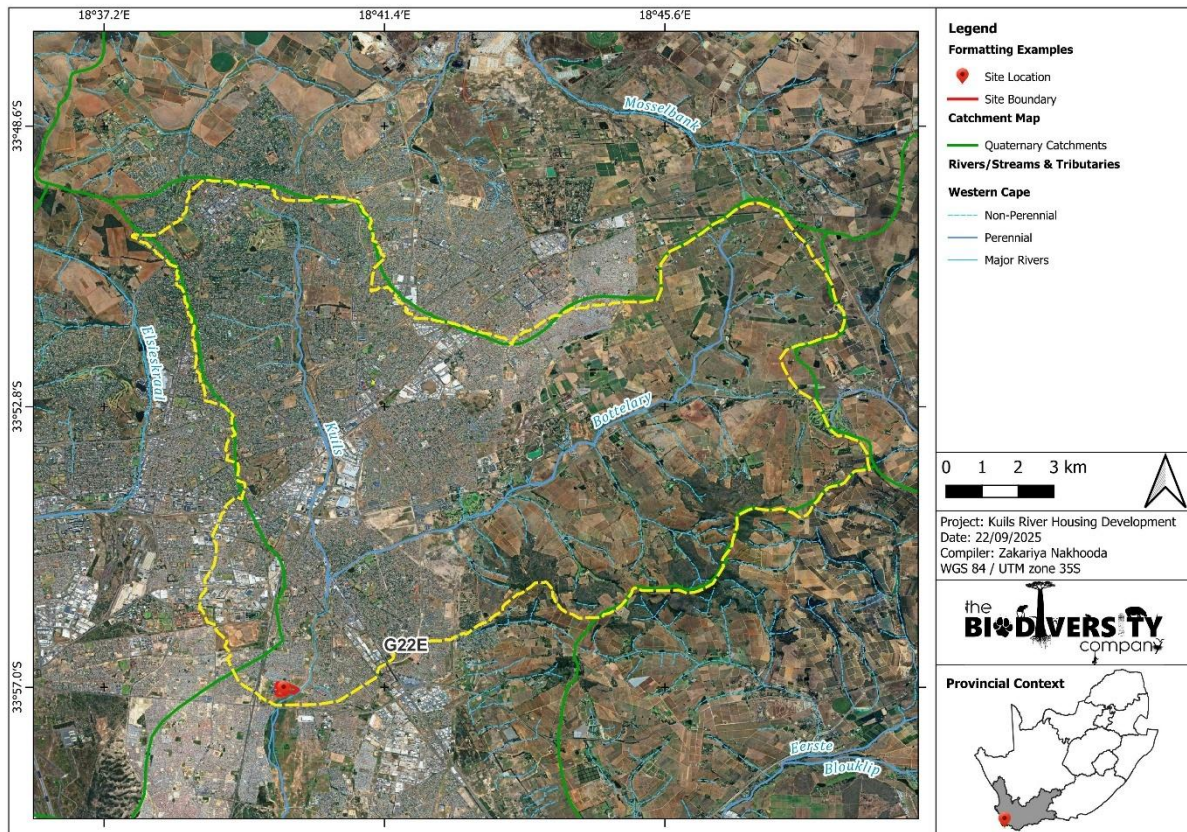


Figure 3-1 Delineated Catchments

Table 3-1 Catchment Parameters

Catchment Parameters	C1
Catchment Area (km ²)	142.77
Length of Longest watercourse (km)	19.34
Mean Annual Precipitation	563
Slope (m/m)	0.006
% of catchment underlain by dolomite	0
Curve Number (HEC-HMS Method)	91
Rainfall Distribution	SCS Type 2

3.2 Design Flood Peak Calculation Methods

To evaluate design flood peaks for a watercourse or reach, multiple methods can be utilised. These methods are presented in Table 3-2, together with a description elaborating the rationale behind their use or omission.

