

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 1 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.145445	km <sup>2</sup>	Longest water path	L=	0.565	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.365	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	108.000	m	Average slope:	H <sub>0.85L</sub> =	86.000	m	α=	1	β=	0	γ=	0
Overland	H <sub>1/2</sub> =	86.000	m	Watercourse	H <sub>0.10L</sub> =	55.000	m	0.216					
	L <sub>1</sub> =	0.2	km		0.75L=	0.27375	km						
	S <sub>avg1</sub> =	0.11	m/m		S <sub>avg2</sub> =	0.113242	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	10%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	100%	0.15	Residential	0%	0.6
Hilly areas	80%	0.2	Semi-permeable	0%	0.2	Grasveld	0%	0.25	City / Industrial	0%	0.85
Mountaneous	10%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.201</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.15</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.426      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.43	0.43	0.43	0.43	0.43	0.43	0.43

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1787 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.3109

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0710      V = 1.428 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3819

Storm duration 22.914 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	21.67	32.46	40.93	50.10	63.91	75.80	89.16
Point intensity I (mm/h)	56.7	85.0	107.2	131.2	167.3	198.5	233.5
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	56.7	85.0	107.2	131.2	167.3	198.5	233.5

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.977	1.463	1.844	2.258	2.361	2.880	3.416	4.018
Peak flow (l/s)	977	1463	1844	2258	2361	2880	3416	4018

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**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.145445	km <sup>2</sup>	Longest water path	L=	0.565	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.365	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	108.000	m	Average slope:	H <sub>0.85L</sub> =	86.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	86.000	m	Watercourse	H <sub>0.10L</sub> =	55.000	m	0.216					
	L <sub>1</sub> =	0.2	km		0.75L=	0.27375	km						
	S <sub>avg1</sub> =	0.11	m/m		S <sub>avg2</sub> =	0.113242	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)				VEGETATION C <sub>v</sub> (%)		USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	10%	0.05	Lawns & Parks	15%	0.18
Flat areas	10%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	30%	0.15	Residential	65%	0.6
Hilly areas	80%	0.2	Semi-permeable	0%	0.2	Grasveld	60%	0.25	City / Industrial	0%	0.85
Mountaneous	10%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	20%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.201</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.20</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C<sub>1</sub>= 0.476      Urban coefficient C<sub>2</sub>= 0.61

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Adjusted C <sub>1</sub>	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Total C	0.61	0.61	0.61	0.61	0.61	0.61	0.61

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1787 m/s  
T<sub>c</sub> = 0.3109      (0.2 - 0.5m/s)

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0710      V = 1.428 m/s  
(0.8 - 1.3m/s)

Storm duration 22.914 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	21.67	32.46	40.93	50.10	63.91	75.80	89.16
Point intensity I (mm/h)	56.7	85.0	107.2	131.2	167.3	198.5	233.5
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	56.7	85.0	107.2	131.2	167.3	198.5	233.5

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	1.398	2.095	2.641	3.233	3.381	4.124	4.892	5.754
Peak flow (l/s)	1398	2095	2641	3233	3381	4124	4892	5754

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**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.110069	km <sup>2</sup>	Longest water path	L=	0.166	km	Area distribution factors (α + β + γ = 1)			
Water path (overland)	L <sub>1</sub> =	0.166	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes	
Average slope:	H <sub>1</sub> =	103.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	β=	γ=	
Overland	H <sub>1/2</sub> =	85.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m				
	L <sub>1</sub> =	0.166	km		0.75L=	0	km				
	S <sub>avg1</sub> =	0.108433735	m/m		S <sub>avg2</sub> =	0	m/m				
Area dolomite	D=	0%									0.108

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	30%	0.18
Flat areas	40%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	25%	0.6
Hilly areas	60%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	50%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	75%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.164</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>180%</b>	<b>1.3</b>

Rural coefficient C<sub>1</sub>= 0.399      Urban coefficient C<sub>2</sub>= 1.34

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Adjusted C <sub>1</sub>	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Total C	0.40	0.40	0.40	0.40	0.40	0.40	0.40

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1613 m/s  
T<sub>c</sub> = 0.2859      (0.2 - 0.5m/s)

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s  
(0.8 - 1.3m/s)

Storm duration 17.157 min

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	15.78	28.85	36.40	44.57	56.85	67.43	79.29
Point intensity I (mm/h)	55.2	100.9	127.3	155.9	198.8	235.8	277.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	55.2	100.9	127.3	155.9	198.8	235.8	277.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.673	1.231	1.553	1.902	1.989	2.425	2.877	3.383
Peak flow (l/s)	673	1231	1553	1902	1989	2425	2877	3383

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 2 Post Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.110069	km <sup>2</sup>	Longest water path	L=	0.166	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.166	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	103.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.8	β=	0.2	γ=	0
Overland	H <sub>1/2</sub> =	85.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.108					
	L <sub>1</sub> =	0.166	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.108433735	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>s</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	40%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	25%	0.6
Hilly areas	60%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	75%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.164</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.9</b>

Rural coefficient C <sub>1</sub> =	0.399	Urban coefficient C <sub>2</sub> =	0.86
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Adjusted C <sub>1</sub>	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Total C	0.49	0.49	0.49	0.49	0.49	0.49	0.49

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4	V = 0.1613 m/s (0.2 - 0.5m/s)	<b>Values for r</b>
		T <sub>c</sub> = 0.2859		Paved areas 0.02
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0000	V = #DIV/0! m/s (0.8 - 1.3m/s)	Clean soil 0.1
		T <sub>c</sub> = 0.2859		Sparse Grass 0.3
		<b>Storm duration 17.157 min</b>		Moderate Grass 0.4
Average annual rainfall:	1018 mm / annum			Thick Bush 0.8
Rainfall region:	Summer			<b>Dolomite reduction (D.)</b>
				Steep (>30%) 0.5
				Hilly (10 -30%) 0.35
				Flat (3 - 10%) 0.2
				Vlei's & Pans (<3%) 0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	19.29	28.85	36.40	44.57	56.85	67.43	79.29
Point intensity I (mm/h)	67.5	100.9	127.3	155.9	198.8	235.8	277.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	67.5	100.9	127.3	155.9	198.8	235.8	277.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	1.013	1.515	1.912	2.341	2.448	2.986	3.542	4.165
Peak flow (l/s)	1013	1515	1912	2341	2448	2986	3542	4165

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Area of catchment:	A=	0.110069	km <sup>2</sup>	Longest water path	L=	0.166	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.166	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	103.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	85.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m						
	L <sub>1</sub> =	0.166	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.108433735	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											0.108

RURAL								URBAN					
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)				VEGETATION C <sub>v</sub> (%)		USE					
Lakes and pans	0%	0.05	Very permeable		50%	0.05	Thick bush & plantations		0%	0.05	Lawns & Parks	0%	0.18
Flat areas	40%	0.11	Permeable		50%	0.1	Light bush & cultivated areas		90%	0.15	Residential	100%	0.6
Hilly areas	60%	0.2	Semi-permeable		0%	0.2	Grasveld		10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable		0%	0.3	No vegetation		0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.164</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>		

Rural coefficient C<sub>1</sub>= 0.399      Urban coefficient C<sub>2</sub>= 0.60

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Adjusted C <sub>1</sub>	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Total C	0.60	0.60	0.60	0.60	0.60	0.60	0.60

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1613 m/s  
T<sub>c</sub> = 0.2859      (0.2 - 0.5m/s)

Values for r

Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s  
(0.8 - 1.3m/s)

Dolomite reduction (D<sub>i</sub>)

Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Storm duration 17.157 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	19.29	28.85	36.40	44.57	56.85	67.43	79.29
Point intensity I (mm/h)	67.5	100.9	127.3	155.9	198.8	235.8	277.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	67.5	100.9	127.3	155.9	198.8	235.8	277.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	1.238	1.851	2.335	2.859	2.991	3.647	4.326	5.087
Peak flow (l/s)	1238	1851	2335	2859	2991	3647	4326	5087

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Area of catchment:	A=	0.110069	km <sup>2</sup>	Longest water path	L=	0.166	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.166	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	103.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	85.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m						
	L <sub>1</sub> =	0.166	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.108433735	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											0.108

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)				VEGETATION C <sub>v</sub> (%)		USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	40%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	60%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.164</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.399      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Adjusted C <sub>1</sub>	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Total C	0.95	0.95	0.95	0.95	0.95	0.95	0.95

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1613 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2859

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2859

**Storm duration 17.157 min**

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	19.29	28.85	36.40	44.57	56.85	67.43	79.29
Point intensity I (mm/h)	67.5	100.9	127.3	155.9	198.8	235.8	277.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	67.5	100.9	127.3	155.9	198.8	235.8	277.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	1.960	2.931	3.697	4.527	4.735	5.774	6.850	8.055
Peak flow (l/s)	1960	2931	3697	4527	4735	5774	6850	8055

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 3 Pre Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.026007 km <sup>2</sup>	Longest water path	L=	0.045 km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.045 km				Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	92.000 m	Water path (water course)	L <sub>2</sub> =	0 km	α=	0.85	β=	0.15	γ=	0
Overland	H <sub>2</sub> =	88.500 m	Average slope:	H <sub>0.85L</sub> =	0.000 m						
	L <sub>1</sub> =	0.045 km	Watercourse	H <sub>0.10L</sub> =	0.000 m						
	S <sub>avg1</sub> =	0.077777778 m/m		0.75L=	0 km						
Area dolomite	D=	0%	S <sub>avg2</sub> =	0 m/m	0.078						

RURAL						URBAN					
SLOPE SLOPE C <sub>s</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C <sub>1</sub> =	0.372	Urban coefficient C <sub>2</sub> =	0.00
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.32	0.32	0.32	0.32	0.32	0.32	0.32

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.168	V = 0.0744 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0000 T <sub>c</sub> = 0.2500	V = #DIV/0! m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 -30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 -30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration 15 min														
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.168	0.251	0.317	0.388	0.406	0.495	0.588	0.691
Peak flow (l/s)	168	251	317	388	406	495	588	691

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 3 Post Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.026007 km <sup>2</sup>	Longest water path	L=	0.045 km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.045 km				Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	92.000 m	Water path (water course)	L <sub>2</sub> =	0 km	α=	0.85	β=	0.15	γ=	0
Overland	H <sub>2</sub> =	88.500 m	Average slope:	H <sub>0.85L</sub> =	0.000 m	0.078					
	L <sub>1</sub> =	0.045 km	Watercourse	H <sub>0.10L</sub> =	0.000 m						
	S <sub>avg1</sub> =	0.077777778 m/m		0.75L=	0 km						
Area dolomite	D=	0%		S <sub>avg2</sub> =	0 m/m						

RURAL						URBAN					
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C <sub>r</sub> =	0.372	Urban coefficient C <sub>u</sub> =	0.95
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.46	0.46	0.46	0.46	0.46	0.46	0.46

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.168	V = 0.0744 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0000 T <sub>c</sub> = 0.2500	V = #DIV/0! m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 -30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 -30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration 15 min														
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.244	0.365	0.460	0.563	0.589	0.718	0.852	1.002
Peak flow (l/s)	244	365	460	563	589	718	852	1002

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 3 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.026007	km <sup>2</sup>	Longest water path	L=	0.045	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.045	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	92.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	88.500	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.078					
	L <sub>1</sub> =	0.045	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.077777778	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	100%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C<sub>1</sub>= 0.372      Urban coefficient C<sub>2</sub>= 0.60

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.60	0.60	0.60	0.60	0.60	0.60	0.60

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.0744 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.168

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.319	0.477	0.602	0.737	0.771	0.940	1.115	1.311
Peak flow (l/s)	319	477	602	737	771	940	1115	1311

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 3 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.026007	km <sup>2</sup>	Longest water path	L=	0.045	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.045	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	92.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	88.500	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.078					
	L <sub>1</sub> =	0.045	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.077777778	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>s</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.372      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.95	0.95	0.95	0.95	0.95	0.95	0.95

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.0744 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.168

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.505	0.755	0.953	1.167	1.220	1.488	1.765	2.075
Peak flow (l/s)	505	755	953	1167	1220	1488	1765	2075

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 4 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.007502	km <sup>2</sup>	Longest water path	L=	0.077	km	Area distribution factors (α + β + γ = 1)		
Water path (overland)	L <sub>1</sub> =	0.077	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes
Average slope:	H <sub>1</sub> =	97.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	β=	γ=
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	1	0	0
	L <sub>1</sub> =	0.077	km		0.75L=	0	km	0.091		
	S <sub>avg1</sub> =	0.090909091	m/m		S <sub>avg2</sub> =	0	m/m			
Area dolomite	D=	0%								

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	35%	0.18
Flat areas	60%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	40%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	45%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	20%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.146</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C<sub>1</sub>= 0.381      Urban coefficient C<sub>2</sub>= 0.64

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Adjusted C <sub>1</sub>	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Total C	0.38	0.38	0.38	0.38	0.38	0.38	0.38

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1028 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2081

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.058	0.087	0.110	0.135	0.141	0.172	0.204	0.240
Peak flow (l/s)	58	87	110	135	141	172	204	240

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 4 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.007502	km <sup>2</sup>	Longest water path	L=	0.077	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.077	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	97.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.85	β=	0.15	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m						
	L <sub>1</sub> =	0.077	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.090909091	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%						0.091					

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	60%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	40%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.146</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>r</sub>= 0.381      Urban coefficient C<sub>u</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Adjusted C <sub>1</sub>	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Total C	0.47	0.47	0.47	0.47	0.47	0.47	0.47

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1028 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2081

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D.)	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.072	0.107	0.135	0.165	0.173	0.211	0.250	0.294
Peak flow (l/s)	72	107	135	165	173	211	250	294

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 4 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.007502	km <sup>2</sup>	Longest water path	L=	0.077	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.077	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	97.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.091					
	L <sub>1</sub> =	0.077	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.090909091	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	60%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	100%	0.6
Hilly areas	40%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.146</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C<sub>1</sub>= 0.381      Urban coefficient C<sub>2</sub>= 0.60

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Adjusted C <sub>1</sub>	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Total C	0.60	0.60	0.60	0.60	0.60	0.60	0.60

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1028 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2081

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.092	0.138	0.174	0.213	0.222	0.271	0.322	0.378
Peak flow (l/s)	92	138	174	213	222	271	322	378

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 4 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.007502	km <sup>2</sup>	Longest water path	L=	0.077	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.077	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	97.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m						
	L <sub>1</sub> =	0.077	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.090909091	m/m		S <sub>avg2</sub> =	0	m/m	0.091					
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	60%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	40%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.146</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.381      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Adjusted C <sub>1</sub>	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Total C	0.95	0.95	0.95	0.95	0.95	0.95	0.95

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1028 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2081

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.146	0.218	0.275	0.337	0.352	0.429	0.509	0.599
Peak flow (l/s)	146	218	275	337	352	429	509	599

