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STEYN CITY DEVELOPMENT

RIVERSIDE VIEW EXT 84

STORMWATER MANAGMENT REPORT

AUGUST 2020

COMPILED BY: A COMLEY
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TEKCIV CONSULTING ENGINEERS
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1. Background

The site for the proposed township of Riverside View Extension 84 is situated in Riverside View, north of Johannesburg within the City of Johannesburg's Region A. The site is surrounded by the Steyn City Development, Riverside View and Riversands.

The intention of the development is to create a place of instruction, residential buildings, and offices with ancillary purposes such as restaurants and shops.
Refer to ***Annexure A*** for the Site Development Plan.

Tekciv Consulting Engineers has been appointed as the engineers to prepare a Stormwater Management Report for the proposed development.

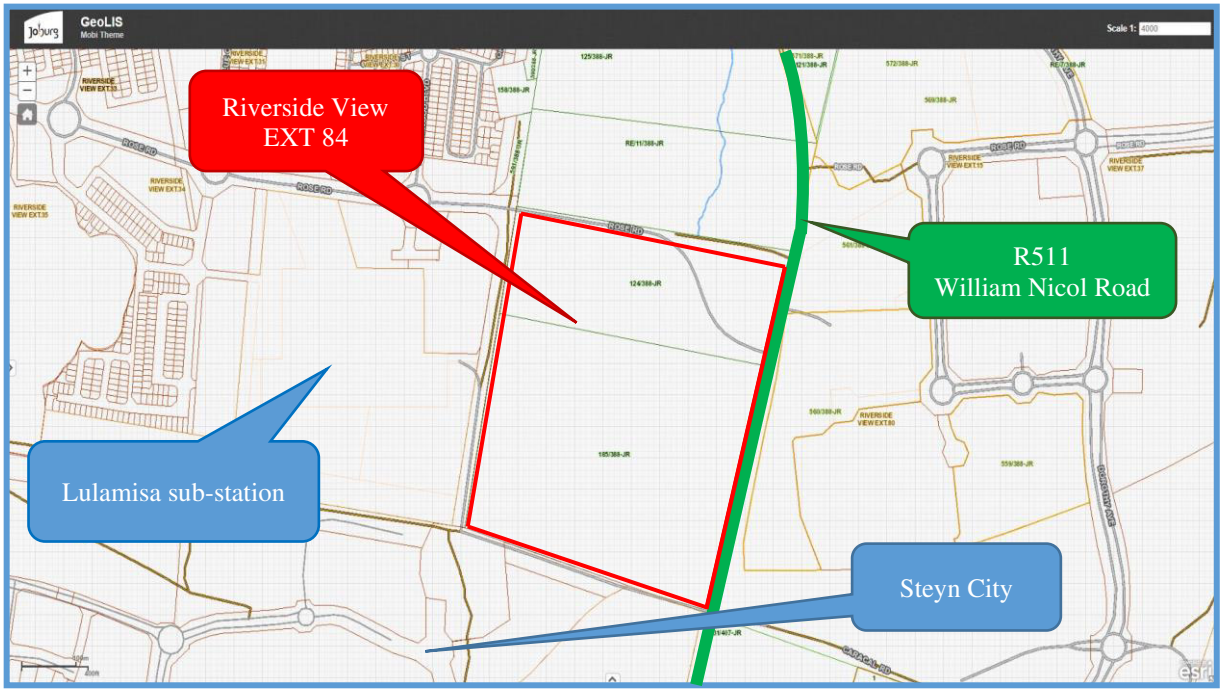
This report provides information regarding the stormwater drainage and sustainable management requirements of the new development for the approval by the City of Johannesburg.

2. Site Locality

The site is situated on Portion 124 and 185 of Farm Diepsloot 388-JR – Province of Gauteng. The site is bound by Porcupine Park Avenue to the north, a Provincial Road (William Nicol Drive, R511) to the east, Zeven Road to the south and View Road to the west.

The Lulamisa sub-station lies directly to the west of the site.

The Joburg GeoLIS map extract below indicates the location of the site. See ***Annexure B*** for a larger version.



3. Site Characteristics

3.1 Area and Rainfall

The total site measures some 25 570 m^2.
Elevation across the site ranges from 1422m to 1392m.
The annual rainfall in this area is 750 mm.

3.2 Site Topography

The site currently has no buildings on it and is covered in veld grass and several medium and large trees which are scattered around the site.

The site is at an elevation of 1422m on the southern boundary and falls to 1392m at the northern boundary. The average grade across the whole site is 6.73%.

There is a wetland area flowing northward through the site. As per the SDP a wetland and buffer area of approximately 5500 m^2 has been created.

The Joburg GeoLIS map extract below shows the topography and vegetation of the site.

4. Zoning

The site is currently zoned as “undetermined”. The proposed township will consist of 3 erven, namely erf 1, 2 and 3. The new zoning for the site will be:

ERF	1&2	3
Zoning	Special	Private Open Space
FAR	0.6	0.01
Density	Shall not exceed 20 du/ha	N/A
Height Restriction	5 storeys	1 storey
Parking	As per scheme	As per scheme
	As per scheme	As per scheme

Refer to **Annexure A** for each erf demarcation.

5. Storm water Management

Storm water management of the site is crucial to ensure that the developer complies with the City of Joburg regulations in terms of attenuation and control of the run-off as well as the protection of the environment. The management system proposed is in line with the latest SUDS guidelines.

5.1 Existing Storm Water Infrastructure

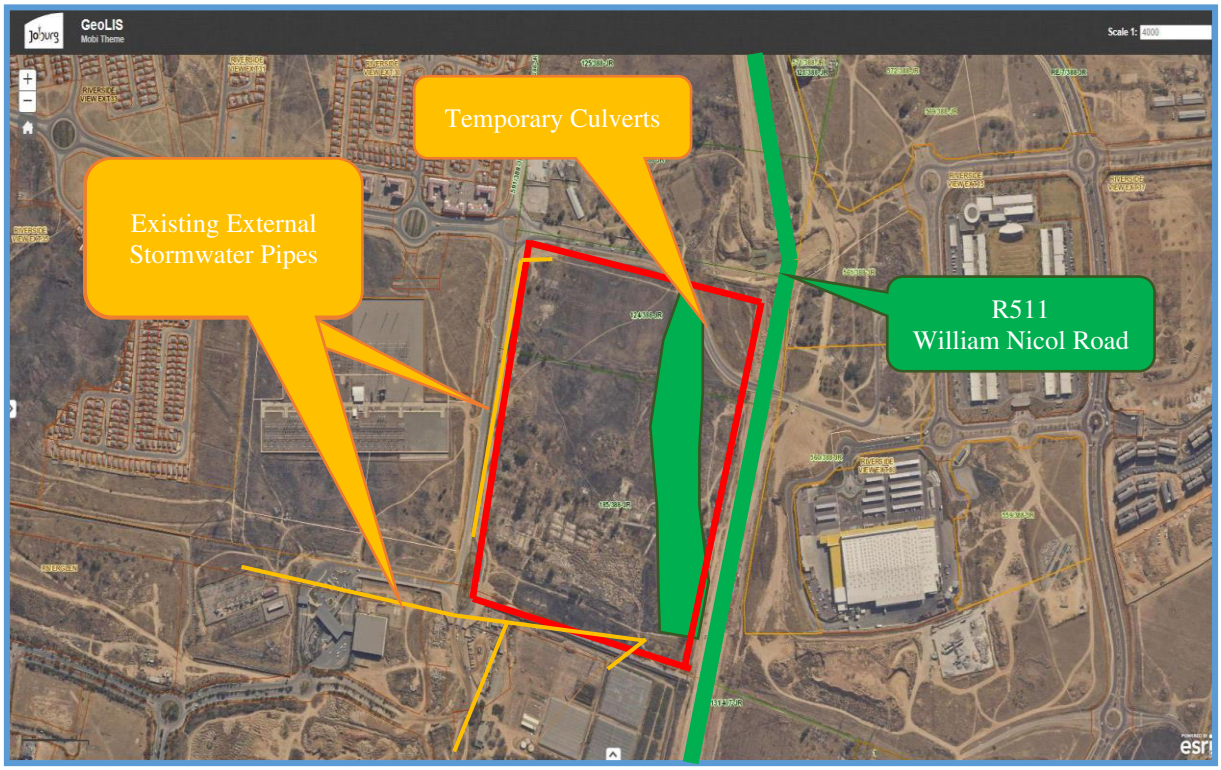
A survey of the site, as well as information supplied by the Johannesburg Roads Agency have indicated that there is currently no formal stormwater infrastructure in the area into which the site can connect. However, there are three temporary culverts under Porcupine Park Avenue that allows site drainage to the lower lying area.

The stormwater pipes in View Road discharges onto the north western side of the property and then drains overland towards the wetland portion of the site.

Bigen Africa have calculated the flow for both the 1: 50 and the1:100-year flood line for the wetland, considering the full catchment, the existing infrastructure as well as future development of the William Nicol Road to the east of the site.

A copy of the flood line with catchment area is attached as ***Annexure C.***

The Joburg GeoLIS map below indicates the position of the external stormwater infrastructure.



A larger copy of the map is available as ***Annexure D.***

5.2 Storm Water Run-Off and Model Selection

The Rational method is an accepted method to determine the peak flow in terms of run-off from a site and has been selected to calculate the run-off and attenuation requirements for the full extent of the site.

Due to the layout and topography of the site, and the constraints caused by the wetland area, as well as an Eskom Servitude running through the northern portion of the site, it is proposed that site be split into separate catchments and create separate attenuation ponds to manage the flow from each section. See ***Annexure E*** for drawing 1574/84/310 showing the separate attenuation ponds with their respective catchment area.

The runoff for each respective catchment area is summarised below:

5.2.1 Catchment Area #1 (School Parking):

Table showing Site run-off characteristics

	Pre-Developed	Post-Developed
Area	14 200 m^2	14 200 m^2
Longest watercourse	60 m	280 m
Average slope	0.069 m/m	0.017 m/m
Roughness C	0.29	0.98

Table showing Results for Pre-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	70.8	96.2	116.4	159.4	177.1	212.5	258.0
Flow Q m3/s	0.06	0.09	0.11	0.16	0.18	0.23	0.30

Table showing Results for Post-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	63.2	88.4	120.4	143.6	166.4	196.0	244.8
Flow Q m3/s	0.24	0.34	0.46	0.55	0.64	0.79	0.94

5.2.2 Catchment Area #2 (School buildings):

Table showing Site run-off characteristics

	Pre-Developed	Post-Developed
Area	71 000 m^2	71 000 m^2
Longest watercourse	340 m	200 m
Average slope	0.057 m/m	0.041 m/m
Roughness C	0.29	0.40

Table showing Results for Pre-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	49.0	69.8	89.8	111.7	131.3	153.0	195.5
Flow Q m3/s	0.21	0.32	0.44	0.58	0.68	0.83	1.12

Table showing Results for Post-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	63.2	88.4	120.4	143.6	166.4	196.0	244.8
Flow Q m3/s	0.50	0.70	0.95	1.14	1.32	1.55	1.94

5.2.3 Catchment Area #3 (Office Area):

Table showing Site run-off characteristics

	Pre-Developed	Post-Developed
Area	60 150 m^2	60 150 m^2
Longest watercourse	395 m	360 m
Average slope	0.063 m/m	0.067 m/m
Roughness C	0.28	0.39

Table showing Results for Pre-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	43.5	63.4	82.2	102.7	113.4	132.9	166.9
Flow Q m3/s	0.16	0.24	0.33	0.44	0.49	0.60	0.79

Table showing Results for Post-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	63.2	88.4	120.4	143.6	166.4	196.0	244.8
Flow Q m3/s	0.41	0.57	0.78	0.93	1.08	1.27	1.59

5.2.4 Catchment Area #4 (Office Park and Residential Area East):

Table showing Site run-off characteristics

	Pre-Developed	Post-Developed
Area	16 050 m^2	16 050 m^2
Longest watercourse	150 m	145 m
Average slope	0.057 m/m	0.033 m/m
Roughness C	0.29	0.69

Table showing Results for Pre-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	58.3	75.7	98.1	127.1	142.2	167.2	214.2
Flow Q m3/s	0.06	0.08	0.11	0.15	0.17	0.21	0.28

Table showing Results for Post-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	63.2	88.4	120.4	143.6	166.4	196.0	244.8
Flow Q m3/s	0.19	0.27	0.37	0.44	0.51	0.60	0.74

5.2.5 Catchment Area #5 (Office Park and Residential Area West):

Table showing Site run-off characteristics

	Pre-Developed	Post-Developed
Area	21 600 m^2	8 700 m^2
Longest watercourse	250 m	240 m
Average slope	0.079 m/m	0.039 m/m
Roughness C	0.29	0.43

Table showing Results for Pre-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	53.8	72.5	88.5	111.7	135.1	159.9	191.6
Flow Q m3/s	0.07	0.10	0.13	0.17	0.21	0.26	0.33

Table showing Results for Post-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	63.2	88.4	120.4	143.6	1664	196.0	244.8
Flow Q m3/s	0.16	0.22	0.31	0.37	0.42	0.50	0.62

5.2.5 Catchment Area #6 (Courtyard Area and Soccer Field):

Table showing Site run-off characteristics

	Pre-Developed	Post-Developed
Area	15 150 m^2	15 150 m^2
Longest watercourse	140 m	140 m
Average slope	0.071 m/m	0.033 m/m
Roughness C	0.29	0.36

Table showing Results for Pre-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	55.1	78.1	104.4	130.5	145.9	175.0	213.7
Flow Q m3/s	0.05	0.08	0.11	0.14	0.16	0.20	0.26

Table showing Results for Post-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	63.2	88.4	120.4	1443.6	166.4	196.0	244.8
Flow Q m3/s	0.10	0.14	0.18	0.22	0.25	0.30	0.37

5.2.5 Catchment Area #7 (Total Site):

Table showing Site run-off characteristics

	Pre-Developed	Post-Developed
Area	199 890 m^2	199 860 m^2
Longest watercourse	600 m	620 m
Average slope	0.069 m/m	0.045 m/m
Roughness C	0.29	0.47

Table showing Results for Pre-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	3832	55.3	71.0	88.6	104.7	121.8	151.0
Flow Q m3/s	0.46	0.71	0.97	1.28	1.53	1.86	2.43

Table showing Results for Post-Developed run off:

Return Period	1:2	1:5	1:10	1:20	1:25	1:50	1:100
Point Intensity mm/hr	63.2	88.4	120.4	143.6	166.4	196.0	244.8
Flow Q m3/s	1.63	2.28	3.11	3.71	4.30	5.06	6.32

The calculation of all the catchment areas of storm water run-off for both pre-and post-development is attached as ***Annexure F***.

5.3 Stormwater Attenuation

The Johannesburg Roads Agency requirements regarding attenuation are that for new developments, the run-off difference between the 1:25 year post and 1:5-year pre-development volume is to be stored on site.

Both the City of Johannesburg and the Johannesburg Roads Agency also require that the attenuation facility discharge at the rate of the 1:5 year pre-developed flow rate.

5.3.1 Method of Attenuation

The run-off from the site has been spilt into separate catchments. The proposed method of attenuation will comprise of the following:

- Grass lined attenuation ponds
- Use of the soccer field to attenuate stormwater and allow for ground water recharge
- Bio swales with stone filled sumps to allow for run-off retardation, encourage sheet flow and absorption into the underlying soil
- Throttled outlet structures
- Energy dissipation slabs to limit erosion and encourage sheet flow at outlets.