Table 3-2 Design Flood Peak Methodologies' Applicability

Method	Used	Comments
Rational Method Alternative 1	No	Applicable catchment <15km ² but old database
Rational Method Alternative 2	No	Applicable catchment <15km ² but old database
Rational Method Alternative 3	No	Applicable catchment <15km ² with new database
Standard Design Flood (SDF) Method	<u>Yes</u>	Applicable catchment 10km ² to 40 000km ²
SCS-SA Method	No	Applicable catchment <30km ²
HEC-HMS	<u>Yes</u>	Applicable to catchments of all sizes
Empirical Methods		
Midgely and Pitman (M&P)	<u>Yes</u>	May be applicable to smaller catchments, with preference given to catchment > 100km ²

The following methods were used to evaluate the relevant design flood peaks for the non-perennial watercourse under consideration owing to the catchment size:

- SDF;
- HEC-HMS model; and
- Empirical Methods;

These methods and associated limitations are elaborated upon in the underlying subsections.

3.2.1 SDF

The SDF Method specifically addresses the uncertainty in flood prediction under South African conditions. The runoff coefficient (C) used in the Rational Method is replaced by a calibrated value based on the subdivision of the country into 29 regions or water management areas (WMAs) by using the 2-year mean of the annual daily maximum rainfall and average number of days per year on which thunder was heard. The method is generally a more conservative estimate than the Rational or UH Methods. The SDF Method can be applied to catchments from 10km² to 40 000km² in area.

3.2.2 HEC-HMS

The HEC-HMS programme was developed at the Hydrologic Engineering Center (HEC) of the US Army Corps of Engineers. HEC-HMS provides various methods to calculate the loss rate in a basin such as Deficit and constant, exponential loss, Green-Ampt, SCS Curve Number (CN), initial and Constant. Among the methods, the SCS-CN method is widely used. The Soil Conservation Service (SCS) proposed a parametric Unit Hydrograph model; this model is included in the programme.

3.2.3 Empirical Methods (M&P)

The Midgely & Pitman method is based on the statistical correlation of observed peak flows in the region in question and the catchment properties to generate regional constants. The accuracy of the predictions is dependent on the similarity of the catchment characteristics to the generalised Kovacs K region constant. The Empirical Method should be applied to catchments larger than 100km² but could be applied with caution to catchments larger than 10 km² (SANRAL, 2013)

3.3 Design Flood Peak Results

Design flood peaks were calculated using the Rational, HEC-HMS model and SCS-SA methods. The relevant flood peaks for the 1:100-year return interval for the catchment area is shown in Table 3-3.

Table 3-3 Design Flood Values

Catchment	Return Interval	SDF	HEC-HMS (m ³ /s)	Empirical (m ³ /s)
C1	1:100-year	367.86	344.56	371.67

For the purposes of the hydraulic modelling undertaken as part of this assessment, and in keeping with a conservative approach, the highest peaks were utilised.

4 Hydraulic Modelling

4.1 Methodology

The US Army Corp of Engineers (USACE) Hydrologic Engineering Centre River Analysis System (HEC-RAS) model was used to calculate the relevant flood levels. HEC-RAS undertakes hydraulic calculations between user defined, consecutive river cross-sections along the defined length of the river channel. The HEC-RAS model simulates total energy of water by applying basic principles of mass, continuity and momentum as well as roughness factors between all cross sections (US Army Corps of Engineers, 1995). A depth of flow is calculated at each cross-section, which represents the level to which water will rise at that section, given the potential peak flows.

This was calculated for the 1:100-year recurrence interval for the Kuilis River reach in question.

4.2 Model Inputs and Assumptions

The following model inputs and assumptions were made:

- The accuracy of the floodline delineation and flood hydrographs is reliant on the resolution of the topographical data. The greater the resolution, the higher the accuracy of the delineated flood lines. Readily available 5m contour developed by the Department of Rural Development and Land Reform was utilised; and
- The relevant Manning's roughness coefficients (n) (Chow, 1959 and Arcement and Schneider, 1989) were estimated for channel characteristics, riparian and bank areas based on observations made during the site visit. Relevant values were obtained via data published in, 'HEC-RAS River Analysis System – Hydraulic Reference Manual Version 4.1' (January 2010). The Manning's roughness coefficients (n) for the river channel was chosen to be 0.030 and the Manning's roughness coefficients (n) for the banks was chosen to be 0.035.

4.3 Results

The modelled 1:100-year floodline for the Kuilis River reach is presented in Figure 4-1.