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 5 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.022075	km <sup>2</sup>	Longest water path	L=	0.079	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.079	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	95.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	1	β=	0	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.063					
	L <sub>1</sub> =	0.079	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.063291139	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.372      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.37	0.37	0.37	0.37	0.37	0.37	0.37

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.0957 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2292

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.168	0.251	0.317	0.388	0.406	0.495	0.587	0.690
Peak flow (l/s)	168	251	317	388	406	495	587	690

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 5 Post Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.022075	km <sup>2</sup>	Longest water path	L=	0.079	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.079	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	95.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.85	β=	0.15	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.063					
	L <sub>1</sub> =	0.079	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.063291139	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	40%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	45%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	15%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C <sub>1</sub> =	0.372	Urban coefficient C <sub>2</sub> =	0.60
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.41	0.41	0.41	0.41	0.41	0.41	0.41

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_C = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.2292	V = 0.0957 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_C = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0000 T <sub>c</sub> = 0.2500	V = #DIV/0! m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 -30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 -30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration	15 min													
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.183	0.274	0.346	0.423	0.443	0.540	0.641	0.753
Peak flow (l/s)	183	274	346	423	443	540	641	753

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 5 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.022075	km <sup>2</sup>	Longest water path	L=	0.079	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.079	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	95.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.063					
	L <sub>1</sub> =	0.079	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.063291139	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>s</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	100%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C<sub>1</sub>= 0.372      Urban coefficient C<sub>2</sub>= 0.60

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.60	0.60	0.60	0.60	0.60	0.60	0.60

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.0957 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2292

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.271	0.405	0.511	0.625	0.654	0.798	0.946	1.113
Peak flow (l/s)	271	405	511	625	654	798	946	1113

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 5 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.022075	km <sup>2</sup>	Longest water path	L=	0.079	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.079	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	95.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m						
	L <sub>1</sub> =	0.079	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.063291139	m/m		S <sub>avg2</sub> =	0	m/m	0.063					
Area dolomite	D=	0%											

RURAL								URBAN					
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)				VEGETATION C <sub>v</sub> (%)		USE					
Lakes and pans	0%	0.05	Very permeable		50%	0.05	Thick bush & plantations		0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable		50%	0.1	Light bush & cultivated areas		90%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable		0%	0.2	Grasveld		10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable		0%	0.3	No vegetation		0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>		

Rural coefficient C<sub>1</sub>= 0.372      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.95	0.95	0.95	0.95	0.95	0.95	0.95

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.0957 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2292

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.429	0.641	0.809	0.990	1.036	1.263	1.498	1.762
Peak flow (l/s)	429	641	809	990	1036	1263	1498	1762

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 6 Pre Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.062637	km <sup>2</sup>	Longest water path	L=	0.28	km	Area distribution factors (α + β + γ = 1)				
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.08	km	Rural	Urban	Lakes		
Average slope:	H <sub>1</sub> =	103.000	m	Average slope:	H <sub>0.85L</sub> =	90.000	m	α=	β=	γ=		
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	85.000	m					
	L <sub>1</sub> =	0.2	km		0.75L=	0.06	km					
	S <sub>avg1</sub> =	0.065	m/m		S <sub>avg2</sub> =	0.0833333	m/m				0.064	
Area dolomite	D=	0%										

RURAL								URBAN					
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)				VEGETATION C <sub>v</sub> (%)		USE					
Lakes and pans	0%	0.05	Very permeable		50%	0.05	Thick bush & plantations		0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable		50%	0.1	Light bush & cultivated areas		90%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable		0%	0.2	Grasveld		10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable		0%	0.3	No vegetation		0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>		

Rural coefficient C <sub>1</sub> =	0.372	Urban coefficient C <sub>2</sub> =	0.00
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.37	0.37	0.37	0.37	0.37	0.37	0.37

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.3515	V = 0.158 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0250 T <sub>c</sub> = 0.3765	V = 0.8889 m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 -30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 -30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration 22.592 min														
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	21.54	32.26	40.67	49.79	63.51	75.33	88.61
Point intensity I (mm/h)	57.2	85.7	108.0	132.2	168.7	200.1	235.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	57.2	85.7	108.0	132.2	168.7	200.1	235.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.370	0.555	0.699	0.856	0.895	1.092	1.295	1.523
Peak flow (l/s)	370	555	699	856	895	1092	1295	1523

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 6 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.062637	km <sup>2</sup>	Longest water path	L=	0.28	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.08	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	103.000	m	Average slope:	H <sub>0.85L</sub> =	90.000	m	α=	0.85	β=	0.15	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	85.000	m	0.064					
	L <sub>1</sub> =	0.2	km		0.75L=	0.06	km						
	S <sub>avg1</sub> =	0.065	m/m		S <sub>avg2</sub> =	0.0833333	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.372      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.46	0.46	0.46	0.46	0.46	0.46	0.46

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.158 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.3515

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0250      V = 0.8889 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3765

Storm duration 22.592 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	21.54	32.26	40.67	49.79	63.51	75.33	88.61
Point intensity I (mm/h)	57.2	85.7	108.0	132.2	168.7	200.1	235.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	57.2	85.7	108.0	132.2	168.7	200.1	235.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.457	0.684	0.862	1.055	1.104	1.346	1.597	1.878
Peak flow (l/s)	457	684	862	1055	1104	1346	1597	1878

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 6 Post Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.062637	km <sup>2</sup>	Longest water path	L=	0.28	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.08	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	103.000	m	Average slope:	H <sub>0.85L</sub> =	90.000	m	α=	0	β=	1	γ=	0
Overland	H <sub>1/2</sub> =	90.000	m	Watercourse	H <sub>0.10L</sub> =	85.000	m	0.064					
	L <sub>1</sub> =	0.2	km		0.75L=	0.06	km						
	S <sub>avg1</sub> =	0.065	m/m		S <sub>avg2</sub> =	0.0833333	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)				VEGETATION C <sub>v</sub> (%)		USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	70%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	100%	0.6
Hilly areas	30%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.137</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C <sub>1</sub> =	0.372	Urban coefficient C <sub>2</sub> =	0.60
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Adjusted C <sub>1</sub>	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Total C	0.60	0.60	0.60	0.60	0.60	0.60	0.60

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.3515	V = 0.158 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0250 T <sub>c</sub> = 0.3765	V = 0.8889 m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 -30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 -30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration 22.592 min														
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	21.54	32.26	40.67	49.79	63.51	75.33	88.61
Point intensity I (mm/h)	57.2	85.7	108.0	132.2	168.7	200.1	235.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	57.2	85.7	108.0	132.2	168.7	200.1	235.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.597	0.894	1.128	1.380	1.444	1.761	2.089	2.457
Peak flow (l/s)	597	894	1128	1380	1444	1761	2089	2457

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 7 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.156554	km <sup>2</sup>	Longest water path	L=	0.317	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.117	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	91.000	m	Average slope:	H <sub>0.85L</sub> =	70.000	m	α=	1	β=	0	γ=	0
Overland	H <sub>1/2</sub> =	70.000	m	Watercourse	H <sub>0.10L</sub> =	62.000	m	0.099					
	L <sub>1</sub> =	0.2	km		0.75L=	0.08775	km						
	S <sub>avg1</sub> =	0.105	m/m		S <sub>avg2</sub> =	0.0911681	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.41	0.41	0.41	0.41	0.41	0.41	0.41

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1768 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.3143

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0320      V = 1.0156 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3463

Storm duration 20.777 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	20.79	31.12	39.24	48.05	61.29	72.70	85.50
Point intensity I (mm/h)	60.0	89.9	113.3	138.7	177.0	209.9	246.9
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	60.0	89.9	113.3	138.7	177.0	209.9	246.9