5.4 Attenuation Calculation

The combined attenuation volumes for the future development was calculated using the Hydrograph Generation and Reservoir Routing calculation sheet as made available by Chris Brooker of CBA Specialist Engineers for each catchment area.

Flood routing through the ponds were performed by considering the inflow volume, the stage height in the pond and the outflow volume.

5.4.1 Required Attenuation for each catchment

The tables below summarize the results of each catchment-attenuation calculation wherein the results of the stored volume and outlet flow is noted.

Catchment Area 1	1:5 year	1:25 year	1:50 year
Pond Storage m^3	272	457	508
Flow in Pipe m^3/s	0.061	0.082	0.387
Flow over Tower m^3/s	0.000	0.000	0.000
Flow over Spillway m^3/s	0.000	0.000	0.000

Catchment Area 2	1:5 year	1:25 year	1:50 year
Pond Storage m^3	745	1210	1520
Flow in Pipe m^3/s	0.053	0.070	0.077
Flow over Tower m^3/s	0.000	0.000	0.000
Flow over Spillway m^3/s	0.000	0.000	0.000

Catchment Area 3	1:5 year	1:25 year	1:50 year
Pond Storage m^3	656	1185	1407
Flow in Pipe m^3/s	0.246	0.309	0.527
Flow over Tower m^3/s	0.000	0.000	0.029
Flow over Spillway m^3/s	0.000	0.000	0.000

Catchment Area 4	1:5 year	1:25 year	1:50 year
Pond Storage m^3	213	366	422
Flow in Pipe m^3/s	0.061	0.079	0.482
Flow over Tower m^3/s	0.000	0.000	0.130
Flow over Spillway m^3/s	0.000	0.000	0.000

Catchment Area 5	1:5 year	1:25 year	1:50 year
Pond Storage m^3	166	290	333
Flow in Pipe m^3/s	0.073	0.096	0.479
Flow over Tower m^3/s	0.000	0.000	0.000
Flow over Spillway m^3/s	0.000	0.000	0.000

Catchment Area 6	1:5 year	1:25 year	1:50 year
Pond Storage m^3	126	200	242
Flow in Pipe m^3/s	0.030	0.059	0.082
Flow over Tower m^3/s	0.000	0.000	0.000
Flow over Spillway m^3/s	0.000	0.000	0.000

As seen in the above tables, should the site experience a 1:50 year storm, the water level will to rise to the top of the outlet tower but will not reach the spill way for any of the Attenuation Areas. Thus, the volume will be contained within the attenuation ponds.

The calculation of required attenuation is attached as ***Annexure G***

5.5 Effectiveness of the Scheme

Due to the layout of the site and wanting to adhere to best practice principles for stormwater management, the option to create separate catchments with their own attenuation areas was chosen.

For this option of individual catchment areas to be effective, the combined release of each attenuation pond may not exceed the 1:5 pre-developed flow for the total site.

The table below indicates the combined release from each pond and compares it to the 1:5 yr pre-developed run-off for the site.

Attenuation Pond	#1	#2	#3	#4	#5	#6	**Sum:**	**Total Site - 1:5 Year Pre Developed**
Area m^2	14 200	71 000	60 150	16 050	21 600	15450	**198 450**	**199 860**
Flow out (m^3/s)	0.082	0.070	0.309	0.079	0.096	0.059	**0.695**	**0.71**
Stored Volume (m^3)	457	1210	1185	366	290	200	**3708**	**3574**

The 1:5 year pre-developed flow for the whole site is 0.71 m^3/s. The combined outflow from all six attenuation ponds is 0.695 m^3/s. The results noted in the table show that the combined release of each catchment is less than the 1:5 yr pre-developed flow for the total site, thus conforming to the City of Joburg environmental regulations.

5.6 Stormwater Run-off and control

All run-off from the site will be routed to the attenuation ponds of each respective catchment.

Each catchment area drains into an attenuation pond whereby the run-off from the area is throttled to release into the wetland and buffer zone at the 1:5 year pre-developed flow. Energy dissipating structures will be constructed at each outlet to limit any erosion and encourage sheet flow into the wetland area.

5.6.1 Developed Site

The developed site will comprise of both kerb and grid inlets connecting to underground pipe systems that will flow into the either the attenuation ponds or open soccer field.

5.6.2 Road Crossing

Once the site is developed, a road crossing is to be constructed to allow access to the offices and residential development on the eastern side of the site. A road-bridge will be constructed which allows for the 1:100 year flow of 8.7 m^3/s to pass under the road.

The bridge is to be constructed of pre-cast portal culverts and will extend the full width of the flood line. To cater for animal crossings, smaller culverts will be placed above the flood line to all for migration.

A drawing of the proposed bridge is included as Drawing 1574/84/320 in ***Annexure H.***

5.6.3 Future Upgrade of William Nicol and Porcupine Park Avenue

The run-off from the site currently flow through 3 temporary culverts under Porcupine Park Avenue. The future upgrade of the William Nicol and Porcupine Park Avenue intersection allows for a gabion-type cascading structure that caters for the 1:100 year flow to pass under the road and connect to future infrastructure.

The layout of the future upgrade is included on drawing 1574/84/310 and included as ***Annexure E.***

6. Recommendation

The stormwater flow will be collected in a formal stormwater system which drains into grass-lined attenuation ponds, bio swales and open fields with the required storage meeting the municipal regulations. The combined discharge from each attenuation structure will be reduced to pre-developed flows and allowed to discharge into the wetland area.

We trust that this stormwater management report meets with your approval and avail ourselves should there be clarification needed on any aspect.

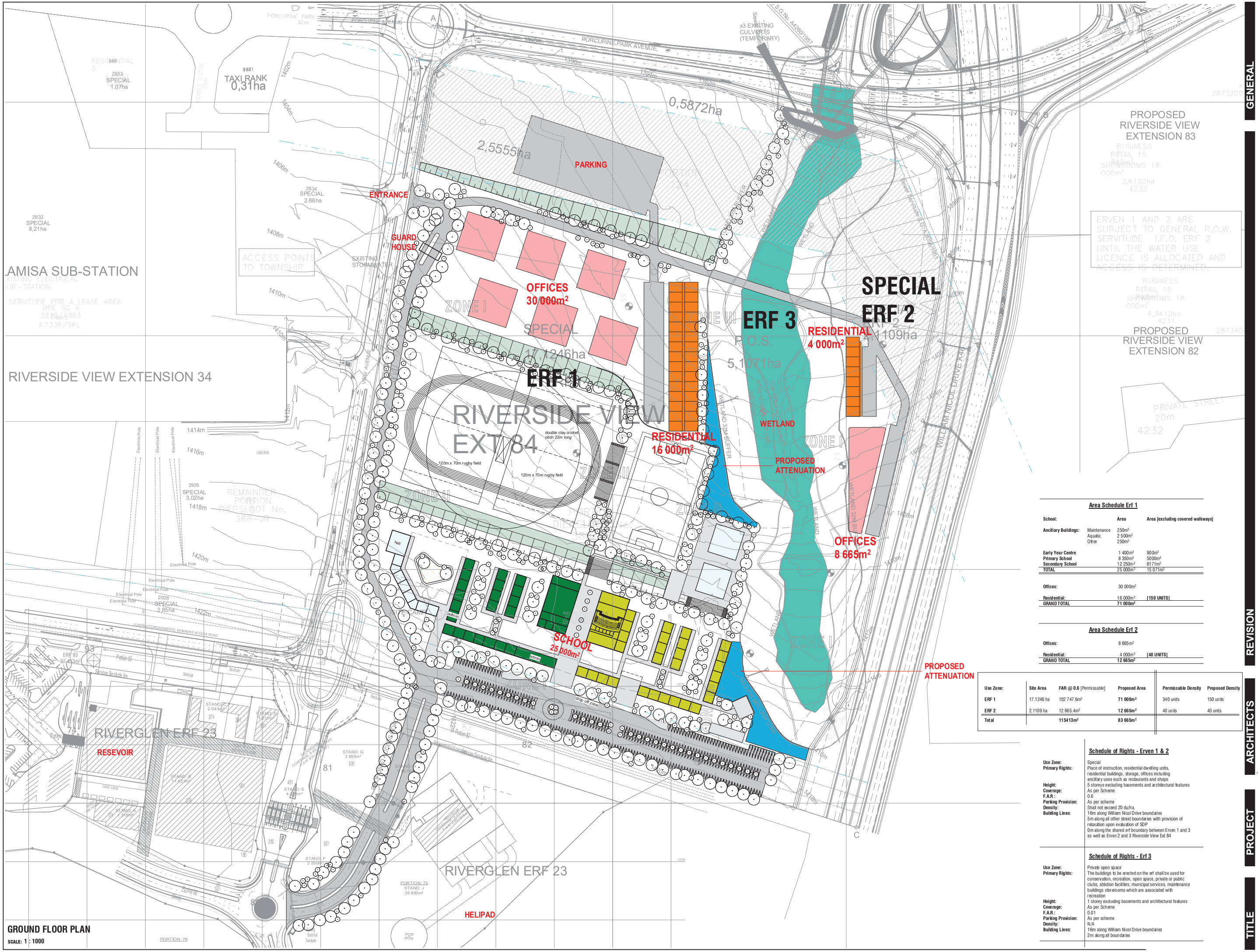
Yours faithfully,

_____

Tekciv Consulting Engineers
Andrew Comley Pr Tech Eng

Annexure A

Site Layout Plan



GROUND FLOOR PLAN

SCALE: 1 : 1000

Area Schedule Erf 1

School:		Area	Area [excluding covered walkways]
Ancillary Buildings:	Maintenance	250m²	
	Aquatic	2 500m²	
	Other	250m²	
Early Year Centre		1 400m²	900m²
Primary School		8 350m²	5000m²
Secondary School		12 250m²	6171m²
TOTAL		25 000m²	15 071m²
Offices:		30 000m²	
Residential:		16 000m²	[150 UNITS]
GRAND TOTAL		71 000m²	

Area Schedule Erf 2

Offices:	8 665m²	
Residential:	4 000m²	[40 UNITS]
GRAND TOTAL	12 665m²	

Use Zone:	Site Area	FAR @ 0.6 [Permissable]	Proposed Area	Permissable Density	Proposed Density
ERF 1	17.1246 ha	102 747.6m²	71 000m²	340 units	150 units
ERF 2	2.1109 ha	12 665.4m²	12 665m²	40 units	40 units
Total		115413m²	83 665m²		

Schedule of Rights - Erven 1 & 2

Use Zone:	Special
Primary Rights:	Place of instruction, residential dwelling units, residential buildings, storage, offices including ancillary uses such as restaurants and shops
Height:	5 storeys excluding basements and architectural features
Coverage:	As per Scheme
F.A.R.:	0.6
Parking Provision:	As per scheme
Density:	Shall not exceed 20 du/ha.
Building Lines:	16m along William Nicol Drive boundaries 5m along all other street boundaries with provision of relaxation upon evaluation of SDP 0m along the shared erf boundary between Erven 1 and 3 as well as Erven 2 and 3 Riverside View Ext 84

Schedule of Rights - Erf 3

Use Zone:	Private open space
Primary Rights:	The buildings to be erected on the erf shall be used for conservation, recreation, open space, private or public clubs, ablution facilities, municipal services, maintenance buildings storerooms which are associated with recreation
Height:	1 storey excluding basements and architectural features
Coverage:	As per Scheme
F.A.R.:	0.01
Parking Provision:	As per scheme
Density:	N/A
Building Lines:	16m along William Nicol Drive boundaries 2m along all boundaries

GENERAL

- All work is to be done in accordance with the SANS 10400 National building Regulations.
- All materials and workmanship are to comply with the relevant SANS 10400 codes and or the specified international codes where applicable in the Architectural specifications. Where relevant South African National Standards, British Standards, BS codes of practice or Agrément Certificates applicable to the design exists, the recommendations and requirements of such documents to be considered a minimum standard for the works.
- The contractor shall in all aspects of the works comply with the provisions of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) and any regulations promulgated in terms of that Act or the Factories Machinery and Building Works Act of 1941.
- The contractor shall set up, document and maintain a quality assurance and quality control system, in accordance with SANS 9001/ISO 9001, able to be checked to the satisfaction of the Architect, that all materials and workmanship, whatever their sources, meet the requirements of the Specification. Should the Contractor or any of his sub-contractors be certified to the SANS 9000 family of standards then monitor these works accordingly.
- This drawing must be read in conjunction with all the relevant drawings, schedules and specifications from SCAD and all other consultants related to the project.
- All portions of the works related to any service or consultant's information is to be done in accordance with the National Building Regulations.
- This drawing is not to be scaled. Figured dimensions to be used. All dimensions are in millimeters unless otherwise stated.
- All dimensions and levels must be checked on site by the contractor before putting work in hand.
- All work to be executed by competent persons qualified for the specific trade.

REVISION

REV	DATE	DRAWN	DESCRIPTION
A	13-01-2020	KT	UPDATED ATTENUATION LAYOUT
B	29-01-2020	KT	UPDATED ATTENUATION LAYOUT

ARCHITECTS

SCAD
STEYN CITY ARCHITECTURE + DESIGN
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1ST FLOOR, BLACKHEATH MEWS
CRESTA, 2118
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IN JOINT VENTURE WITH