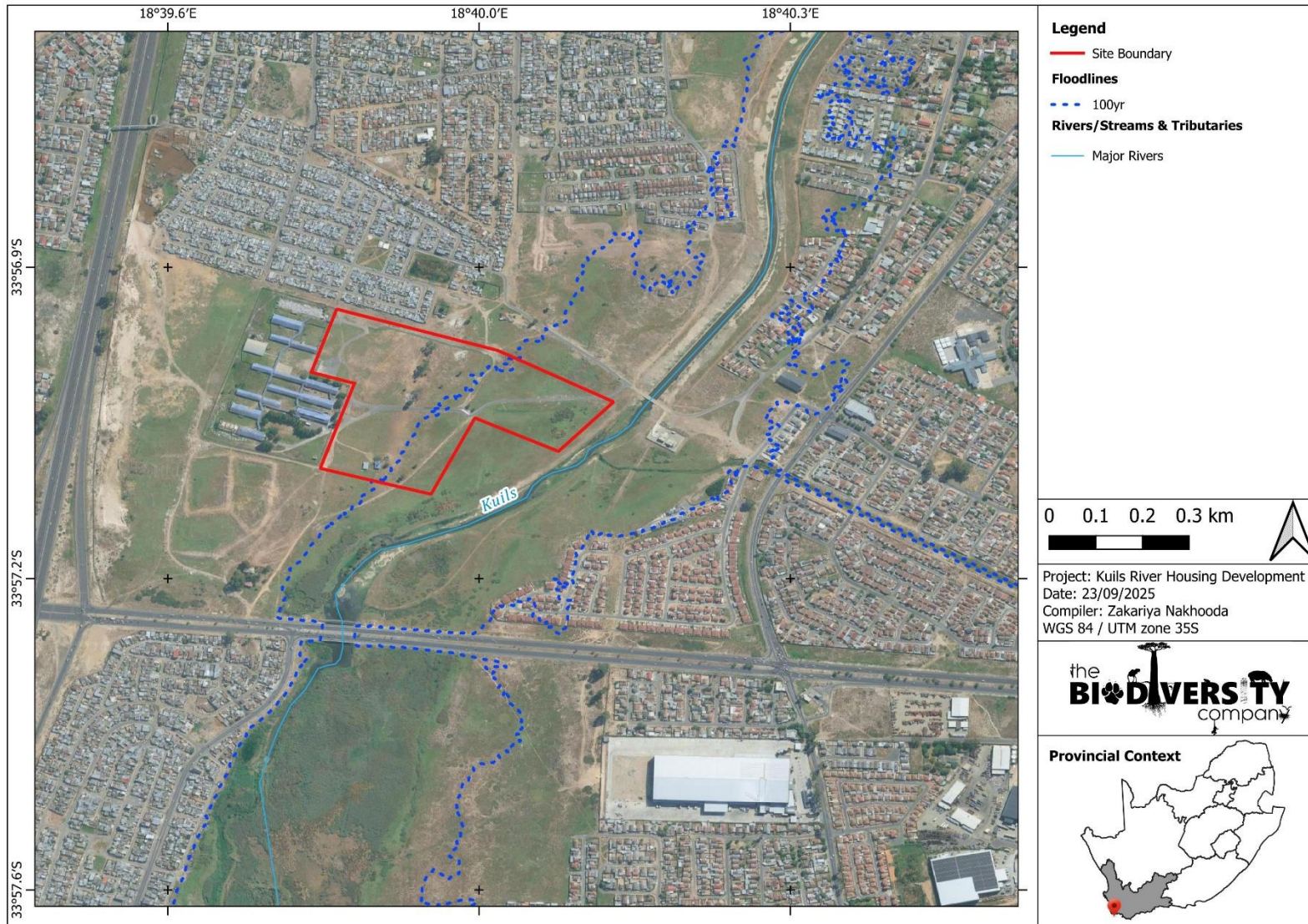


Figure 4-1 1:100-year Floodline

5 Conclusion

The 1:100-year floodline was delineated for the Kuils River located adjacent to the proposed development site. The results indicated that approximately 40% of the site lies within the delineated 100-year floodline extent. It is recommended that this portion be utilised for parking areas, provided the associated City of Cape Town by-laws are not transgressed.

The floodlines presented in this report should be interpreted with caution owing to the overall low resolution of the topographical information utilised.

6 References

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