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	1.065	1.595	2.011	2.462	2.575	3.140	3.725	4.381
Peak flow (l/s)	1065	1595	2011	2462	2575	3140	3725	4381

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 7 Post Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.156554	km <sup>2</sup>	Longest water path	L=	0.317	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.117	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	91.000	m	Average slope:	H <sub>0.85L</sub> =	70.000	m	α=	0.11	β=	0.89	γ=	0
Overland	H <sub>1/2</sub> =	70.000	m	Watercourse	H <sub>0.10L</sub> =	62.000	m	0.099					
	L <sub>1</sub> =	0.2	km		0.75L=	0.08775	km						
	S <sub>avg1</sub> =	0.105	m/m		S <sub>avg2</sub> =	0.0911681	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	98%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	2%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C <sub>1</sub> =	0.408	Urban coefficient C <sub>2</sub> =	0.61
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.59	0.59	0.59	0.59	0.59	0.59	0.59

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.3143	V = 0.1768 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0320 T <sub>c</sub> = 0.3463	V = 1.0156 m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 - 30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 - 30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 - 30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration 20.777 min														
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	20.79	31.12	39.24	48.05	61.29	72.70	85.50
Point intensity I (mm/h)	60.0	89.9	113.3	138.7	177.0	209.9	246.9
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	60.0	89.9	113.3	138.7	177.0	209.9	246.9

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	1.534	2.297	2.896	3.546	3.709	4.523	5.365	6.310
Peak flow (l/s)	1534	2297	2896	3546	3709	4523	5365	6310

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 8 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.096688	km <sup>2</sup>	Longest water path	L=	0.264	km	Area distribution factors (α + β + γ = 1)			
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.064	km	Rural	Urban	Lakes	
Average slope:	H <sub>1</sub> =	104.000	m	Average slope:	H <sub>0.85L</sub> =	66.000	m	α=	β=	γ=	
Overland	H <sub>1/2</sub> =	66.000	m	Watercourse	H <sub>0.10L</sub> =	60.000	m				
	L <sub>1</sub> =	0.2	km		0.75L=	0.048	km				
	S <sub>avg1</sub> =	0.19	m/m		S <sub>avg2</sub> =	0.125	m/m				
Area dolomite	D=	0%									0.156

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	15%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	80%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.192</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.427      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.43	0.43	0.43	0.43	0.43	0.43	0.43

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.203 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2736

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0180      V = 0.9877 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2916

**Storm duration 17.499 min**

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D.)	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	19.43	29.07	36.67	44.90	57.27	67.93	79.88
Point intensity I (mm/h)	66.6	99.7	125.7	153.9	196.4	232.9	273.9
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	66.6	99.7	125.7	153.9	196.4	232.9	273.9

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.763	1.142	1.440	1.763	1.844	2.249	2.668	3.137
Peak flow (l/s)	763	1142	1440	1763	1844	2249	2668	3137

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 8 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.096688	km <sup>2</sup>	Longest water path	L=	0.264	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.064	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	104.000	m	Average slope:	H <sub>0.85L</sub> =	66.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	66.000	m	Watercourse	H <sub>0.10L</sub> =	60.000	m	0.156					
	L <sub>1</sub> =	0.2	km		0.75L=	0.048	km						
	S <sub>avg1</sub> =	0.19	m/m		S <sub>avg2</sub> =	0.125	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	15%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	100%	0.6
Hilly areas	80%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.192</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C<sub>1</sub>= 0.427      Urban coefficient C<sub>2</sub>= 0.60

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.60	0.60	0.60	0.60	0.60	0.60	0.60

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_C = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.2736	V = 0.203 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_C = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0180 T <sub>c</sub> = 0.2916	V = 0.9877 m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 - 30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 - 30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 - 30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration	17.499 min													
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	19.43	29.07	36.67	44.90	57.27	67.93	79.88
Point intensity I (mm/h)	66.6	99.7	125.7	153.9	196.4	232.9	273.9
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	66.6	99.7	125.7	153.9	196.4	232.9	273.9

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	1.074	1.606	2.026	2.481	2.595	3.164	3.753	4.414
Peak flow (l/s)	1074	1606	2026	2481	2595	3164	3753	4414

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 9 Pre Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.004209 km <sup>2</sup>	Longest water path	L=	0.08 km	Area distribution factors (α + β + γ = 1)			
Water path (overland)	L <sub>1</sub> =	0.08 km				Rural	Urban	Lakes	
Average slope:	H <sub>1</sub> =	73.000 m	Water path (water course)	L <sub>2</sub> =	0 km	α=	β=	γ=	0
Overland	H <sub>2</sub> =	62.000 m	Average slope:	H <sub>0.85L</sub> =	0.000 m				
	L <sub>1</sub> =	0.08 km	Watercourse	H <sub>0.10L</sub> =	0.000 m				
	S <sub>avg1</sub> =	0.1375 m/m		0.75L=	0 km				
Area dolomite	D=	0%	S <sub>avg2</sub> =	0 m/m					0.138

RURAL						URBAN					
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	15%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	80%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.192</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C <sub>1</sub> =	0.427	Urban coefficient C <sub>2</sub> =	0.00
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.43	0.43	0.43	0.43	0.43	0.43	0.43

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.1924	V = 0.1155 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0000 T <sub>c</sub> = 0.2500	V = #DIV/0! m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 -30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 -30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration	15 min													
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.037	0.055	0.069	0.085	0.089	0.108	0.128	0.151
Peak flow (l/s)	37	55	69	85	89	108	128	151

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 9 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.004209	km <sup>2</sup>	Longest water path	L=	0.08	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.08	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	73.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	62.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.138					
	L <sub>1</sub> =	0.08	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.1375	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>s</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	30%	0.18
Flat areas	15%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	80%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	70%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.192</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.7</b>

Rural coefficient C<sub>1</sub>= 0.427      Urban coefficient C<sub>2</sub>= 0.72

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.72	0.72	0.72	0.72	0.72	0.72	0.72

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1155 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1924

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 - 30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.062	0.093	0.117	0.143	0.150	0.183	0.217	0.255
Peak flow (l/s)	62	93	117	143	150	183	217	255

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 10 Pre Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.058569 km <sup>2</sup>	Longest water path	L=	0.52 km	Area distribution factors (α + β + γ = 1)			
Water path (overland)	L <sub>1</sub> =	0.2 km				Rural	Urban	Lakes	
Average slope:	H <sub>1</sub> =	103.000 m	Water path (water course)	L <sub>2</sub> =	0.32 km	α=	β=	γ=	0
Overland	H <sub>2</sub> =	88.000 m	Average slope:	H <sub>0.85L</sub> =	88.000 m				
	L <sub>1</sub> =	0.2 km	Watercourse	H <sub>0.10L</sub> =	61.000 m				
	S <sub>avg1</sub> =	0.075 m/m		0.75L=	0.24 km				
Area dolomite	D=	0%	S <sub>avg2</sub> =	0.1125 m/m					0.177

RURAL							URBAN				
SLOPE SLOPE C <sub>s</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	65%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.178</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C <sub>1</sub> =	0.413	Urban coefficient C <sub>2</sub> =	0.00
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.41	0.41	0.41	0.41	0.41	0.41	0.41

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4 T <sub>c</sub> = 0.34	V = 0.1634 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0640 T <sub>c</sub> = 0.4040	V = 1.3889 m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 -30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 -30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration	24.239 min													
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22.22	33.29	41.97	51.37	65.53	77.73	91.43
Point intensity I (mm/h)	55.0	82.4	103.9	127.2	162.2	192.4	226.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	55.0	82.4	103.9	127.2	162.2	192.4	226.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.370	0.554	0.698	0.854	0.894	1.090	1.293	1.521
Peak flow (l/s)	370	554	698	854	894	1090	1293	1521