Partners
obm architects | pty

PROJECT

PROPOSED SCHOOL
FOR
STEYN CITY PROPERTIES RIVERSIDE VIEW EXT 84 TOWNSHIP

TITLE

SITE PLAN

SCALE: 1 : 1000 @ A0

PROJECT	PHASE	DESCRIPTION	BLOCK / SERIES / SUFFIX	REVISION
XXX	1	AR	100	B

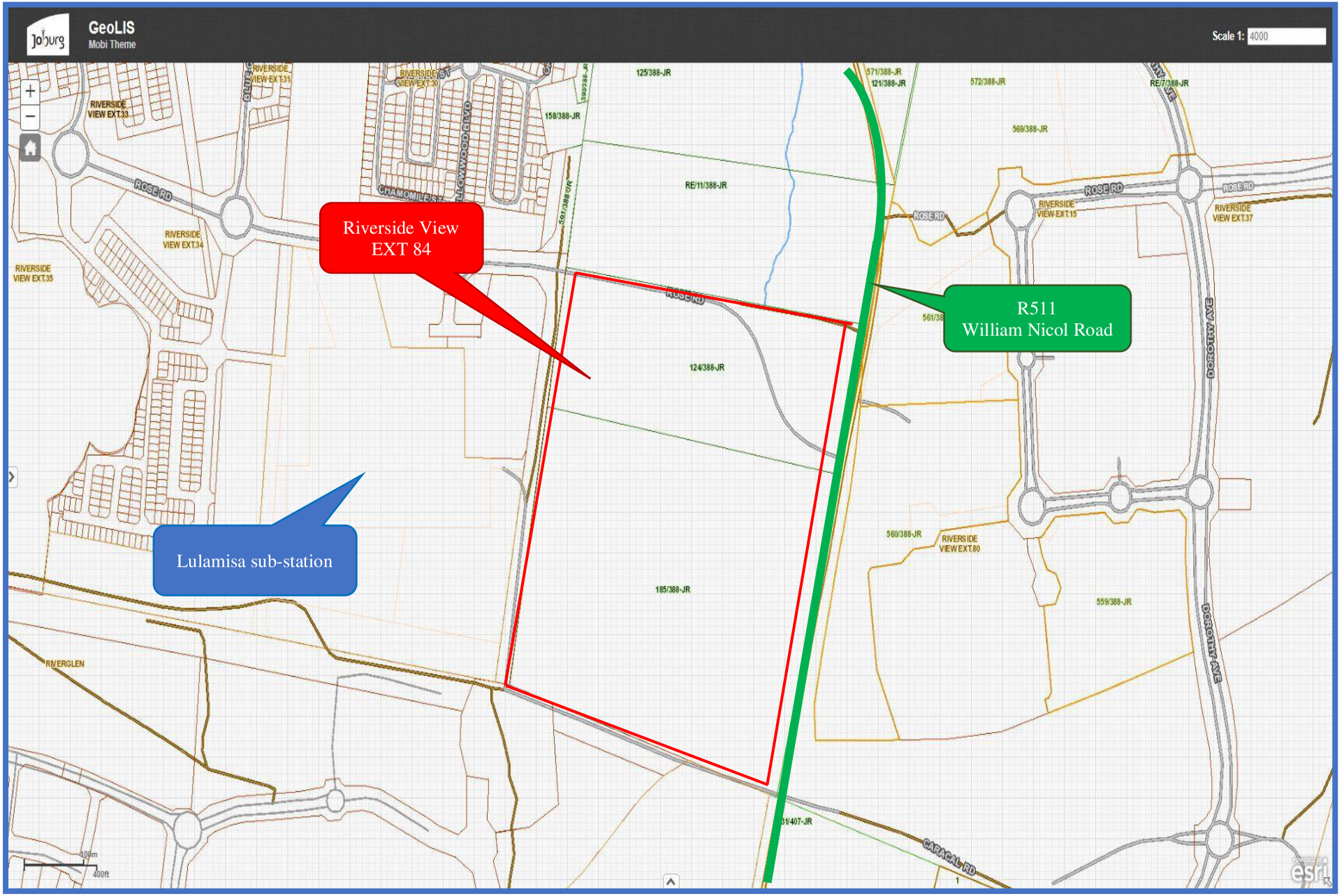
DRAWING STATUS

INFO	TENDER	CONSTRUCTION

DRAWN BY: Author
CHECKED BY: Checker
DATE: 11/15/17
SIGNED:

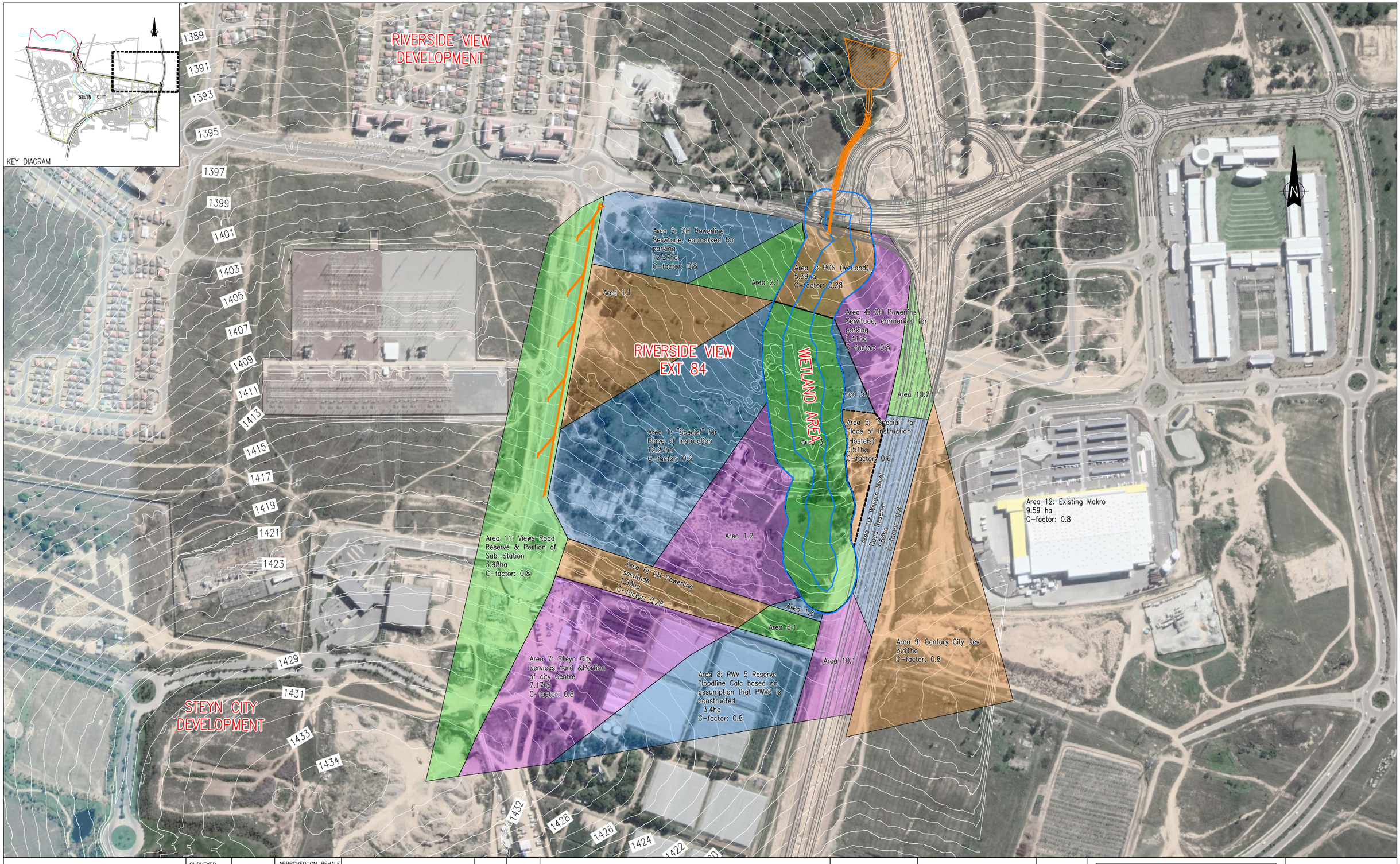
Annexure B

City of Johannesburg GeoLIS Locality


GeoLIS
Mobi Theme
Scale 1: 4000
Riverside View EXT 84
R511 William Nicol Road
Lulamisa sub-station
ROSE RD
RIVERSIDE VIEW EXT.33
RIVERSIDE VIEW EXT.34
RIVERSIDE VIEW EXT.35
RIVERSIDE VIEW EXT.31
RIVERSIDE VIEW EXT.30
RIVERSIDE VIEW EXT.15
RIVERSIDE VIEW EXT.37
RIVERSIDE VIEW EXT.80
CHAMOMILE ST
DAISY GOODWOOD BLVD
EW AVENUE
DOROTHY AVE
CARACAL RD
RIVERGLEN
125/388-JR
158/388-JR
RE/11/388-JR
124/388-JR
185/388-JR
571/388-JR
121/388-JR
572/388-JR
569/388-JR
RE/7/388-JR
560/388-JR
559/388-JR
31/407-JR
100m
400ft

Annexure C

Bigen Africa Floodline Catchment Area Drawing



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PRIVATE DRAWING No.	VERSION:	APPROVED: M McGARRY
1459.10.ZA.04.A074	1.0	Pr. Eng. No.: 20150385 DATE:

SURVEYED	–
DESIGNED	M McGarry
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CHECKED	M McGarry
CO-ORDINATE SYSTEM	WG 29
GEOTECHNICAL INVESTIGATION	–
SERVITUDES	–
APPROVED	FJ VILJOEN

APPROVED ON BEHALF OF BIGEN AFRICA:
NAME: M McGARRY
SIGNATURE: .....
DATE: .....

AMENDMENTS	APPROVED	DATE

STEYN CITY PROPERTIES (PTY) LTD

STEYN CITY DEVELOPMENT

STEYN CITY
RIVERSIDE VIEW EXT 84
STORMWATER CATCHMENT LAYOUT

Steyn City

Johannesburg Roads Agency
Private Bag X 70, Broamfontein, Johannesburg, 2017
Gauteng, South Africa
TEL: 011-407-6487
FAX: 011-339-1607

SCALE
1 : 2500
ON
ORIGINAL
A1
DRAWING

AS-BUILT RECORD

CONTRACT No.	CONTRACT DESCRIPTION	CERTIFIED	DATE

CERTIFIED AS-BUILT FOR CONTRACT :
ENGINEER DATE

DRAWING No.

FILE No.

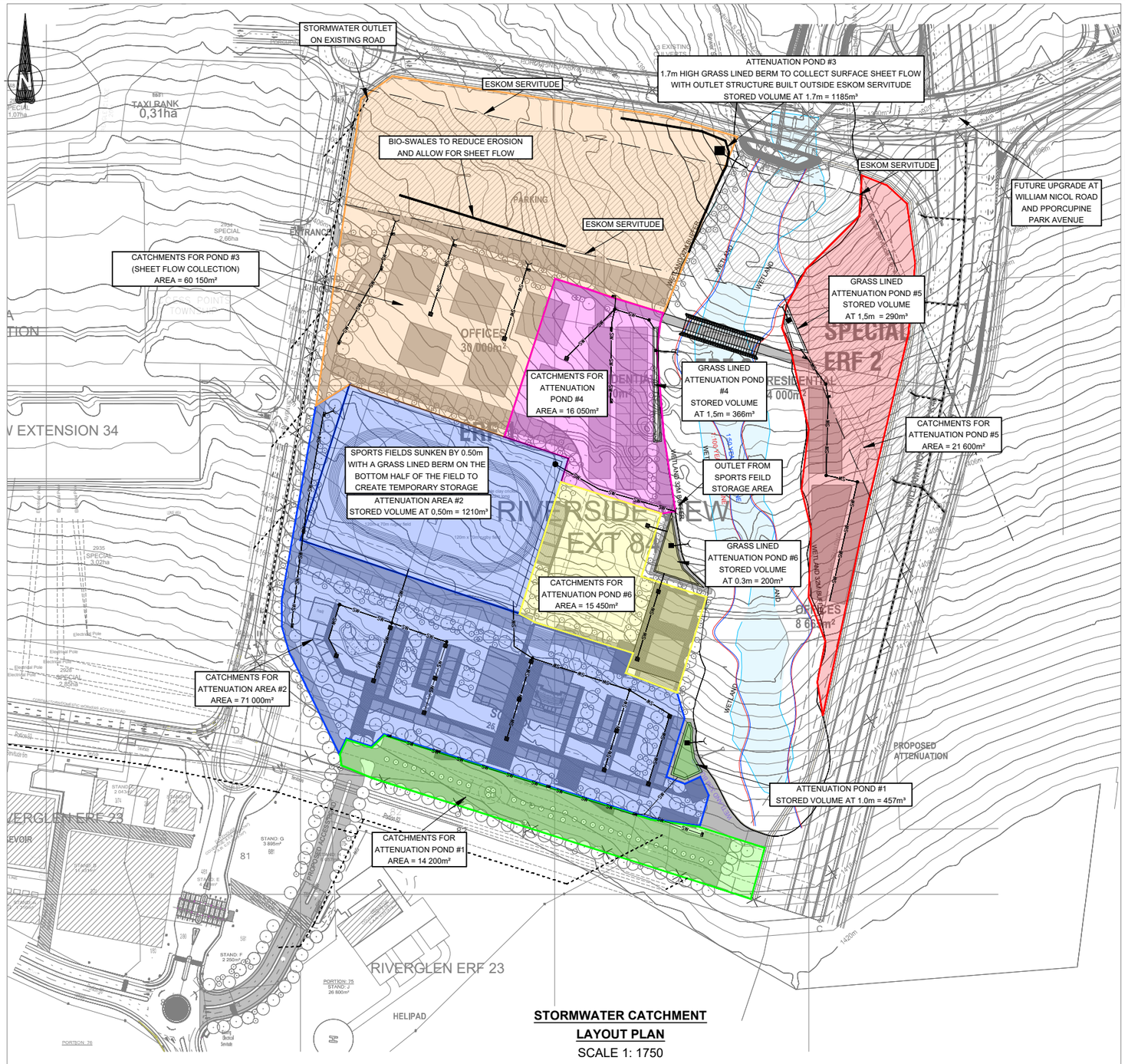
Annexure D

Existing Stormwater Infrastructure


GeoLIS
Mobi Theme
Scale 1: 4000
Temporary Culverts
Existing External Stormwater Pipes
R511
William Nicol Road
RIVERSIDE VIEW EXT 33
RIVERSIDE VIEW EXT 31
RIVERSIDE VIEW EXT 30
RIVERSIDE VIEW EXT 34
RIVERSIDE VIEW EXT 35
RIVERSIDE VIEW EXT 19
RIVERSIDE VIEW EXT 17
RIVERSIDE VIEW EXT 20
RIVERGLEN
125/388 JR
158/388
124/388 JR
165/388 JR
560/388 JR
559/388 JR
569/388 JR
572/388 JR
RE/7/388 JR
121/388 JR
81/407 JR
esri

Annexure E

Drawing 1574/84/310 – Stormwater Runoff Catchment Areas



STORMWATER CATCHMENT LAYOUT PLAN

SCALE 1: 1750

LEGEND

- SW — NEW 450mm Ø CONCRETE STORMWATER PIPE
- EXISTING STORMWATER PIPE
- KERB INLETS
- GRID INLET
- OUTLET STRUCTURE

1. JOHANNESBURG ROAD AGENCY

1.1. ALL CONSTRUCTION SHALL CONFORM WITH ROAD & STORMWATER MANUAL, VOLUME 2 STANDARD DESIGN AND DETAIL FOR ROADS AND STORMWATER , PART 2 - STORMWATER (JUNE 2015), OR WITH RELEVANT SANS 1200 SPECIFICATIONS.

1.2. NO HIDDEN JUNCTION BOXES WILL BE ALLOWED WITHIN PUBLIC ROAD RESERVE.

2. NOTES

2.1. STORMWATER PIPES SHALL BE CONCRETE OGEE PIPES (CLASS 100D).

2.2. THE CONTRACTOR IS TO SEARCH FOR AND CONFIRM POSITIONS AND DEPTHS OF ALL SERVICES BEFORE COMMENCING WORK.

2.3. CONTRACTOR TO CONFIRM INVERT LEVELS OF EXISTING STORMWATER MANHOLES AT CONNECTION POINTS, PRIOR TO CONSTRUCTION OF EXT 14 : STORMWATER RETICULATION COMMENCING.

2.4. ALL STORMWATER PIPES AND INLETS ARE POSITIONED ACCORDING TO AVAILABLE SURVEY INFORMATION AND MAY REQUIRE ADJUSTMENT AS INSTRUCTED BY THE ENGINEER TO SUIT CONDITIONS ON SITE.

