SCIP ENGINEERING GROUP

Our reference: 098/424
17 November 2011

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Attention: Me L Swarts
Mr KW Rost

PROPOSED DEVELOPMENT: REMAINDER OF FARM 283-JS LEEUPOORT AND PORTION 79 FARM BLESBOKLAAGTE 296-JS WITBANK

This report should be read in conjunction with the floodline drawing *098/477-06-01 revision A* that was emailed to your offices on *11 November 2011*.

This report covers the floodline calculations and methodologies relating to the 1:100 year floodlines for the above development.

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1. Background

SCIP Engineering Group (Pty) Ltd. was instructed by *Townscape Planning Solutions of Witbank* to calculate the 1:100 year floodlines for all streams in the vicinity of the above property.

The appointment letter dated 14 September 2011 has reference.

2. Methodology

The methodology for the calculations of floodlines in general can be described as follows:

- The gathering of topographical information for the catchment/s and river reach/es. *The procedure provides slopes, shapes and catchment parameters of the catchment/s.*
- Hydrological modeling of the catchment/s according to historical rainfall data of weather stations situated close to the catchment or within the catchment. *This procedure provides the peak flow rates needed for the hydraulic model.*

- Hydraulic modeling of the river reach as well as hydraulic modeling of structures contained in the river channel or floodplain. *This procedure entails the routing of peak flow rates through the different river reaches to determine water levels at different points along the river.*

2.1 Topographical information

Topographical information about the catchment size, slope and vegetation cover was identified from 1:50,000 topographical maps obtained from the Chief Directorate, Survey and Mapping, Mowbray.

Due to the size of the catchment/s, 4 maps were used for this study, namely: 2529CA, 2529CB, 2529CC and 2529CD.

Typical vegetation and land-use cover were identified during a site visit on 16 September 2011. The land is mostly grassland as shown in *Photo 1* below.

Photo 1

2.2 Hydrological modeling

The hydrological modeling procedure involved the calculation of that flood peak that is expected to occur on average once every 100 years and hence the 1:100 year floodline.

Four distinct catchments were identified for the 5 different river reaches that were modeled. The 5 river reaches were numbered A to E for calculations purposes.

The flood peak or peak flow rate for the 1:100 year storm was determined for each of the 4 catchments by using the *UPFD* software developed by Sinotech CC in association with the *University of Pretoria*.

Deterministic and empirical methods were used to calculate the 1:100 year flood peaks for the different streams, a summary of which is shown next.

Hydrological model used for calculating the 1:100 year peak flow rate	1:100 year flood peak rate (m^3/s)
Rational Method	239 m^3/s
Rational Method (Alternative)	223 m^3/s
Unit hydrograph method	130 m^3/s
Standard Design Flood Method	200 m^3/s
Emperical	117 m^3/s
Average flood peak rate	*182 m^3/s*
Flood peak adopted for design purposes	**201 m^3/s**

Table 1-Catchment A

Hydrological model used for calculating the 1:100 year peak flow rate	1:100 year flood peak rate (m^3/s)
Rational Method	195 m^3/s
Rational Method (Alternative)	185 m^3/s
Unit hydrograph method	71 m^3/s
Standard Design Flood Method	166 m^3/s
Emperical	76 m^3/s
Average flood peak rate	*139 m^3/s*
Flood peak adopted for design purposes	**166 m^3/s**

Table 2-Catchment B

Hydrological model used for calculating the 1:100 year peak flow rate	1:100 year flood peak rate (m^3/s)
Rational Method	57 m^3/s
Rational Method (Alternative)	54 m^3/s
Unit hydrograph method	61 m^3/s
Standard Design Flood Method	49 m^3/s
Emperical	34 m^3/s
Average flood peak rate	*51 m^3/s*
Flood peak adopted for design purposes	**252 m^3/s**

Table 3-Catchment C

Hydrological model used for calculating the 1:100 year peak flow rate	1:100 year flood peak rate (m^3/s)
Rational Method	160 m^3/s
Rational Method (Alternative)	149 m^3/s
Unit hydrograph method	105 m^3/s
Standard Design Flood Method	134 m^3/s
Emperical	71 m^3/s
Average flood peak rate	*124 m^3/s*
Flood peak adopted for design purposes	**134 m^3/s**

Table 4-Catchment D

The peak flow rates used for design purposes vary for each catchment as shown on the tables above.

As the 4 catchments' response to rainfall are different in time, the flow rates used as design flows for the 5 river streams were determined by summation of time adjusted hydrographs of each catchment.

A simplistic hydrograph (assuming the time of concentration being 1/3 of the total time of flow) was created for each catchment and summed in time. Time summation was based in different travel times of hydrograph peaks in each catchment. This methodology provided the *Design Engineer* with a realistic peak flow rate at each confluence of two identified river reaches.

The calculated average velocities through the different catchments was in the region of 2.8 m/s which is high but realistic as the flow regime in all 5 stream sections showed to be just supercritical with Froude numbers in the order of 1.

2.3 Hydraulic modeling

The hydraulic modeling was done with CFP developed by *Ninham Shands Consulting Engineers (now Aurecon)*.

River cross sections were obtained from aerial photographic survey data provided for specifically for this project.

Roughness parameters were assigned in accordance with guidelines for channels and flood plains detailed in the *South African National Roads Agency's Road Drainage Manual*. Manning n-values of 0.035 $s/m^{1/3}$ were adopted for all streams.

Seasonal variation in parameters were not modeled. The n-value adopted caters for higher overgrowth in channels and floodplains during the wet season.

No substantial bridges or other structures on the river reach was identified during the site visit that was modeled.

It should be noted that any construction of bridges or culverts on any of these streams later should be hydraulically modeled to determine their impact on the floodlines under consideration at the time.

3. Conclusions

- The calculated 1:100 floodline shows that some residence of *Pine Ridge* (south of river reach 1) run the risk of their property being flooded
- Any alterations to the stream channel or floodplain in whatever way will result in the calculated floodlines being invalid and care shall be taken to maintain the river as is.
- It is recommended that a buffer zone of 50m should be provided on either side of the 1:100 year floodline. The 50m should be measured horizontally independently of the slope of the embankment under consideration.
- The proposed development is affected by 1:100 year floodlines but not to a great extent. These floodlines can now be used as guideline for Town Planners to determine a land use layout for further discussion and evaluation.

4. Recommendations

- That the floodlines shown on drawing *098-477-06-01 revision A* is adopted as that level to which flood water is expected to rise during that event that will on average (statistically) occur once every 100 years.

5. Recommendations

- That the calculated floodlines in this report shown on other property than that of "REMAINDER OF FARM 283-JS LEEUPOORT AND PORTION 79 FARM BLESBOKLAAGTE 296-JS WITBANK" are interpreted with care and may only be used for information purposes. It remains the copyright information of *SCIP Engineering Group (Pty) Ltd.* and *SCIP Engineering Group (Pty) Ltd.* takes no responsibility for the use of these floodlines by other parties without our consult and approval.

SCIP ENGINEERING GROUP

We trust that you find the above in order, please do not hesitate to contact us should you require any additional information.

Yours faithfully,
SCIP Engineering Group (Pty) Ltd.

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