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 10 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.058569	km <sup>2</sup>	Longest water path	L=	0.52	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.32	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	103.000	m	Average slope:	H <sub>0.85L</sub> =	88.000	m	α=	0.28	β=	0.72	γ=	0
Overland	H <sub>12</sub> =	88.000	m	Watercourse	H <sub>0.10L</sub> =	61.000	m	0.177					
	L <sub>1</sub> =	0.2	km		0.75L=	0.24	km						
	S <sub>avg1</sub> =	0.075	m/m		S <sub>avg2</sub> =	0.1125	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	30%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	20%	0.6
Hilly areas	65%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	50%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.178</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C<sub>1</sub>= 0.413      Urban coefficient C<sub>2</sub>= 0.65

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.58	0.58	0.58	0.58	0.58	0.58	0.58

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1634 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.34

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0640      V = 1.3889 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.4040

Storm duration 24.239 min

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 - 30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22.22	33.29	41.97	51.37	65.53	77.73	91.43
Point intensity I (mm/h)	55.0	82.4	103.9	127.2	162.2	192.4	226.3
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	55.0	82.4	103.9	127.2	162.2	192.4	226.3

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.522	0.782	0.986	1.207	1.263	1.540	1.827	2.149
Peak flow (l/s)	522	782	986	1207	1263	1540	1827	2149

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 11 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.0917	km <sup>2</sup>	Longest water path	L=	0.315	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.115	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	92.000	m	Average slope:	H <sub>0.85L</sub> =	65.500	m	α=	1	β=	0	γ=	0
Overland	H <sub>12</sub> =	65.500	m	Watercourse	H <sub>0.10L</sub> =	57.000	m	0.116					
	L <sub>1</sub> =	0.2	km		0.75L=	0.08625	km						
	S <sub>avg1</sub> =	0.1325	m/m		S <sub>avg2</sub> =	0.0985507	m/m						
Area dolomite	D=	0%											

RURAL								URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)				VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable		50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable		50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	65%	0.2	Semi-permeable		0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable		0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.178</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>	

Rural coefficient C<sub>1</sub>= 0.413      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.41	0.41	0.41	0.41	0.41	0.41	0.41

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1866 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2977

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0310      V = 1.0305 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3287

Storm duration 19.721 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	20.35	30.46	38.41	47.03	59.99	71.16	83.69
Point intensity I (mm/h)	61.9	92.7	116.9	143.1	182.5	216.5	254.6
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	61.9	92.7	116.9	143.1	182.5	216.5	254.6

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.651	0.975	1.230	1.505	1.574	1.920	2.278	2.679
Peak flow (l/s)	651	975	1230	1505	1574	1920	2278	2679

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 11 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.0917	km <sup>2</sup>	Longest water path	L=	0.315	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.115	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	92.000	m	Average slope:	H <sub>0.85L</sub> =	65.500	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	65.500	m	Watercourse	H <sub>0.10L</sub> =	57.000	m	0.116					
	L <sub>1</sub> =	0.2	km		0.75L=	0.08625	km						
	S <sub>avg1</sub> =	0.1325	m/m		S <sub>avg2</sub> =	0.0985507	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	100%	0.6
Hilly areas	65%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.178</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.6</b>

Rural coefficient C<sub>1</sub>= 0.413      Urban coefficient C<sub>2</sub>= 0.60

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.60	0.60	0.60	0.60	0.60	0.60	0.60

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1866 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2977

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0310      V = 1.0305 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3287

Storm duration 19.721 min

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 - 30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	20.35	30.46	38.41	47.03	59.99	71.16	83.69
Point intensity I (mm/h)	61.9	92.7	116.9	143.1	182.5	216.5	254.6
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	61.9	92.7	116.9	143.1	182.5	216.5	254.6

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.946	1.416	1.786	2.187	2.287	2.790	3.309	3.891
Peak flow (l/s)	946	1416	1786	2187	2287	2790	3309	3891

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 12 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.009345	km <sup>2</sup>	Longest water path	L=	0.06	km	Area distribution factors (α + β + γ = 1)		
Water path (overland)	L <sub>1</sub> =	0.06	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes
Average slope:	H <sub>1</sub> =	73.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	β=	γ=
Overland	H <sub>1/2</sub> =	59.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	1	0	0
	L <sub>1</sub> =	0.06	km		0.75L=	0	km	0.233		
	S <sub>avg1</sub> =	0.233333333	m/m		S <sub>avg2</sub> =	0	m/m			
Area dolomite	D=	0%								

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	20%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	65%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	15%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.197</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>r</sub>= 0.432      Urban coefficient C<sub>u</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.43	0.43	0.43	0.43	0.43	0.43	0.43

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1121 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1487

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.083	0.123	0.156	0.191	0.199	0.243	0.288	0.339
Peak flow (l/s)	83	123	156	191	199	243	288	339

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 12 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.009345	km <sup>2</sup>	Longest water path	L=	0.06	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.06	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	73.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	59.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.233					
	L <sub>1</sub> =	0.06	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.233333333	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	20%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	65%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	15%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.197</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.432      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.95	0.95	0.95	0.95	0.95	0.95	0.95

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1121 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1487

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.182	0.271	0.342	0.419	0.438	0.535	0.634	0.746
Peak flow (l/s)	182	271	342	419	438	535	634	746

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 13 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.008165	km <sup>2</sup>	Longest water path	L=	0.07	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.07	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	70.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	1	β=	0	γ=	0
Overland	H <sub>1/2</sub> =	59.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m						
	L <sub>1</sub> =	0.07	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.157142857	m/m		S <sub>avg2</sub> =	0	m/m	0.157					
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	20%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	65%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	15%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.197</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.432      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.43	0.43	0.43	0.43	0.43	0.43	0.43

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_C = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.111 m/s  
T<sub>c</sub> = 0.1752      (0.2 - 0.5m/s)

T<sub>c</sub> (channel flow)

$$T_C = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s  
(0.8 - 1.3m/s)

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.072	0.108	0.136	0.167	0.174	0.212	0.252	0.296
Peak flow (l/s)	72	108	136	167	174	212	252	296

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 13 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.008165	km <sup>2</sup>	Longest water path	L=	0.07	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.07	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	70.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.85	β=	0.15	γ=	0
Overland	H <sub>1/2</sub> =	59.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.157					
	L <sub>1</sub> =	0.07	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.157142857	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	20%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	65%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	15%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.197</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.432      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.51	0.51	0.51	0.51	0.51	0.51	0.51

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.111 m/s  
T<sub>c</sub> = 0.1752      (0.2 - 0.5m/s)

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s  
(0.8 - 1.3m/s)

Storm duration 15 min

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 - 30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.085	0.127	0.160	0.197	0.206	0.251	0.297	0.350
Peak flow (l/s)	85	127	160	197	206	251	297	350

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 14 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.038518	km <sup>2</sup>	Longest water path	L=	0.22	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.02	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	86.000	m	Average slope:	H <sub>0.85L</sub> =	63.000	m	α=	1	β=	0	γ=	0
Overland	H <sub>1/2</sub> =	63.000	m	Watercourse	H <sub>0.10L</sub> =	60.000	m	0.106					
	L <sub>1</sub> =	0.2	km		0.75L=	0.015	km						
	S <sub>avg1</sub> =	0.115	m/m		S <sub>avg2</sub> =	0.2	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)				VEGETATION C <sub>v</sub> (%)		USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	20%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	75%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.187</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.422      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Adjusted C <sub>1</sub>	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Total C	0.42	0.42	0.42	0.42	0.42	0.42	0.42