2.5. ACCESS TO PRIVATE PROPERTIES IS TO BE MAINTAINED AT ALL TIMES.

2.6. THE CONTRACTOR TO INFORM ENGINEER'S OF ANY STORMWATER CLASHING WITH OTHER SERVICES.

2.7. ALL RELEVANT WAYLEAVES TO BE OBTAINED BY CONTRACTOR PRIOR TO CONSTRUCTION COMMENCING.

TEKCIV CONSULTING ENGINEERS
25 Arend Avenue, Randpark, Randburg, GAUTENG
PO Box 1347, Cresta, 2118, GAUTENG
+27 (0)83 468 5910
geoff@tekciv.co.za
www.tekciv.co.za

APPROVED:
Pr. Eng. No.:
DATE:

Dwg No. 1574/84/310SW | Rev No. A

		REV	AMENDMENTS	DATE
SURVEYED				
DESIGNED	B. DENYSSCHEN			
DRAWN	B. DENYSSCHEN			
CHECKED	A COMLEY			
CO-ORDINATE SYSTEM	WGS 29			
GEOTECHNICAL INVESTIGATION				
SERVITUDES				
APPROVED				
		A	ISSUED FOR INFORMATION	11/08/2020

STEYN CITY DEVELOPMENT

STORMWATER MANAGEMENT PLAN

STEYN CITY INVESTMENTS (PTY) LTD

Johannesburg Roads Agency
PRIVATE BAG X 70, BRAAMFONTEIN,
JOHANNESBURG, 2017 GAUTENG,
SOUTH AFRICA
TEL: 011-407-6487
FAX: 011-339-1607

SCALE: AS SHOWN

PROJECT No. 1574/84/310SW | REV. A

ORIGINAL PAGE SIZE A1 | SHEET 1 OF 1

FILE No.

Annexure F-1

Storm Water Run-off Calculations Catchment #1

Project & Job No.	:	**Catchment #1 - School Parking**		**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Pre-Developed		**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.0142	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.06	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.06889	[m / m]	$H_{0.85L}$	1420	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1416.9	[m]
Overland flow (0) or watercourse (1)	0	[.]	ΔH	3.1	[m]
Roughness coefficient, r (overland flow)	0.4	[.]	0.75L	45	[m]
Rainfall region (winter / summer)	Summer	[.]	S_{av}	0.06889	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.198
Watercourse	0.000

Areal Distribution Factors						
Rural		Urban		Lakes		
α	1.0000	β	0.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	30.0	Very permeable	30.0	Thick bush & plantation	10.0	Lawns & Parks	0.0
Flat areas (3-10%)	70.0	Permeable	20.0	Light bush & farm lands	60.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	50.0	Grass lands	30.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	0.0
∑ = 100	100	∑ = 100	100	∑ = 100	100	∑ = 100	0

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	0.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	0.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	0

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.03	0.065	**0.290**
	Flat areas (3-10%)	0.08		
	Hilly (10-30%)	0.16		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.096	
	Permeable	0.08		
	Semi permeable	0.16		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.129	
	Light bush & farm lands	0.11		
	Grass lands	0.21		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.290**

Return Period	Adjusted rural runoff factor
2	0.218
5	0.232
10	0.247
20	0.261
25	0.264
50	0.276
100	0.290

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.00	0.000	**0.000**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.000	
	Suburban	0.00		
	Streets	0.00		
	Maximum Flood	0.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.218	0.000	0.218
5	0.232	0.000	0.232
10	0.247	0.000	0.247
20	0.261	0.000	0.261
25	0.264	0.000	0.264
50	0.276	0.000	0.276
100	0.290	0.000	0.290

Return Period	**Q_T [m^3/s]**
2	**0.06**
5	**0.09**
10	**0.11**
20	**0.16**
25	**0.18**
50	**0.23**
100	**0.30**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	14.0	19.0	23.0	31.5	35.0	42.0	51.0
Point intensity Pi [mm/hr]	70.83	96.13	116.37	159.38	177.08	212.50	258.04
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**70.8**	**96.1**	**116.4**	**159.4**	**177.1**	**212.5**	**258.0**

Project & Job No.	:	**Catchment #1 - School Parking**	**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Post Developed	**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.0142	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.28	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.0167	[m / m]	$H_{0.85L}$	1420	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1416.5	[m]
Overland flow (0) or watercourse (1)	1	[.]	ΔH	3.5	[m]
Roughness coefficient, r (overland flow)	0.02	[.]	0.75L	210	[m]
Rainfall region (winter / summer)	summer	[.]	S_{av}	0.01667	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.000
Watercourse	0.120

Tc taken as 0.25 (recommended minimum)

Areal Distribution Factors						
Rural		Urban		Lakes		
α	0.0000	β	1.0000	φ	0.0000	∑ = 1

Rural

Surface Slope	%	**Permeability**	%	**Vegetation**	%
Vleis & pans(<3%)	0.0	Very permeable	0.0	Thick bush & plantation	0.0
Flat areas (3-10%)	0.0	Permeable	0.0	Light bush & farm lands	0.0
Hilly (10-30%)	0.0	Semi permeable	0.0	Grass lands	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0

Urban

	% split
Lawns & Parks	0.0
Industrial Areas	0.0
Residential Areas	0.0
Business	100.0
∑ = 100	100

Urban

Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	100.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	10.0
Heavy soil, flat (<2%)	0.0					Streets	90.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	100	∑ = 100	0	∑ = 100	0	∑ = 100	100

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.00	0.000	**0.000**
	Flat areas (3-10%)	0.00		
	Hilly (10-30%)	0.00		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.000	
	Permeable	0.00		
	Semi permeable	0.00		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.000	
	Light bush & farm lands	0.00		
	Grass lands	0.00		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.000**

Return Period	Adjusted rural runoff factor
2	0.000
5	0.000
10	0.000
20	0.000
25	0.000
50	0.000
100	0.000

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.08	0.080	**0.977**
	Sandy, steep (>7%)	0.20		
	Heavy soil, flat (<2%)	0.25		
	heavy soil, steep (>7%)	0.35		
Industrial areas	Light industry	0.80	0.000	
	heavy industry	0.80		
Residential	Houses (Res 1)	0.50	0.000	
	Flats (Res 2 +)	0.80		
Business	City centre	0.95	0.977	
	Suburban	0.95		
	Streets	0.98		
	Maximum Flood	1.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.000	0.977	0.977
5	0.000	0.977	0.977
10	0.000	0.977	0.977
20	0.000	0.977	0.977
25	0.000	0.977	0.977
50	0.000	0.977	0.977
100	0.000	0.977	0.977

Return Period	**Q_T [m^3/s]**
2	**0.24**
5	**0.34**
10	**0.46**
20	**0.55**
25	**0.64**
50	**0.76**
100	**0.94**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	15.8	22.1	30.1	35.9	41.6	49.0	61.2
Point intensity Pi [mm/hr]	63.20	88.40	120.40	143.60	166.40	196.00	244.80
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**63.2**	**88.4**	**120.4**	**143.6**	**166.4**	**196.0**	**244.8**

Annexure F-2

Storm Water Run-off Calculations Catchment #2

Project & Job No.	:	**Catchment #2 - School Area**			**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Pre-Developed			**Date**	:	11.08.2020
		INPUT					
		OUTPUT					
Physical Characteristics: (Inland catchments)							
Size of catchment, A		0.071	[km^2]		To be completed only if defined watercourse		
Longest water course, L		0.34	[km]		Calculation of S_{av}		
Average slope, S (Watercourse / overland)		0.05647	[m / m]		$H_{0.85L}$	1420	[m]
Dolomitic percentage [%]		0	[%]		$H_{0.10L}$	1405.6	[m]
Overland flow (0) or watercourse (1)		0	[.]		ΔH	14.4	[m]
Roughness coefficient, r (overland flow)		0.4	[.]		0.75L	255	[m]
Rainfall region (winter / summer)		Summer	[.]		S_{av}	0.05647	[m / m]
Mean annual precipitation, MAP		750	[mm]				
Steep & impermeable (0), flat & permeable (1)		0					

Time of Concentration, T_c [hrs]	
Overland Flow	0.465
Watercourse	0.000

Areal Distribution Factors						
Rural		Urban		Lakes		
α	1.0000	β	0.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	30.0	Very permeable	30.0	Thick bush & plantation	10.0	Lawns & Parks	0.0
Flat areas (3-10%)	70.0	Permeable	20.0	Light bush & farm lands	60.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	50.0	Grass lands	30.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	0.0
∑ = 100	100	∑ = 100	100	∑ = 100	100	∑ = 100	0

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	0.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	0.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	0

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.03	0.065	**0.290**
	Flat areas (3-10%)	0.08		
	Hilly (10-30%)	0.16		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.096	
	Permeable	0.08		
	Semi permeable	0.16		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.129	
	Light bush & farm lands	0.11		
	Grass lands	0.21		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.290**

Return Period	Adjusted rural runoff factor
2	0.218
5	0.232
10	0.247
20	0.261
25	0.264
50	0.276
100	0.290

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.00	0.000	**0.000**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.000	
	Suburban	0.00		
	Streets	0.00		
	Maximum Flood	0.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.218	0.000	0.218
5	0.232	0.000	0.232
10	0.247	0.000	0.247
20	0.261	0.000	0.261
25	0.264	0.000	0.264
50	0.276	0.000	0.276
100	0.290	0.000	0.290

Return Period	**Q_T [m^3/s]**
2	**0.21**
5	**0.32**
10	**0.44**
20	**0.58**
25	**0.68**
50	**0.83**
100	**1.12**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	22.8	32.5	41.8	52.0	61.1	71.2	91.0
Point intensity Pi [mm/hr]	48.99	69.83	89.81	111.73	131.28	152.98	195.52
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**49.0**	**69.8**	**89.8**	**111.7**	**131.3**	**153.0**	**195.5**

Project & Job No.	:	**Catchment #2 - School Area**		**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Post Developed		**Date**	:	11.08.2020

	INPUT / OUTPUT					
Physical Characteristics: (Inland catchments)						
Size of catchment, A	0.071	[km^2]	To be completed only if defined watercourse			
Longest water course, L	0.34	[km]	Calculation of S_{av}			
Average slope, S (Watercourse / overland)	0.0412	[m / m]	$H_{0.85L}$	1416.2	[m]	
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1405.7	[m]	
Overland flow (0) or watercourse (1)	1	[.]	ΔH	10.5	[m]	
Roughness coefficient, r (overland flow)	0.02	[.]	0.75L	255	[m]	
Rainfall region (winter / summer)	summer	[.]	S_{av}	0.04118	[m / m]	
Mean annual precipitation, MAP	750	[mm]				
Steep & impermeable (0), flat & permeable (1)	0					

Time of Concentration, T_c [hrs]	
Overland Flow	0.000
Watercourse	0.099

Tc taken as 0.25 (recommended minimum)

Areal Distribution Factors						
Rural		Urban		Lakes		
α	0.0000	β	1.0000	φ	0.0000	∑ = 1

Rural

Surface Slope	%	**Permeability**	%	**Vegetation**	%
Vleis & pans(<3%)	0.0	Very permeable	0.0	Thick bush & plantation	0.0
Flat areas (3-10%)	0.0	Permeable	0.0	Light bush & farm lands	0.0
Hilly (10-30%)	0.0	Semi permeable	0.0	Grass lands	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0

Urban

	% split
Lawns & Parks	65.0
Industrial Areas	0.0
Residential Areas	0.0
Business	35.0
∑ = 100	100

Urban

Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	100.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	100.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	100	∑ = 100	0	∑ = 100	0	∑ = 100	100

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.00	0.000	**0.000**
	Flat areas (3-10%)	0.00		
	Hilly (10-30%)	0.00		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.000	
	Permeable	0.00		
	Semi permeable	0.00		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.000	
	Light bush & farm lands	0.00		
	Grass lands	0.00		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.000**

Return Period	Adjusted rural runoff factor
2	0.000
5	0.000
10	0.000
20	0.000
25	0.000
50	0.000
100	0.000

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.08	0.080	**0.402**
	Sandy, steep (>7%)	0.20		
	Heavy soil, flat (<2%)	0.25		
	heavy soil, steep (>7%)	0.35		
Industrial areas	Light industry	0.80	0.000	
	heavy industry	0.80		
Residential	Houses (Res 1)	0.50	0.000	
	Flats (Res 2 +)	0.80		
Business	City centre	0.95	1.000	
	Suburban	1.00		
	Streets	1.00		
	Maximum Flood	1.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.000	0.402	0.402
5	0.000	0.402	0.402
10	0.000	0.402	0.402
20	0.000	0.402	0.402
25	0.000	0.402	0.402
50	0.000	0.402	0.402
100	0.000	0.402	0.402

Return Period	**Q_T [m^3/s]**
2	**0.50**
5	**0.70**
10	**0.95**
20	**1.14**
25	**1.32**
50	**1.55**
100	**1.94**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	15.8	22.1	30.1	35.9	41.6	49.0	61.2
Point intensity Pi [mm/hr]	63.20	88.40	120.40	143.60	166.40	196.00	244.80
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**63.2**	**88.4**	**120.4**	**143.6**	**166.4**	**196.0**	**244.8**

Annexure F-3

Storm Water Run-off Calculations Catchment #3

Project & Job No.	:	**Catchment #3 - Office Area**	**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Pre-Developed	**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.06015	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.395	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.06245	[m / m]	$H_{0.85L}$	1410	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1391.5	[m]
Overland flow (0) or watercourse (1)	0	[.]	ΔH	18.5	[m]
Roughness coefficient, r (overland flow)	0.4	[.]	0.75L	296.25	[m]
Rainfall region (winter / summer)	Summer	[.]	S_{av}	0.06245	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.488
Watercourse	0.000

Areal Distribution Factors						
Rural		Urban		Lakes		
α	1.0000	β	0.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	40.0	Very permeable	30.0	Thick bush & plantation	10.0	Lawns & Parks	0.0
Flat areas (3-10%)	60.0	Permeable	20.0	Light bush & farm lands	60.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	50.0	Grass lands	30.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	0.0
∑ = 100	100	∑ = 100	100	∑ = 100	100	∑ = 100	0

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	0.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	0.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	0

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.03	0.060	**0.285**
	Flat areas (3-10%)	0.08		
	Hilly (10-30%)	0.16		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.096	
	Permeable	0.08		
	Semi permeable	0.16		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.129	
	Light bush & farm lands	0.11		
	Grass lands	0.21		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.285**

Return Period	Adjusted rural runoff factor
2	0.214
5	0.228
10	0.242
20	0.257
25	0.259
50	0.271
100	0.285

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.00	0.000	**0.000**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.000	
	Suburban	0.00		
	Streets	0.00		
	Maximum Flood	0.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.214	0.000	0.214
5	0.228	0.000	0.228
10	0.242	0.000	0.242
20	0.257	0.000	0.257
25	0.259	0.000	0.259
50	0.271	0.000	0.271
100	0.285	0.000	0.285

Return Period	**Q_T [m^3/s]**
2	**0.16**
5	**0.24**
10	**0.33**
20	**0.44**
25	**0.49**
50	**0.60**
100	**0.79**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	21.2	30.9	40.1	50.1	55.3	64.8	81.4
Point intensity Pi [mm/hr]	43.48	63.37	82.24	102.75	113.41	132.90	166.94
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**43.5**	**63.4**	**82.2**	**102.7**	**113.4**	**132.9**	**166.9**

Project & Job No.	:	**Catchment #3 - Office Area**			**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Post Developed			**Date**	:	11.08.2020

		INPUT					
		OUTPUT					
Physical Characteristics: (Inland catchments)							
Size of catchment, A		0.06015	[km^2]		To be completed only if defined watercourse		
Longest water course, L		0.36	[km]		Calculation of S_{av}		
Average slope, S (Watercourse / overland)		0.0667	[m / m]		$H_{0.85L}$	1408	[m]
Dolomitic percentage [%]		0	[%]		$H_{0.10L}$	1390	[m]
Overland flow (0) or watercourse (1)		1	[.]		ΔH	18	[m]
Roughness coefficient, r (overland flow)		0.02	[.]		0.75L	270	[m]
Rainfall region (winter / summer)		summer	[.]		S_{av}	0.06667	[m / m]
Mean annual precipitation, MAP		750	[mm]				
Steep & impermeable (0), flat & permeable (1)		0					

Time of Concentration, T_c [hrs]	
Overland Flow	0.000
Watercourse	0.086

Tc taken as 0.25 (recommended minimum)

Areal Distribution Factors						
Rural		Urban		Lakes		
α	0.0000	β	1.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	0.0	Very permeable	0.0	Thick bush & plantation	0.0	Lawns & Parks	60.0
Flat areas (3-10%)	0.0	Permeable	0.0	Light bush & farm lands	0.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	0.0	Grass lands	0.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	40.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	100

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	100.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	100.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	100	∑ = 100	0	∑ = 100	0	∑ = 100	100

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.00	0.000	**0.000**
	Flat areas (3-10%)	0.00		
	Hilly (10-30%)	0.00		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.000	
	Permeable	0.00		
	Semi permeable	0.00		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.000	
	Light bush & farm lands	0.00		
	Grass lands	0.00		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.000**

Return Period	Adjusted rural runoff factor
2	0.000
5	0.000
10	0.000
20	0.000
25	0.000
50	0.000
100	0.000

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.08	0.080	**0.388**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.850	
	Suburban	0.85		
	Streets	0.00		
	Maximum Flood	1.00		

Return Period	Adjusted Rural Runoff Coefficient incl Dolomitic Influence	Urban Runoff Coefficient	Combined runoff coefficient
2	0.000	0.388	0.388
5	0.000	0.388	0.388
10	0.000	0.388	0.388
20	0.000	0.388	0.388
25	0.000	0.388	0.388
50	0.000	0.388	0.388
100	0.000	0.388	0.388

Return Period	Q_T [m^3/s]
2	**0.41**
5	**0.57**
10	**0.78**
20	**0.93**
25	**1.08**
50	**1.27**
100	**1.59**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	15.8	22.1	30.1	35.9	41.6	49.0	61.2
Point intensity Pi [mm/hr]	63.20	88.40	120.40	143.60	166.40	196.00	244.80
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**63.2**	**88.4**	**120.4**	**143.6**	**166.4**	**196.0**	**244.8**

Annexure F-4

Storm Water Run-off Calculations Catchment #4

Project & Job No.	:	**Catchment #4 - Office area and Residential West**	**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Pre-Developed	**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.01605	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.15	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.05689	[m / m]	$H_{0.85L}$	1404.7	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1398.3	[m]
Overland flow (0) or watercourse (1)	0	[.]	ΔH	6.4	[m]
Roughness coefficient, r (overland flow)	0.4	[.]	0.75L	112.5	[m]
Rainfall region (winter / summer)	Summer	[.]	S_{av}	0.05689	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.317
Watercourse	0.000

Areal Distribution Factors						
Rural		Urban		Lakes		
α	1.0000	β	0.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	30.0	Very permeable	30.0	Thick bush & plantation	10.0	Lawns & Parks	0.0
Flat areas (3-10%)	70.0	Permeable	20.0	Light bush & farm lands	60.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	50.0	Grass lands	30.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	0.0
∑ = 100	100	∑ = 100	100	∑ = 100	100	∑ = 100	0

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	0.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	0.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	0

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.03	0.065	**0.290**
	Flat areas (3-10%)	0.08		
	Hilly (10-30%)	0.16		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.096	
	Permeable	0.08		
	Semi permeable	0.16		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.129	
	Light bush & farm lands	0.11		
	Grass lands	0.21		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.290**

Return Period	Adjusted rural runoff factor
2	0.218
5	0.232
10	0.247
20	0.261
25	0.264
50	0.276
100	0.290

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.00	0.000	**0.000**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.000	
	Suburban	0.00		
	Streets	0.00		
	Maximum Flood	0.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.218	0.000	0.218
5	0.232	0.000	0.232
10	0.247	0.000	0.247
20	0.261	0.000	0.261
25	0.264	0.000	0.264
50	0.276	0.000	0.276
100	0.290	0.000	0.290

Return Period	**Q_T [m^3/s]**
2	**0.06**
5	**0.08**
10	**0.11**
20	**0.15**
25	**0.17**
50	**0.21**
100	**0.28**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	18.5	24.0	31.1	40.3	45.1	53.0	67.9
Point intensity Pi [mm/hr]	58.35	75.70	98.09	127.11	142.25	167.16	214.16
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**58.3**	**75.7**	**98.1**	**127.1**	**142.2**	**167.2**	**214.2**

Project & Job No.	:	**Catchment #4 - Office area and Residential West**	**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Post Developed	**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.01605	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.15	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.0329	[m / m]	$H_{0.85L}$	1403.7	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1400	[m]
Overland flow (0) or watercourse (1)	1	[.]	ΔH	3.7	[m]
Roughness coefficient, r (overland flow)	0.02	[.]	0.75L	112.5	[m]
Rainfall region (winter / summer)	summer	[.]	S_{av}	0.03289	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.000
Watercourse	0.057

Tc taken as 0.25 (recommended minimum)

Areal Distribution Factors						
Rural		Urban		Lakes		
α	0.0000	β	1.0000	φ	0.0000	∑ = 1

Rural

Surface Slope	%	**Permeability**	%	**Vegetation**	%
Vleis & pans(<3%)	0.0	Very permeable	0.0	Thick bush & plantation	0.0
Flat areas (3-10%)	0.0	Permeable	0.0	Light bush & farm lands	0.0
Hilly (10-30%)	0.0	Semi permeable	0.0	Grass lands	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0

Urban

	% split
Lawns & Parks	30.0
Industrial Areas	0.0
Residential Areas	0.0
Business	70.0
∑ = 100	100

Urban

Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	100.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	60.0
Heavy soil, flat (<2%)	0.0					Streets	40.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	100	∑ = 100	0	∑ = 100	0	∑ = 100	100

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.00	0.000	**0.000**
	Flat areas (3-10%)	0.00		
	Hilly (10-30%)	0.00		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.000	
	Permeable	0.00		
	Semi permeable	0.00		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.000	
	Light bush & farm lands	0.00		
	Grass lands	0.00		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.000**

Return Period	Adjusted rural runoff factor
2	0.000
5	0.000
10	0.000
20	0.000
25	0.000
50	0.000
100	0.000

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.08	0.080	**0.682**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.940	
	Suburban	0.90		
	Streets	1.00		
	Maximum Flood	1.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.000	0.682	0.682
5	0.000	0.682	0.682
10	0.000	0.682	0.682
20	0.000	0.682	0.682
25	0.000	0.682	0.682
50	0.000	0.682	0.682
100	0.000	0.682	0.682

Return Period	**Q_T [m^3/s]**
2	**0.19**
5	**0.27**
10	**0.37**
20	**0.44**
25	**0.51**
50	**0.60**
100	**0.74**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	15.8	22.1	30.1	35.9	41.6	49.0	61.2
Point intensity Pi [mm/hr]	63.20	88.40	120.40	143.60	166.40	196.00	244.80
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**63.2**	**88.4**	**120.4**	**143.6**	**166.4**	**196.0**	**244.8**

Annexure F-5

Storm Water Run-off Calculations Catchment #5

Project & Job No.	:	**Catchment #5 - Office area and Residential East**		**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Pre-Developed		**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.0216	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.25	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.07680	[m / m]	$H_{0.85L}$	1409.1	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1394.7	[m]
Overland flow (0) or watercourse (1)	0	[.]	ΔH	14.4	[m]
Roughness coefficient, r (overland flow)	0.4	[.]	0.75L	187.5	[m]
Rainfall region (winter / summer)	Summer	[.]	S_{av}	0.07680	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.375
Watercourse	0.000

Areal Distribution Factors						
Rural		Urban		Lakes		
α	1.0000	β	0.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	30.0	Very permeable	30.0	Thick bush & plantation	10.0	Lawns & Parks	0.0
Flat areas (3-10%)	70.0	Permeable	20.0	Light bush & farm lands	60.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	50.0	Grass lands	30.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	0.0
∑ = 100	100	∑ = 100	100	∑ = 100	100	∑ = 100	0

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	0.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	0.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	0

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.03	0.065	**0.290**
	Flat areas (3-10%)	0.08		
	Hilly (10-30%)	0.16		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.096	
	Permeable	0.08		
	Semi permeable	0.16		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.129	
	Light bush & farm lands	0.11		
	Grass lands	0.21		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.290**

Return Period	Adjusted rural runoff factor
2	0.218
5	0.232
10	0.247
20	0.261
25	0.264
50	0.276
100	0.290

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.00	0.000	**0.000**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.000	
	Suburban	0.00		
	Streets	0.00		
	Maximum Flood	0.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.218	0.000	0.218
5	0.232	0.000	0.232
10	0.247	0.000	0.247
20	0.261	0.000	0.261
25	0.264	0.000	0.264
50	0.276	0.000	0.276
100	0.290	0.000	0.290

Return Period	**Q_T [m^3/s]**
2	**0.07**
5	**0.10**
10	**0.13**
20	**0.17**
25	**0.21**
50	**0.26**
100	**0.33**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	20.2	27.2	33.2	41.9	50.7	60.0	71.9
Point intensity Pi [mm/hr]	53.83	72.49	88.48	111.66	135.11	159.90	191.61
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**53.8**	**72.5**	**88.5**	**111.7**	**135.1**	**159.9**	**191.6**

Project & Job No.	:	**Catchment #5 - Office area and Residential East**	**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Post Developed	**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.0216	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.24	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.0389	[m / m]	$H_{0.85L}$	1407	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1400	[m]
Overland flow (0) or watercourse (1)	1	[.]	ΔH	7	[m]
Roughness coefficient, r (overland flow)	0.02	[.]	0.75L	180	[m]
Rainfall region (winter / summer)	summer	[.]	S_{av}	0.03889	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.000
Watercourse	0.077

Tc taken as 0.25 (recommended minimum)

Areal Distribution Factors						
Rural		Urban		Lakes		
α	0.0000	β	1.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	0.0	Very permeable	0.0	Thick bush & plantation	0.0	Lawns & Parks	60.0
Flat areas (3-10%)	0.0	Permeable	0.0	Light bush & farm lands	0.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	0.0	Grass lands	0.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	40.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	100

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	100.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	60.0
Heavy soil, flat (<2%)	0.0					Streets	40.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	100	∑ = 100	0	∑ = 100	0	∑ = 100	100

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.00	0.000	**0.000**
	Flat areas (3-10%)	0.00		
	Hilly (10-30%)	0.00		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.000	
	Permeable	0.00		
	Semi permeable	0.00		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.000	
	Light bush & farm lands	0.00		
	Grass lands	0.00		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.000**

Return Period	Adjusted rural runoff factor
2	0.000
5	0.000
10	0.000
20	0.000
25	0.000
50	0.000
100	0.000

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.08	0.080	**0.424**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.940	
	Suburban	0.90		
	Streets	1.00		
	Maximum Flood	1.00		

Return Period	Adjusted Rural Runoff Coefficient incl Dolomitic Influence	Urban Runoff Coefficient	Combined runoff coefficient
2	0.000	0.424	0.424
5	0.000	0.424	0.424
10	0.000	0.424	0.424
20	0.000	0.424	0.424
25	0.000	0.424	0.424
50	0.000	0.424	0.424
100	0.000	0.424	0.424

Return Period	Q_T [m^3/s]
2	**0.16**
5	**0.22**
10	**0.31**
20	**0.37**
25	**0.42**
50	**0.50**
100	**0.62**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	15.8	22.1	30.1	35.9	41.6	49.0	61.2
Point intensity Pi [mm/hr]	63.20	88.40	120.40	143.60	166.40	196.00	244.80
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**63.2**	**88.4**	**120.4**	**143.6**	**166.4**	**196.0**	**244.8**

Annexure F-6

Storm Water Run-off Calculations Catchment #6

Project & Job No.	:	**Catchment #6 - Sports Field and Paved Area**		**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Pre-Developed		**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.01545	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.14	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.07048	[m / m]	$H_{0.85L}$	1412.7	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1405.3	[m]
Overland flow (0) or watercourse (1)	0	[.]	ΔH	7.4	[m]
Roughness coefficient, r (overland flow)	0.4	[.]	0.75L	105	[m]
Rainfall region (winter / summer)	Summer	[.]	S_{av}	0.07048	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.292
Watercourse	0.000

Areal Distribution Factors						
Rural		Urban		Lakes		
α	1.0000	β	0.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	40.0	Very permeable	30.0	Thick bush & plantation	10.0	Lawns & Parks	0.0
Flat areas (3-10%)	60.0	Permeable	20.0	Light bush & farm lands	60.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	50.0	Grass lands	30.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	0.0
∑ = 100	100	∑ = 100	100	∑ = 100	100	∑ = 100	0

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	0.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	0.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	0

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.03	0.060	**0.285**
	Flat areas (3-10%)	0.08		
	Hilly (10-30%)	0.16		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.096	
	Permeable	0.08		
	Semi permeable	0.16		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.129	
	Light bush & farm lands	0.11		
	Grass lands	0.21		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.285**

Return Period	Adjusted rural runoff factor
2	0.214
5	0.228
10	0.242
20	0.257
25	0.259
50	0.271
100	0.285

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.00	0.000	**0.000**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.000	
	Suburban	0.00		
	Streets	0.00		
	Maximum Flood	0.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.214	0.000	0.214
5	0.228	0.000	0.228
10	0.242	0.000	0.242
20	0.257	0.000	0.257
25	0.259	0.000	0.259
50	0.271	0.000	0.271
100	0.285	0.000	0.285

Return Period	**Q_T [m^3/s]**
2	**0.05**
5	**0.08**
10	**0.11**
20	**0.14**
25	**0.16**
50	**0.20**
100	**0.26**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	16.1	22.8	30.5	38.1	42.6	51.1	62.4
Point intensity Pi [mm/hr]	55.13	78.08	104.44	130.47	145.88	174.98	213.68
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**55.1**	**78.1**	**104.4**	**130.5**	**145.9**	**175.0**	**213.7**

Project & Job No.	:	**Catchment #6 - Sports Field and Paved Area**	**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Post Developed	**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.01545	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.14	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.0333	[m / m]	$H_{0.85L}$	1408.5	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1405	[m]
Overland flow (0) or watercourse (1)	1	[.]	ΔH	3.5	[m]
Roughness coefficient, r (overland flow)	0.02	[.]	0.75L	105	[m]
Rainfall region (winter / summer)	summer	[.]	S_{av}	0.03333	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.000
Watercourse	0.054

Tc taken as 0.25 (recommended minimum)

Areal Distribution Factors						
Rural		Urban		Lakes		
α	0.0000	β	1.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	0.0	Very permeable	0.0	Thick bush & plantation	0.0	Lawns & Parks	70.0
Flat areas (3-10%)	0.0	Permeable	0.0	Light bush & farm lands	0.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	0.0	Grass lands	0.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	30.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	100

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	100.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	0.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	100.0
∑ = 100	100	∑ = 100	0	∑ = 100	0	∑ = 100	100

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.00	0.000	**0.000**
	Flat areas (3-10%)	0.00		
	Hilly (10-30%)	0.00		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.000	
	Permeable	0.00		
	Semi permeable	0.00		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.000	
	Light bush & farm lands	0.00		
	Grass lands	0.00		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.000**

Return Period	Adjusted rural runoff factor
2	0.000
5	0.000
10	0.000
20	0.000
25	0.000
50	0.000
100	0.000