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1806 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.3077

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0060      V = 0.9259 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3137

**Storm duration 18.821 min**

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	19.98	29.89	37.71	46.17	58.89	69.85	82.15
Point intensity I (mm/h)	63.7	95.3	120.2	147.2	187.7	222.7	261.9
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	63.7	95.3	120.2	147.2	187.7	222.7	261.9

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.288	0.430	0.543	0.665	0.695	0.848	1.005	1.182
Peak flow (l/s)	288	430	543	665	695	848	1005	1182

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 14 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.038518	km <sup>2</sup>	Longest water path	L=	0.22	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.2	km	Water path (water course)	L <sub>2</sub> =	0.02	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	86.000	m	Average slope:	H <sub>0.85L</sub> =	63.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	63.000	m	Watercourse	H <sub>0.10L</sub> =	60.000	m	0.106					
	L <sub>1</sub> =	0.2	km		0.75L=	0.015	km						
	S <sub>avg1</sub> =	0.115	m/m		S <sub>avg2</sub> =	0.2	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	20%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	75%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	5%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.187</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.422      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Adjusted C <sub>1</sub>	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Total C	0.95	0.95	0.95	0.95	0.95	0.95	0.95

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1806 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.3077

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0060      V = 0.9259 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3137

**Storm duration 18.821 min**

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	19.98	29.89	37.71	46.17	58.89	69.85	82.15
Point intensity I (mm/h)	63.7	95.3	120.2	147.2	187.7	222.7	261.9
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	63.7	95.3	120.2	147.2	187.7	222.7	261.9

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.647	0.969	1.222	1.496	1.565	1.908	2.263	2.662
Peak flow (l/s)	647	969	1222	1496	1565	1908	2263	2662

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 15 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.004887	km <sup>2</sup>	Longest water path	L=	0.078	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.078	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	68.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	1	β=	0	γ=	0
Overland	H <sub>1/2</sub> =	58.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.128					
	L <sub>1</sub> =	0.078	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.128205128	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	10%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	90%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.191</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.426      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.43	0.43	0.43	0.43	0.43	0.43	0.43

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1121 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1932

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.043	0.064	0.080	0.098	0.103	0.125	0.149	0.175
Peak flow (l/s)	43	64	80	98	103	125	149	175

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 15 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.004887	km <sup>2</sup>	Longest water path	L=	0.078	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.078	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	68.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.85	β=	0.15	γ=	0
Overland	H <sub>1/2</sub> =	58.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.128					
	L <sub>1</sub> =	0.078	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.128205128	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	10%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	90%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.191</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.426      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Adjusted C <sub>1</sub>	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Total C	0.50	0.50	0.50	0.50	0.50	0.50	0.50

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1121 m/s  
T<sub>c</sub> = 0.1932      (0.2 - 0.5m/s)

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s  
T<sub>c</sub> = 0.2500      (0.8 - 1.3m/s)

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.050	0.075	0.095	0.116	0.122	0.149	0.176	0.207
Peak flow (l/s)	50	75	95	116	122	149	176	207

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 16 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.030972	km <sup>2</sup>	Longest water path	L=	0.079	km	Area distribution factors (α + β + γ = 1)		
Water path (overland)	L <sub>1</sub> =	0.079	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes
Average slope:	H <sub>1</sub> =	97.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	β=	γ=
Overland	H <sub>1/2</sub> =	85.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	1	0	0
	L <sub>1</sub> =	0.079	km		0.75L=	0	km	0.152		
	S <sub>avg1</sub> =	0.151898734	m/m		S <sub>avg2</sub> =	0	m/m			
Area dolomite	D=	0%								

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.41	0.41	0.41	0.41	0.41	0.41	0.41

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_C = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1174 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1889

T<sub>c</sub> (channel flow)

$$T_C = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D.)	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.258	0.386	0.487	0.597	0.624	0.761	0.903	1.061
Peak flow (l/s)	258	386	487	597	624	761	903	1061

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 16 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.030972	km <sup>2</sup>	Longest water path	L=	0.079	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.079	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	97.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.85	β=	0.15	γ=	0
Overland	H <sub>1/2</sub> =	85.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.152					
	L <sub>1</sub> =	0.079	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.151898734	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.49	0.49	0.49	0.49	0.49	0.49	0.49

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1174 m/s  
T<sub>c</sub> = 0.1869      (0.2 - 0.5m/s)

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s  
T<sub>c</sub> = 0.2500      (0.8 - 1.3m/s)

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.310	0.463	0.584	0.716	0.748	0.913	1.083	1.273
Peak flow (l/s)	310	463	584	716	748	913	1083	1273

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 16 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.030972	km <sup>2</sup>	Longest water path	L=	0.079	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.079	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	97.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	85.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.152					
	L <sub>1</sub> =	0.079	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.151898734	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.95	0.95	0.95	0.95	0.95	0.95	0.95

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1174 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1869

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.602	0.899	1.134	1.389	1.453	1.772	2.102	2.472
Peak flow (l/s)	602	899	1134	1389	1453	1772	2102	2472

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 16 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.030972	km <sup>2</sup>	Longest water path	L=	0.079	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.079	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	97.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	85.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.152					
	L <sub>1</sub> =	0.079	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.151898734	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.95	0.95	0.95	0.95	0.95	0.95	0.95

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1174 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1869

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.602	0.899	1.134	1.389	1.453	1.772	2.102	2.472
Peak flow (l/s)	602	899	1134	1389	1453	1772	2102	2472

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 17 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.0267	km <sup>2</sup>	Longest water path	L=	0.078	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.078	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	68.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	1.00	β=	0.00	γ=	0
Overland	H <sub>2</sub> =	57.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m						
	L <sub>1</sub> =	0.078	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.141025641	m/m		S <sub>avg2</sub> =	0	m/m	0.141					
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.41	0.41	0.41	0.41	0.41	0.41	0.41

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1146 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.189

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.223	0.333	0.420	0.514	0.538	0.656	0.778	0.915
Peak flow (l/s)	223	333	420	514	538	656	778	915

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 18 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.0267	km <sup>2</sup>	Longest water path	L=	0.078	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.078	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	68.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	57.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.141					
	L <sub>1</sub> =	0.078	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.141025641	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	100%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.9</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.85

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.85	0.85	0.85	0.85	0.85	0.85	0.85

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1146 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.189

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 - 30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.464	0.693	0.875	1.072	1.121	1.367	1.621	1.906
Peak flow (l/s)	464	693	875	1072	1121	1367	1621	1906

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 18 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.0174	km <sup>2</sup>	Longest water path	L=	0.052	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.052	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1,1</sub> =	65.000	m	Average slope:	H <sub>0,85L</sub> =	0.000	m	α=	1.00	β=	0.00	γ=	0
Overland	H <sub>1,2</sub> =	59.000	m	Watercourse	H <sub>0,10L</sub> =	0.000	m	0.115					
	L <sub>1</sub> =	0.052	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.115384615	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.41	0.41	0.41	0.41	0.41	0.41	0.41

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.0881 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1639

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.145	0.217	0.274	0.335	0.351	0.428	0.507	0.596
Peak flow (l/s)	145	217	274	335	351	428	507	596

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 18 Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.0174	km <sup>2</sup>	Longest water path	L=	0.052	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.052	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	65.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1/2</sub> =	59.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.115					
	L <sub>1</sub> =	0.052	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.115384615	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	100%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.9</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.85

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.85	0.85	0.85	0.85	0.85	0.85	0.85

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.0881 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1639

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.302	0.452	0.570	0.698	0.730	0.891	1.057	1.242
Peak flow (l/s)	302	452	570	698	730	891	1057	1242

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Area 19 Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.00577	km <sup>2</sup>	Longest water path	L=	0.057	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.057	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1,1</sub> =	68.500	m	Average slope:	H <sub>0,85L</sub> =	0.000	m	α=	1.00	β=	0.00	γ=	0
Overland	H <sub>1,2</sub> =	60.500	m	Watercourse	H <sub>0,10L</sub> =	0.000	m	0.14					
	L <sub>1</sub> =	0.057	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.140350877	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	100%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>1.0</b>

Rural coefficient C<sub>1</sub>= 0.408      Urban coefficient C<sub>2</sub>= 0.95

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.41	0.41	0.41	0.41	0.41	0.41	0.41

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.0969 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.1634

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.048	0.072	0.091	0.111	0.116	0.142	0.168	0.198
Peak flow (l/s)	48	72	91	111	116	142	168	198

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Area 19 Post Development	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.00577	km <sup>2</sup>	Longest water path	L=	0.057	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.057	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1,1</sub> =	68.500	m	Average slope:	H <sub>0,85L</sub> =	0.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>1,2</sub> =	60.500	m	Watercourse	H <sub>0,10L</sub> =	0.000	m	0.14					
	L <sub>1</sub> =	0.057	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.140350877	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	30%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	70%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	100%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.173</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.9</b>

Rural coefficient C <sub>1</sub> =	0.408	Urban coefficient C <sub>2</sub> =	0.85
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Adjusted C <sub>1</sub>	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Total C	0.85	0.85	0.85	0.85	0.85	0.85	0.85

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_C = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.4	V = 0.0969 m/s (0.2 - 0.5m/s)	<b>Values for r</b>
		T <sub>c</sub> = 0.1634		Paved areas 0.02
T <sub>c</sub> (channel flow)	$T_C = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0000	V = #DIV/0! m/s (0.8 - 1.3m/s)	Clean soil 0.1
		T <sub>c</sub> = 0.2500		Sparse Grass 0.3
		<b>Storm duration 15 min</b>		Moderate Grass 0.4
Average annual rainfall:	1018 mm / annum			Thick Bush 0.8
Rainfall region:	Summer			<b>Dolomite reduction (D<sub>i</sub>)</b>
				Steep (>30%) 0.5
				Hilly (10 - 30%) 0.35
				Flat (3 - 10%) 0.2
				Vlei's & Pans (<3%) 0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.100	0.150	0.189	0.232	0.242	0.295	0.350	0.412
Peak flow (l/s)	100	150	189	232	242	295	350	412

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Park Pre Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.053818	km <sup>2</sup>	Longest water path	L=	0.13	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.13	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	108.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	1	β=	0	γ=	0
Overland	H <sub>1/2</sub> =	91.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.131					
	L <sub>1</sub> =	0.13	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.130769231	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	0%	0.18
Flat areas	50%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	50%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.155</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>0%</b>	<b>0.0</b>

Rural coefficient C<sub>1</sub>= 0.390      Urban coefficient C<sub>2</sub>= 0.00

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Adjusted C <sub>1</sub>	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Total C	0.39	0.39	0.39	0.39	0.39	0.39	0.39

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1479 m/s  
T<sub>c</sub> = 0.2442      (0.2 - 0.5m/s)

Values for r

Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s  
(0.8 - 1.3m/s)

Dolomite reduction (D<sub>i</sub>)

Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Storm duration 15 min

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.429	0.641	0.809	0.991	1.037	1.264	1.500	1.763
Peak flow (l/s)	429	641	809	991	1037	1264	1500	1763

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Park Post Development **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.053818	km <sup>2</sup>	Longest water path	L=	0.13	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.13	km	Water path (water course)	L <sub>2</sub> =	0	km	Rural	Urban	Lakes			
Average slope:	H <sub>11</sub> =	108.000	m	Average slope:	H <sub>0.85L</sub> =	0.000	m	α=	0.00	β=	1.00	γ=	0
Overland	H <sub>12</sub> =	91.000	m	Watercourse	H <sub>0.10L</sub> =	0.000	m	0.131					
	L <sub>1</sub> =	0.13	km		0.75L=	0	km						
	S <sub>avg1</sub> =	0.130769231	m/m		S <sub>avg2</sub> =	0	m/m						
Area dolomite	D=	0%											

RURAL							URBAN				
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	0%	0.05	Very permeable	50%	0.05	Thick bush & plantations	0%	0.05	Lawns & Parks	100%	0.3
Flat areas	50%	0.11	Permeable	50%	0.1	Light bush & cultivated areas	90%	0.15	Residential	0%	0.6
Hilly areas	50%	0.2	Semi-permeable	0%	0.2	Grasveld	10%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	0%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.155</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.075</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.16</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.3</b>

Rural coefficient C<sub>1</sub>= 0.390      Urban coefficient C<sub>2</sub>= 0.30

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Adjusted C <sub>1</sub>	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Total C	0.30	0.30	0.30	0.30	0.30	0.30	0.30

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.4      V = 0.1479 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2442

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0000      V = #DIV/0! m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.2500

Storm duration 15 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 - 30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	18.40	27.50	34.70	42.50	54.20	64.30	75.60
Point intensity I (mm/h)	73.6	110.0	138.8	170.0	216.8	257.2	302.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	73.6	110.0	138.8	170.0	216.8	257.2	302.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.330	0.493	0.622	0.762	0.797	0.972	1.153	1.356
Peak flow (l/s)	330	493	622	762	797	972	1153	1356

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Wetland 3 **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.0307	km <sup>2</sup>	Longest water path	L=	0.21	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.101	km	Water path (water course)	L <sub>2</sub> =	0.109	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	59.500	m	Average slope:	H <sub>0.85L</sub> =	53.000	m	α=	1.00	β=	0.00	γ=	0
Overland	H <sub>12</sub> =	53.000	m	Watercourse	H <sub>0.10L</sub> =	48.500	m	0.073					
	L <sub>1</sub> =	0.101	km		0.75L=	0.08175	km						
	S <sub>avg1</sub> =	0.064356436	m/m		S <sub>avg2</sub> =	0.0550459	m/m						
Area dolomite	D=	0%											

RURAL						URBAN					
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	10%	0.05	Very permeable	0%	0.05	Thick bush & plantations	10%	0.05	Lawns & Parks	100%	0.3
Flat areas	60%	0.11	Permeable	10%	0.1	Light bush & cultivated areas	60%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable	60%	0.2	Grasveld	20%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	30%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.131</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.22</b>	<b>Total (100)</b>	<b>90%</b>	<b>0.15</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.3</b>

Rural coefficient C<sub>1</sub>= 0.496      Urban coefficient C<sub>2</sub>= 0.30

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Adjusted C <sub>1</sub>	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Total C	0.50	0.50	0.50	0.50	0.50	0.50	0.50

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.8      V = 0.0793 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.354

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0370      V = 0.8183 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3910

**Storm duration 23.459 min**

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	21.90	32.80	41.35	50.62	64.58	76.59	90.09
Point intensity I (mm/h)	56.0	83.9	105.8	129.5	165.2	195.9	230.4
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	56.0	83.9	105.8	129.5	165.2	195.9	230.4

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.237	0.355	0.447	0.548	0.573	0.699	0.829	0.975
Peak flow (l/s)	237	355	447	548	573	699	829	975