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.08	0.080	**0.356**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	1.000	
	Suburban	0.90		
	Streets	1.00		
	Maximum Flood	1.00		

Return Period	Adjusted Rural Runoff Coefficient incl Dolomitic Influence	Urban Runoff Coefficient	Combined runoff coefficient
2	0.000	0.356	0.356
5	0.000	0.356	0.356
10	0.000	0.356	0.356
20	0.000	0.356	0.356
25	0.000	0.356	0.356
50	0.000	0.356	0.356
100	0.000	0.356	0.356

Return Period	Q_T [m^3/s]
2	**0.10**
5	**0.14**
10	**0.18**
20	**0.22**
25	**0.25**
50	**0.30**
100	**0.37**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	15.8	22.1	30.1	35.9	41.6	49.0	61.2
Point intensity Pi [mm/hr]	63.20	88.40	120.40	143.60	166.40	196.00	244.80
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**63.2**	**88.4**	**120.4**	**143.6**	**166.4**	**196.0**	**244.8**

Annexure F-7

Storm Water Run-off Calculations 'Total Catchment'

Project & Job No.	:	**Total Site**			**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Pre-Developed			**Date**	:	11.08.2020
		INPUT					
		OUTPUT					
Physical Characteristics: (Inland catchments)							
Size of catchment, A		0.19986	[km^2]		To be completed only if defined watercourse		
Longest water course, L		0.6	[km]		Calculation of S_{av}		
Average slope, S (Watercourse / overland)		0.06911	[m / m]		$H_{0.85L}$	1422	[m]
Dolomitic percentage [%]		0	[%]		$H_{0.10L}$	1390.9	[m]
Overland flow (0) or watercourse (1)		0	[.]		ΔH	31.1	[m]
Roughness coefficient, r (overland flow)		0.4	[.]		0.75L	450	[m]
Rainfall region (winter / summer)		Summer	[.]		S_{av}	0.06911	[m / m]
Mean annual precipitation, MAP		750	[mm]				
Steep & impermeable (0), flat & permeable (1)		0					

Time of Concentration, T_c [hrs]	
Overland Flow	0.579
Watercourse	0.000

Areal Distribution Factors						
Rural		Urban		Lakes		
α	1.0000	β	0.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	30.0	Very permeable	30.0	Thick bush & plantation	10.0	Lawns & Parks	0.0
Flat areas (3-10%)	70.0	Permeable	20.0	Light bush & farm lands	60.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	50.0	Grass lands	30.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	0.0
∑ = 100	100	∑ = 100	100	∑ = 100	100	∑ = 100	0

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	0.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	0.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	0

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.03	0.065	**0.290**
	Flat areas (3-10%)	0.08		
	Hilly (10-30%)	0.16		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.096	
	Permeable	0.08		
	Semi permeable	0.16		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.129	
	Light bush & farm lands	0.11		
	Grass lands	0.21		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.290**

Return Period	Adjusted rural runoff factor
2	0.218
5	0.232
10	0.247
20	0.261
25	0.264
50	0.276
100	0.290

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.00	0.000	**0.000**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.000	
	Suburban	0.00		
	Streets	0.00		
	Maximum Flood	0.00		

Return Period	**Adjusted Rural Runoff Coefficient incl Dolomitic Influence**	**Urban Runoff Coefficient**	**Combined runoff coefficient**
2	0.218	0.000	0.218
5	0.232	0.000	0.232
10	0.247	0.000	0.247
20	0.261	0.000	0.261
25	0.264	0.000	0.264
50	0.276	0.000	0.276
100	0.290	0.000	0.290

Return Period	**Q_T [m^3/s]**
2	**0.46**
5	**0.71**
10	**0.97**
20	**1.28**
25	**1.53**
50	**1.86**
100	**2.43**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	22.1	32.0	41.1	51.3	60.6	70.5	87.4
Point intensity Pi [mm/hr]	38.18	55.28	71.00	88.62	104.69	121.79	150.99
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**38.2**	**55.3**	**71.0**	**88.6**	**104.7**	**121.8**	**151.0**

Project & Job No.	:	Steyn City - Riverview EXT 84	**Calculated by**	:	Bradley Denysschen
Catchment Reference	:	Post Developed	**Date**	:	11.08.2020

	INPUT / OUTPUT				
Physical Characteristics: (Inland catchments)					
Size of catchment, A	0.19986	[km^2]	To be completed only if defined watercourse		
Longest water course, L	0.62	[km]	Calculation of S_{av}		
Average slope, S (Watercourse / overland)	0.0452	[m / m]	$H_{0.85L}$	1416	[m]
Dolomitic percentage [%]	0	[%]	$H_{0.10L}$	1395	[m]
Overland flow (0) or watercourse (1)	1	[.]	ΔH	21	[m]
Roughness coefficient, r (overland flow)	0.02	[.]	0.75L	465	[m]
Rainfall region (winter / summer)	summer	[.]	S_{av}	0.04516	[m / m]
Mean annual precipitation, MAP	750	[mm]			
Steep & impermeable (0), flat & permeable (1)	0				

Time of Concentration, T_c [hrs]	
Overland Flow	0.000
Watercourse	0.151

Tc taken as 0.25 (recommended minimum)

Areal Distribution Factors						
Rural		Urban		Lakes		
α	0.0000	β	1.0000	φ	0.0000	∑ = 1

Rural						**Urban**	
Surface Slope	%	**Permeability**	%	**Vegetation**	%		% split
Vleis & pans(<3%)	0.0	Very permeable	0.0	Thick bush & plantation	0.0	Lawns & Parks	50.0
Flat areas (3-10%)	0.0	Permeable	0.0	Light bush & farm lands	0.0	Industrial Areas	0.0
Hilly (10-30%)	0.0	Semi permeable	0.0	Grass lands	0.0	Residential Areas	0.0
Steep areas(>30%)	0.0	Impermeable	0.0	No vegetation	0.0	Business	50.0
∑ = 100	0	∑ = 100	0	∑ = 100	0	∑ = 100	100

Urban							
Lawns & Parks	%	**Industrial Areas**	%	**Residential Areas**	%	**Business**	%
Sandy, flat (<2%)	100.0	Light industry	0.0	Houses (Res 1)	0.0	City centre	0.0
Sandy, steep (>7%)	0.0	heavy industry	0.0	Flats (Res 2 +)	0.0	Suburban	100.0
Heavy soil, flat (<2%)	0.0					Streets	0.0
heavy soil, steep (>7%)	0.0					Maximum Flood	0.0
∑ = 100	100	∑ = 100	0	∑ = 100	0	∑ = 100	100

Rural, C_1

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_1
Surface Slope, C_h	Vleis & pans(<3%)	0.00	0.000	**0.000**
	Flat areas (3-10%)	0.00		
	Hilly (10-30%)	0.00		
	Steep areas(>30%)	0.00		
Permeability, C_d	Very permeable	0.00	0.000	
	Permeable	0.00		
	Semi permeable	0.00		
	Impermeable	0.00		
Vegetation, C_p	Thick bush & plantation	0.00	0.000	
	Light bush & farm lands	0.00		
	Grass lands	0.00		
	No vegetation	0.00		

Dolomitic effect on Rural surface slope C factor	
C_{1D}	**0.000**

Return Period	Adjusted rural runoff factor
2	0.000
5	0.000
10	0.000
20	0.000
25	0.000
50	0.000
100	0.000

Urban, C_2

Component	Classification	Assigned Runoff Coefficient	Weighted C	C_2
Lawns	Sandy, flat (<2%)	0.08	0.080	**0.465**
	Sandy, steep (>7%)	0.00		
	Heavy soil, flat (<2%)	0.00		
	heavy soil, steep (>7%)	0.00		
Industrial areas	Light industry	0.00	0.000	
	heavy industry	0.00		
Residential	Houses (Res 1)	0.00	0.000	
	Flats (Res 2 +)	0.00		
Business	City centre	0.00	0.850	
	Suburban	0.85		
	Streets	0.00		
	Maximum Flood	1.00		

Return Period	Adjusted Rural Runoff Coefficient incl Dolomitic Influence	Urban Runoff Coefficient	Combined runoff coefficient
2	0.000	0.465	0.465
5	0.000	0.465	0.465
10	0.000	0.465	0.465
20	0.000	0.465	0.465
25	0.000	0.465	0.465
50	0.000	0.465	0.465
100	0.000	0.465	0.465

Return Period	Q_T [m^3/s]
2	**1.63**
5	**2.28**
10	**3.11**
20	**3.71**
25	**4.30**
50	**5.06**
100	**6.32**

Return Period [yrs]	2	5	10	20	25	50	100
Point precipitation, P_t (*.dwg) [mm]	15.8	22.1	30.1	35.9	41.6	49.0	61.2
Point intensity Pi [mm/hr]	63.20	88.40	120.40	143.60	166.40	196.00	244.80
ARF (*.dwg) [%]	100	100	100	100	100	100	100
Average rainfall intensity [mm/hr]	**63.2**	**88.4**	**120.4**	**143.6**	**166.4**	**196.0**	**244.8**

Annexure G1

Area #1 Pond Sizing and Hydrograph

Project **Area #1 Riverside View X84** **2020/08/11**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	15.1 min	0.3	hr
RI	**5**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.4	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	100.6 mm/h			
Rational C	0.98		Peak Rainfall Intensity Triangular Hyetograph			
			201.3 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	352 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.200	0.45	m	Crest Lvl	1.1 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	112.0	
Invert Lvl	1.30		Invert Lvl	1.50	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	380	0
0.25	0.25	400	98
0.50	0.50	425	201
0.75	0.75	450	310
1.00	1.00	475	426
1.20	1.20	500	523
1.40	1.40	525	626
1.60	1.60	550	733

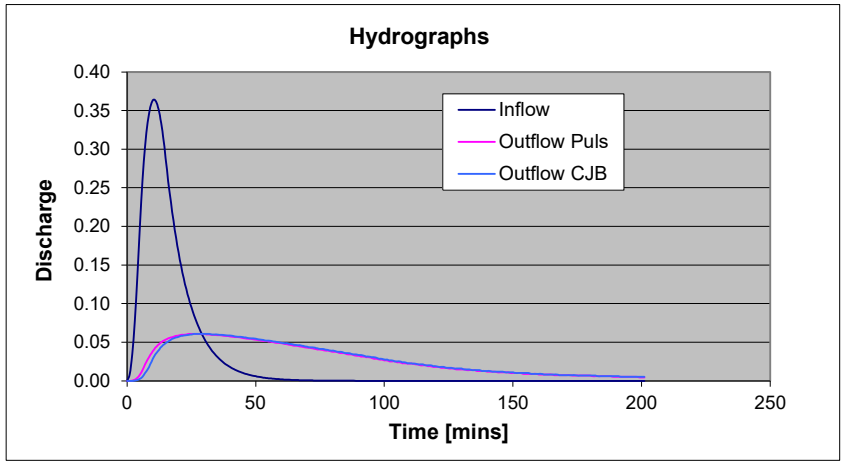
Initial Conditions

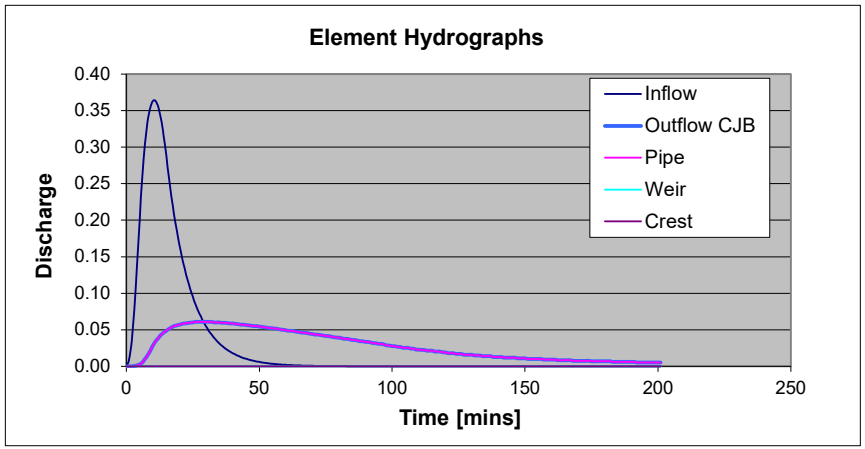
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	380	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.363 m^3/s		
Q_{out} CJB	0.061 m^3/s	Q_{pipe}	0.061 m^3/s
Q_{out} Puls	0.061 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.670 m	Q_{crest}	0.000 m^3/s
Stored Vol	272 m^3		





Project **Area #1 Riverside View X84** **2020/08/11**

Engineer Bradley Denysschen

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	15.1 min	0.3	hr
RI	**25**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.4	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	163.1 mm/h			
Rational C	0.98		Peak Rainfall Intensity	Triangular Hyetograph		
			326.2 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	571 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.200	0.45	m	Crest Lvl	1.1 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	112.0	
Invert Lvl	1.30		Invert Lvl	1.50	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	380	0
0.25	0.25	400	98
0.50	0.50	425	201
0.75	0.75	450	310
1.00	1.00	475	426
1.20	1.20	500	523
1.40	1.40	525	626
1.60	1.60	550	733

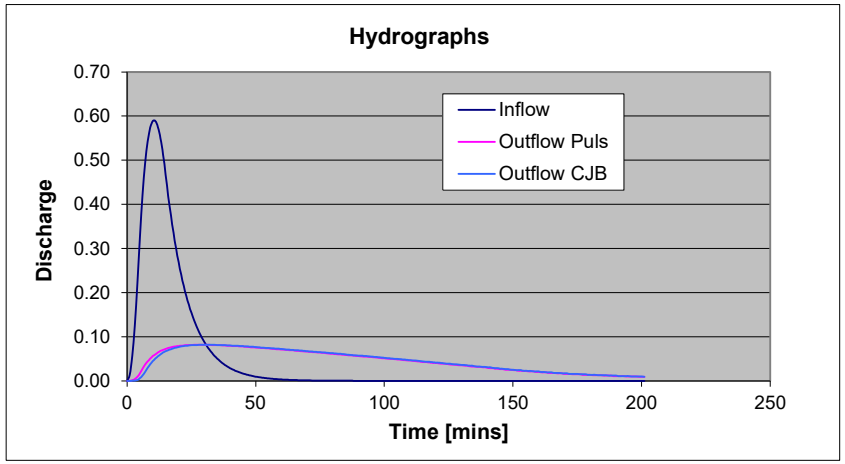
Initial Conditions

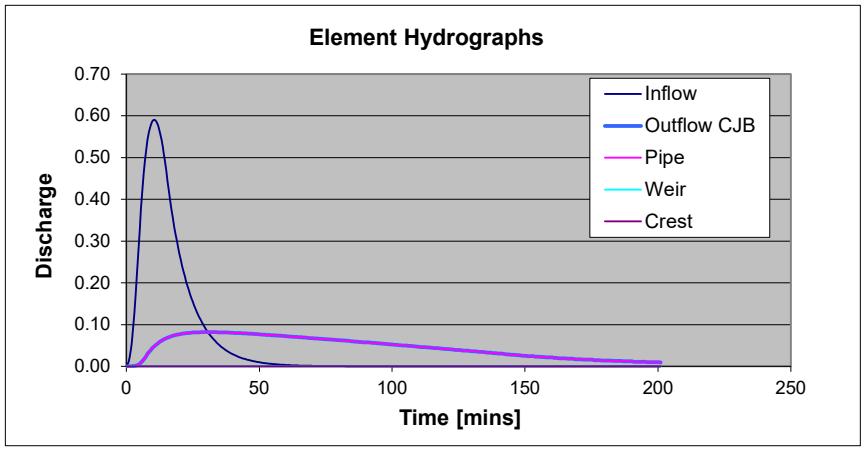
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	380	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.589 m^3/s		
Q_{out} CJB	0.082 m^3/s	Q_{pipe}	0.082 m^3/s
Q_{out} Puls	0.082 m^3/s	Q_{weir}	0.000 m^3/s
Stage	1.072 m	Q_{crest}	0.000 m^3/s
Stored Vol	457 m^3		