<b>Description of catchment:</b>	Sibaya Node 6	<b>Calculated by:</b>	
<b>Element Description:</b>	Wetland 3	<b>Date:</b>	Monday, 11 November 2019
<b>Project Number:</b>	2019_0173	<b>Source:</b>	SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.027725 km <sup>2</sup>	Longest water path	L=	0.3 km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.07 km				Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	66.000 m	Water path (water course)	L <sub>2</sub> =	0.23 km	α=	1.00	β=	0.00	γ=	0
Overland	H <sub>2</sub> =	59.000 m	Average slope:	H <sub>0.85L</sub> =	59.000 m	0.156					
	L <sub>1</sub> =	0.07 km		H <sub>0.10L</sub> =	51.500 m						
	S <sub>avg1</sub> =	0.1 m/m		0.75L=	0.1725 km						
Area dolomite	D=	0%	Watercourse	S <sub>avg2</sub> =	0.0434783 m/m						

RURAL						URBAN					
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)		USE				
Lakes and pans	10%	0.05	Very permeable	0%	0.05	Thick bush & plantations	10%	0.05	Lawns & Parks	100%	0.3
Flat areas	60%	0.11	Permeable	10%	0.1	Light bush & cultivated areas	60%	0.15	Residential	0%	0.6
Hilly areas	30%	0.2	Semi-permeable	60%	0.2	Grasveld	20%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	30%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.131</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.22</b>	<b>Total (100)</b>	<b>90%</b>	<b>0.15</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.3</b>

Rural coefficient C <sub>1</sub> =	0.496	Urban coefficient C <sub>2</sub> =	0.30
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Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Adjusted C <sub>1</sub>	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Total C	0.50	0.50	0.50	0.50	0.50	0.50	0.50

**RAINFALL:**

T <sub>c</sub> (overland flow)	$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0.8 T <sub>c</sub> = 0.2691	V = 0.0723 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0.02</td></tr> <tr><td>Clean soil</td><td>0.1</td></tr> <tr><td>Sparse Grass</td><td>0.3</td></tr> <tr><td>Moderate Grass</td><td>0.4</td></tr> <tr><td>Thick Bush</td><td>0.8</td></tr> </table>	Values for r		Paved areas	0.02	Clean soil	0.1	Sparse Grass	0.3	Moderate Grass	0.4	Thick Bush	0.8
Values for r																
Paved areas	0.02															
Clean soil	0.1															
Sparse Grass	0.3															
Moderate Grass	0.4															
Thick Bush	0.8															
T <sub>c</sub> (channel flow)	$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T <sub>c</sub> = 0.0720 T <sub>c</sub> = 0.3411	V = 0.8873 m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D<sub>i</sub>)</th></tr> <tr><td>Steep (&gt;30%)</td><td>0.5</td></tr> <tr><td>Hilly (10 - 30%)</td><td>0.35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0.2</td></tr> <tr><td>Vlei's &amp; Pans (&lt;3%)</td><td>0.1</td></tr> </table>	Dolomite reduction (D <sub>i</sub> )		Steep (>30%)	0.5	Hilly (10 - 30%)	0.35	Flat (3 - 10%)	0.2	Vlei's & Pans (<3%)	0.1		
Dolomite reduction (D <sub>i</sub> )																
Steep (>30%)	0.5															
Hilly (10 - 30%)	0.35															
Flat (3 - 10%)	0.2															
Vlei's & Pans (<3%)	0.1															
Average annual rainfall:	1018 mm / annum	Storm duration	20.467 min													
Rainfall region:	Summer															

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	20.66	30.93	39.00	47.75	60.91	72.25	84.97
Point intensity I (mm/h)	60.6	90.7	114.3	140.0	178.5	211.8	249.1
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	60.6	90.7	114.3	140.0	178.5	211.8	249.1

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.231	0.346	0.437	0.535	0.559	0.682	0.809	0.951
Peak flow (l/s)	231	346	437	535	559	682	809	951

**Description of catchment:** Sibaya Node 6 **Calculated by:**  
**Element Description:** Wetland 3 **Date:** Monday, 11 November 2019  
**Project Number:** 2019\_0173 **Source:** SANRAL, 2007

**PHYSICAL PROPERTIES OF CATCHMENT:**

Area of catchment:	A=	0.043	km <sup>2</sup>	Longest water path	L=	0.356	km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L <sub>1</sub> =	0.076	km	Water path (water course)	L <sub>2</sub> =	0.28	km	Rural	Urban	Lakes			
Average slope:	H <sub>1</sub> =	64.000	m	Average slope:	H <sub>0.85L</sub> =	58.000	m	α=	1.00	β=	0.00	γ=	0
Overland	H <sub>1/2</sub> =	58.000	m	Watercourse	H <sub>0.10L</sub> =	51.000	m	0.182					
	L <sub>1</sub> =	0.076	km		0.75L=	0.21	km						
	S <sub>avg1</sub> =	0.078947368	m/m		S <sub>avg2</sub> =	0.03333333	m/m						
Area dolomite	D=	0%											

RURAL						URBAN					
SLOPE SLOPE C <sub>S</sub> (%)		PERMEABILITY C <sub>p</sub> (%)			VEGETATION C <sub>v</sub> (%)			USE			
Lakes and pans	30%	0.05	Very permeable	0%	0.05	Thick bush & plantations	50%	0.05	Lawns & Parks	100%	0.3
Flat areas	50%	0.11	Permeable	10%	0.1	Light bush & cultivated areas	30%	0.15	Residential	0%	0.6
Hilly areas	20%	0.2	Semi-permeable	60%	0.2	Grasveld	20%	0.25	City / Industrial	0%	0.85
Mountaneous	0%	0.3	Unpermeable	30%	0.3	No vegetation	0%	0.3	Streets and roofs	0%	0.95
<b>Total (100)</b>	<b>100%</b>	<b>0.11</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.22</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.12</b>	<b>Total (100)</b>	<b>100%</b>	<b>0.3</b>

Rural coefficient C<sub>1</sub>= 0.450      Urban coefficient C<sub>2</sub>= 0.30

Return period	2	5	10	20	50	100	200
F <sub>t</sub>	1	1	1	1	1	1	1
C	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Adjusted C <sub>1</sub>	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Total C	0.45	0.45	0.45	0.45	0.45	0.45	0.45

**RAINFALL:**

T<sub>c</sub> (overland flow)

$$T_c = 0.604 \times \left( \frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r = 0.8      V = 0.0714 m/s (0.2 - 0.5m/s)  
T<sub>c</sub> = 0.2955

T<sub>c</sub> (channel flow)

$$T_c = \left( \frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T<sub>c</sub> = 0.0920      V = 0.8454 m/s (0.8 - 1.3m/s)  
T<sub>c</sub> = 0.3875

Storm duration 23.251 min

Values for r	
Paved areas	0.02
Clean soil	0.1
Sparse Grass	0.3
Moderate Grass	0.4
Thick Bush	0.8

Dolomite reduction (D <sub>i</sub> )	
Steep (>30%)	0.5
Hilly (10 -30%)	0.35
Flat (3 - 10%)	0.2
Vlei's & Pans (<3%)	0.1

Average annual rainfall: 1018 mm / annum  
Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	21.81	32.67	41.19	50.42	64.32	76.29	89.74
Point intensity I (mm/h)	56.3	84.3	106.3	130.1	166.0	196.9	231.6
Area reduction factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average intensity I (mm/hr)	56.3	84.3	106.3	130.1	166.0	196.9	231.6

**PEAK FLOW:**

Return period	2	5	10	20	25	50	100	200
Peak flow (m <sup>3</sup> /s)	0.303	0.453	0.571	0.699	0.731	0.892	1.058	1.245
Peak flow (l/s)	303	453	571	699	731	892	1058	1245