Project **Area #1 Riverside View X84** **2020/08/11**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	15.1 min	0.3	hr
RI	**50**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.4	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	200.8 mm/h			
Rational C	0.98		Peak Rainfall Intensity Triangular Hyetograph			
			401.6 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	703 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.200	0.45	m	Crest Lvl	1.1 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	112.0	
Invert Lvl	1.30		Invert Lvl	1.50	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	380	0
0.25	0.25	400	98
0.50	0.50	425	201
0.75	0.75	450	310
1.00	1.00	475	426
1.20	1.20	500	523
1.40	1.40	525	626
1.60	1.60	550	733

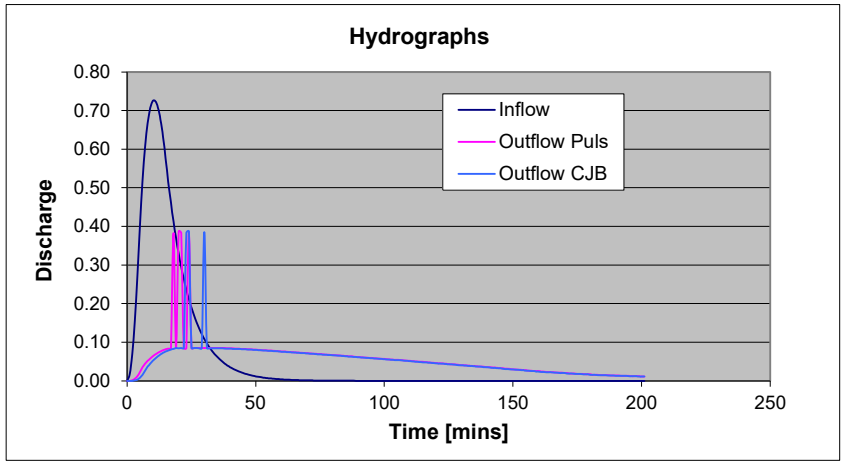
Initial Conditions

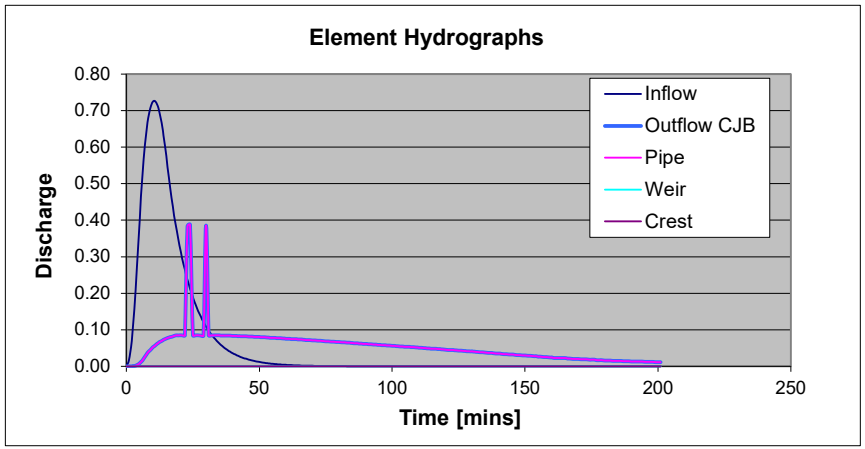
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	380	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.725 m^3/s		
Q_{out} CJB	0.387 m^3/s	Q_{pipe}	0.387 m^3/s
Q_{out} Puls	0.387 m^3/s	Q_{weir}	0.000 m^3/s
Stage	1.170 m	Q_{crest}	0.000 m^3/s
Stored Vol	508 m^3		





Annexure G2

Area #2 Pond Sizing and Hydrograph

Project **Area #2 Riverside View X84** **2020/08/11**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.3 min	0.3	hr
RI	**5**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	7.1	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	91.8 mm/h			
Rational C	0.40		Peak Rainfall Intensity Triangular Hyetograph			
			183.6 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	795 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.250	0.45	m	Crest Lvl	0.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	0.70		Invert Lvl	0.90	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	1000	0
0.10	0.10	1000	100
0.20	0.20	2000	250
0.30	0.30	3000	500
0.40	0.40	4000	850
0.50	0.50	5000	1300
0.60	0.60	6000	1850
1.00	1.00	7000	4450

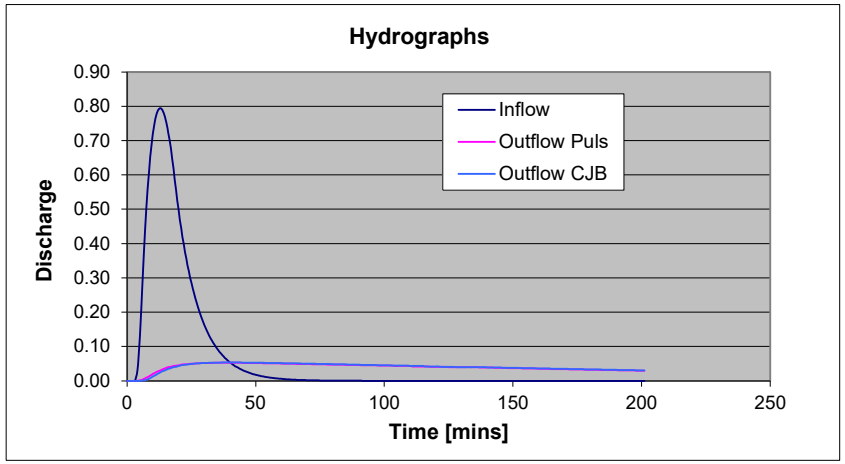
Initial Conditions

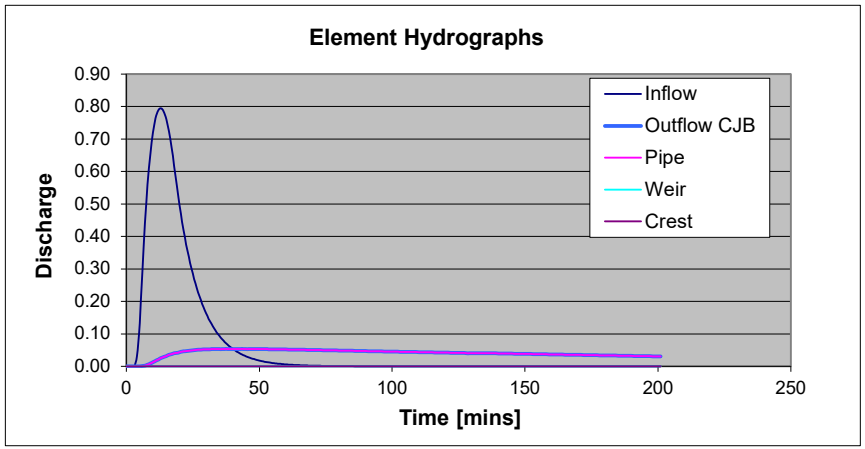
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	1000	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.795 m^3/s		
Q_{out} CJB	0.053 m^3/s	Q_{pipe}	0.053 m^3/s
Q_{out} Puls	0.053 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.371 m	Q_{crest}	0.000 m^3/s
Stored Vol	745 m^3		





Project **Area #2 Riverside View X84** **2020/08/11**

Engineer Bradley Denysschen

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.3 min	0.3	hr
RI	**25**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	7.1	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	148.8 mm/h			
Rational C	0.40		Peak Rainfall Intensity	Triangular Hyetograph		
			297.6 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	1288 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.250	0.45	m	Crest Lvl	0.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	0.70		Invert Lvl	0.90	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	1000	0
0.10	0.10	1000	100
0.20	0.20	2000	250
0.30	0.30	3000	500
0.40	0.40	4000	850
0.50	0.50	5000	1300
0.60	0.60	6000	1850
1.00	1.00	7000	4450

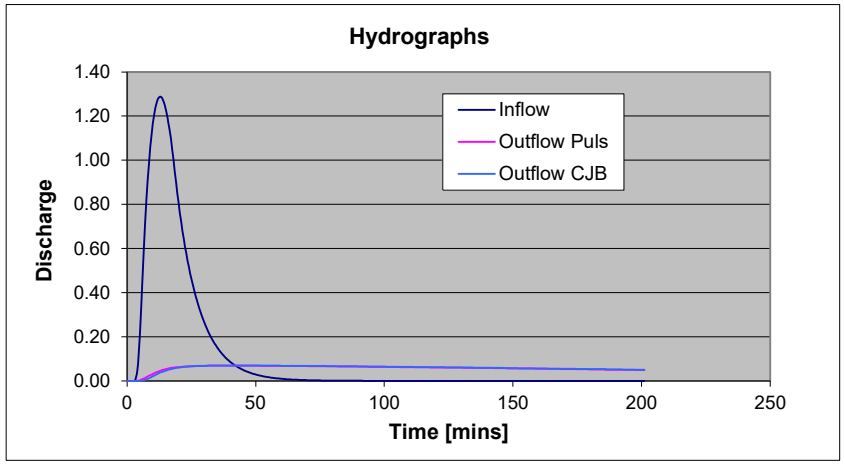
Initial Conditions

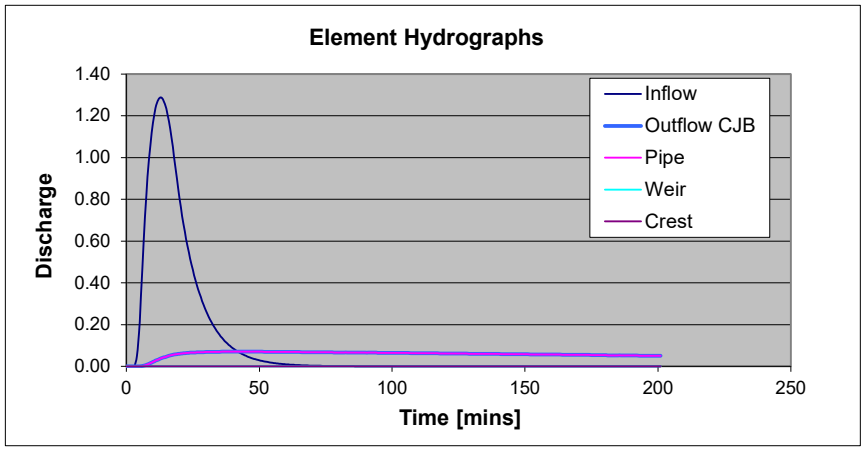
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	1000	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	1.288 m^3/s		
Q_{out} CJB	0.070 m^3/s	Q_{pipe}	0.070 m^3/s
Q_{out} Puls	0.069 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.483 m	Q_{crest}	0.000 m^3/s
Stored Vol	1210 m^3		





Project **Area #2 Riverside View X84** **2020/08/11**

Engineer Bradley Denysschen

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.3 min	0.3	hr
RI	**50**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	7.1	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	183.2 mm/h			
Rational C	0.40		Peak Rainfall Intensity Triangular Hyetograph			
			366.4 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	1586 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.250	0.45	m	Crest Lvl	0.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	0.70		Invert Lvl	0.90	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	1000	0
0.10	0.10	1000	100
0.20	0.20	2000	250
0.30	0.30	3000	500
0.40	0.40	4000	850
0.50	0.50	5000	1300
0.60	0.60	6000	1850
1.00	1.00	7000	4450

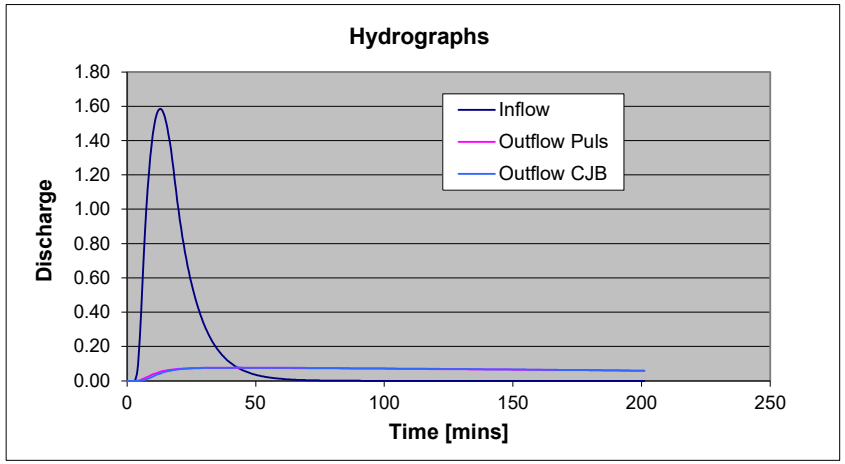
Initial Conditions

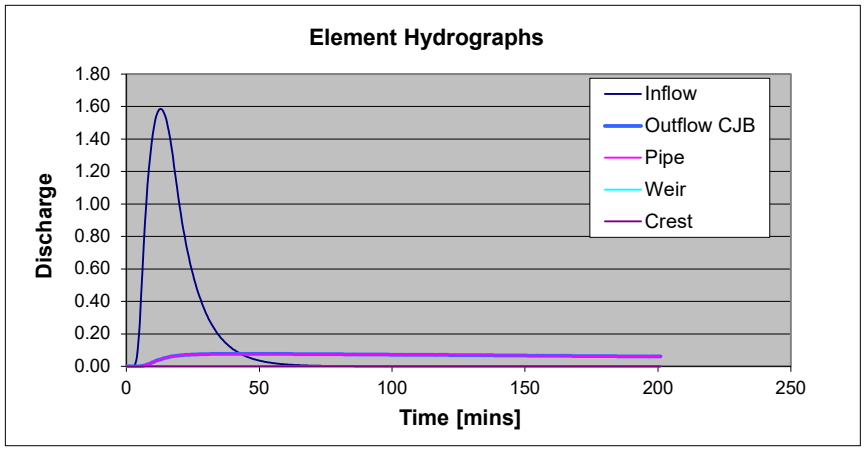
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	1000	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	1.586 m^3/s		
Q_{out} CJB	0.077 m^3/s	Q_{pipe}	0.077 m^3/s
Q_{out} Puls	0.077 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.540 m	Q_{crest}	0.000 m^3/s
Stored Vol	1520 m^3		





Annexure G3

Area #3 Pond Sizing and Hydrograph

Project **Area #3 Riverside View X84** **2020/08/11**

Engineer Bradley Denysschen

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	17.0 min	0.3	hr
RI	**5**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	6.0	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	95.0 mm/h			
Rational C	0.60		Peak Rainfall Intensity Triangular Hyetograph			
			190.1 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	975 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.350	0.45	m	Crest Lvl	1.7 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	1.80		Invert Lvl	2.00	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	280	0
0.25	0.25	400	85
0.50	0.50	520	200
0.75	0.75	640	345
1.00	1.00	760	520
1.25	1.25	880	725
1.50	1.50	1000	960
2.10	2.10	1650	1755

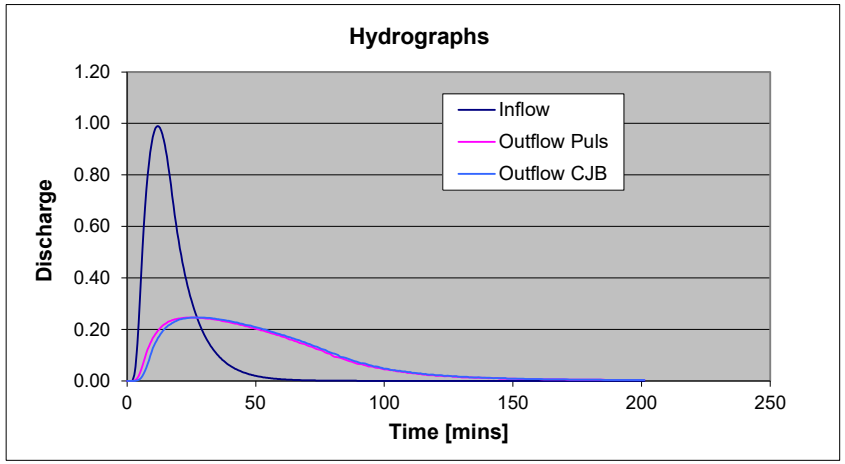
Initial Conditions

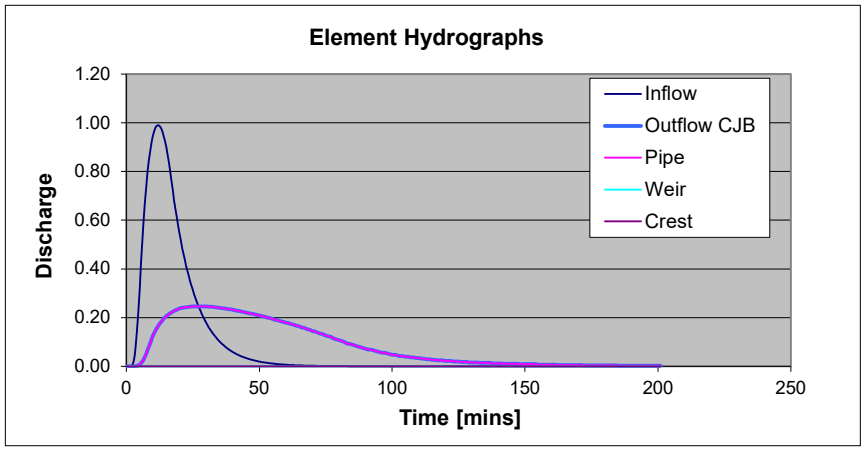
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	280	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.990 m^3/s		
Q_{out} CJB	0.246 m^3/s	Q_{pipe}	0.246 m^3/s
Q_{out} Puls	0.246 m^3/s	Q_{weir}	0.000 m^3/s
Stage	1.175 m	Q_{crest}	0.000 m^3/s
Stored Vol	656 m^3		





Project **Area #3 Riverside View X84** **2020/08/11**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	17.0 min	0.3	hr
RI	**25**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	6.0	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	154.0 mm/h			
Rational C	0.60		Peak Rainfall Intensity Triangular Hyetograph			
			308.1 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	1581 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.350	0.45	m	Crest Lvl	1.7 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	1.80		Invert Lvl	2.00	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	280	0
0.25	0.25	400	85
0.50	0.50	520	200
0.75	0.75	640	345
1.00	1.00	760	520
1.25	1.25	880	725
1.50	1.50	1000	960
2.10	2.10	1650	1755

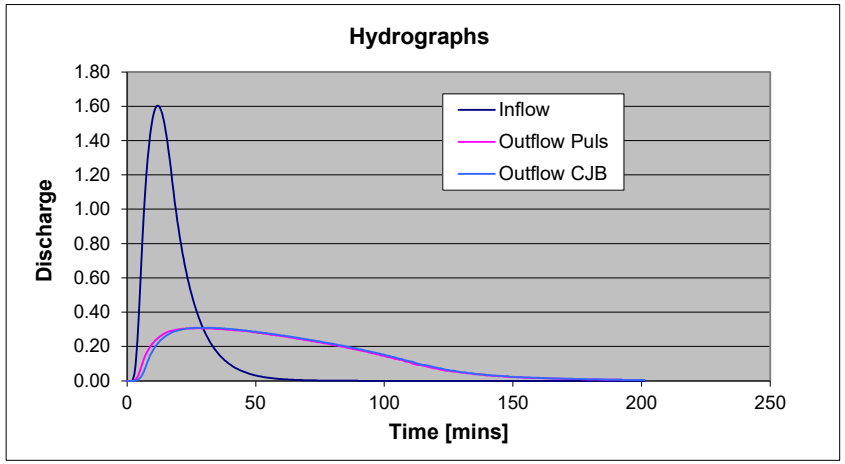
Initial Conditions

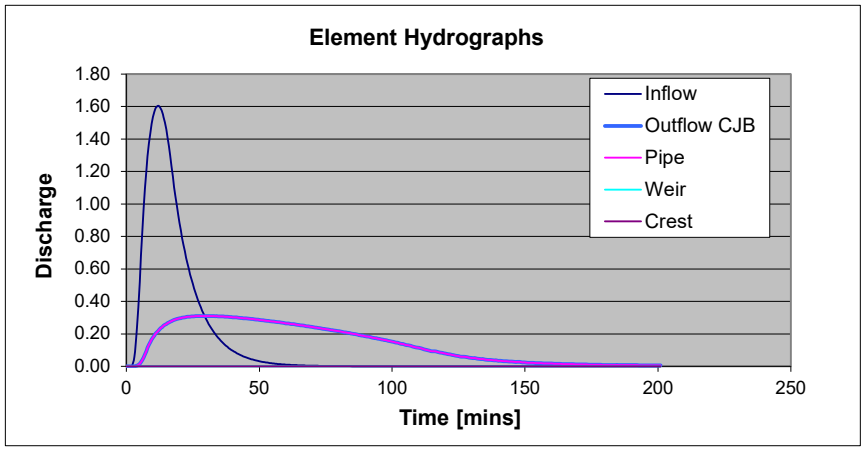
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	280	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	1.604 m^3/s		
Q_{out} CJB	0.309 m^3/s	Q_{pipe}	0.309 m^3/s
Q_{out} Puls	0.307 m^3/s	Q_{weir}	0.000 m^3/s
Stage	1.678 m	Q_{crest}	0.000 m^3/s
Stored Vol	1185 m^3		





Project **Area #3 Riverside View X84** **2020/08/11**

Engineer Bradley Denysschen

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	17.0 min	0.3	hr
RI	**50**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	6.0	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	189.6 mm/h			
Rational C	0.60		Peak Rainfall Intensity Triangular Hyetograph			
			379.3 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	1946 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.350	0.45	m	Crest Lvl	1.7 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	1.80		Invert Lvl	2.00	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	280	0
0.25	0.25	400	85
0.50	0.50	520	200
0.75	0.75	640	345
1.00	1.00	760	520
1.25	1.25	880	725
1.50	1.50	1000	960
2.10	2.10	1650	1755

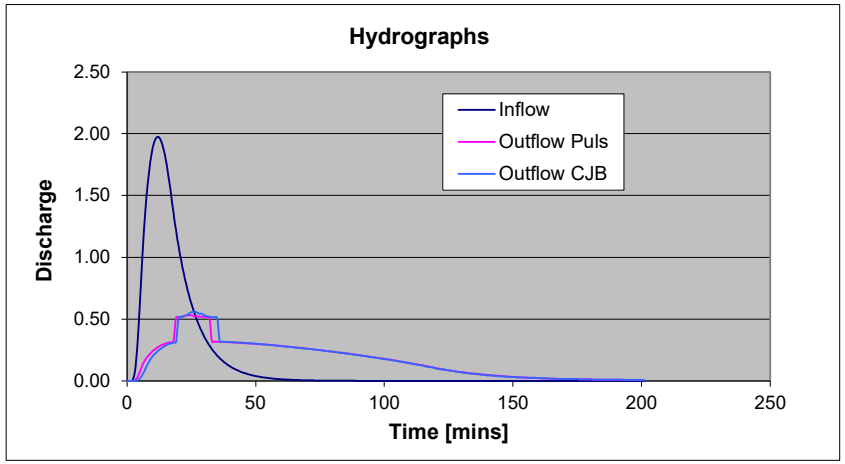
Initial Conditions

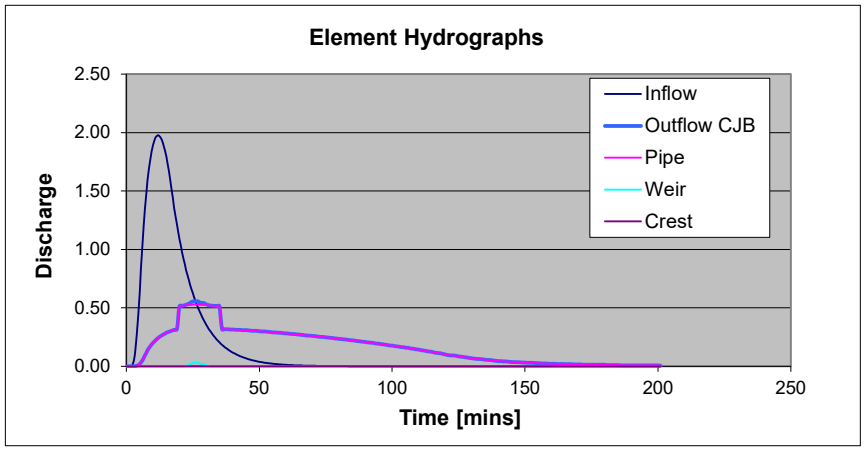
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	280	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	1.975 m^3/s		
Q_{out} CJB	0.556 m^3/s	Q_{pipe}	0.527 m^3/s
Q_{out} Puls	0.532 m^3/s	Q_{weir}	0.029 m^3/s
Stage	1.841 m	Q_{crest}	0.000 m^3/s
Stored Vol	1407 m^3		





Annexure G4

Area #4 Pond Sizing and Hydrograph

Project **Area #4 Riverside View X84** **2020/08/07**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	16.6 min	0.3	hr
RI	**5**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.6	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	96.3 mm/h			
Rational C	0.68		Peak Rainfall Intensity Triangular Hyetograph			
			192.6 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	292 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.180	0.45	m	Crest Lvl	1.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	175.0	
Invert Lvl	1.50		Invert Lvl	1.70	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	190	0
0.20	0.20	200	39
0.40	0.40	225	82
0.60	0.60	250	129
0.90	0.90	275	208
1.20	1.20	300	294
1.50	1.50	325	388
1.80	1.80	350	489

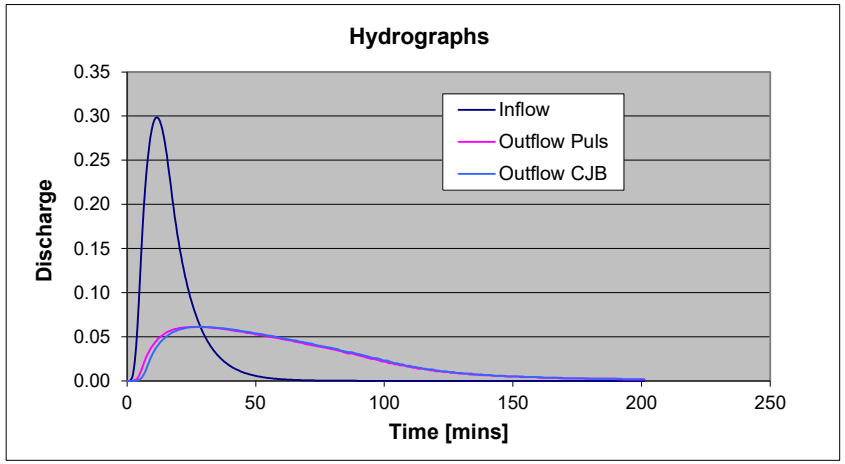
Initial Conditions

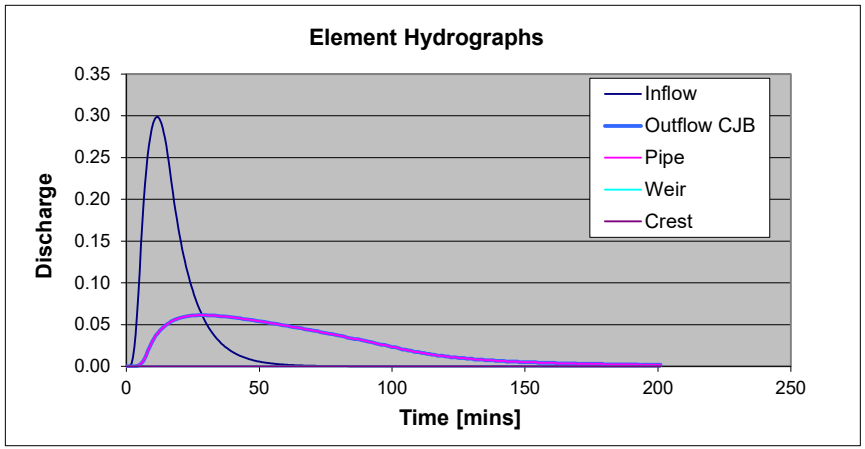
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	190	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.298 m^3/s		
Q_{out} CJB	0.061 m^3/s	Q_{pipe}	0.061 m^3/s
Q_{out} Puls	0.061 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.921 m	Q_{crest}	0.000 m^3/s
Stored Vol	213 m^3		





Project **Area #4 Riverside View X84** **2020/08/07**

Engineer Bradley Denysschen

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	16.6 min	0.3	hr
RI	**25**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.6	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	156.0 mm/h			
Rational C	0.68		Peak Rainfall Intensity	Triangular Hyetograph		
			312.1 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	472 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.180	0.45	m	Crest Lvl	1.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	175.0	
Invert Lvl	1.50		Invert Lvl	1.70	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	190	0
0.20	0.20	200	39
0.40	0.40	225	82
0.60	0.60	250	129
0.90	0.90	275	208
1.20	1.20	300	294
1.50	1.50	325	388
1.80	1.80	350	489

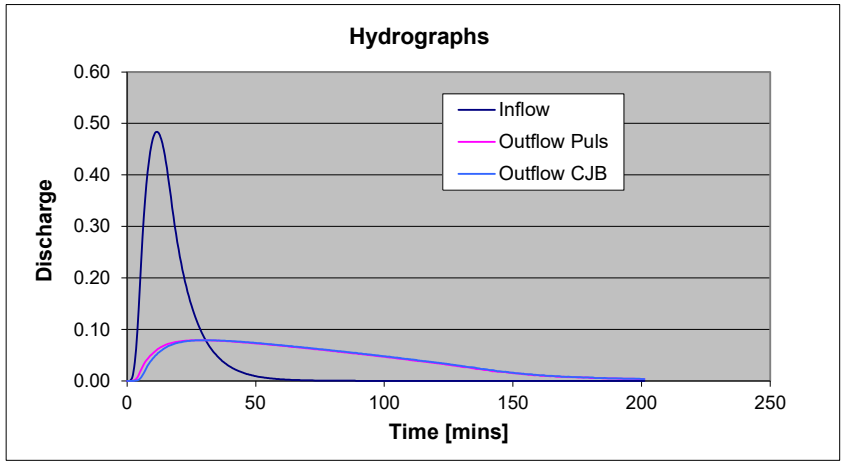
Initial Conditions

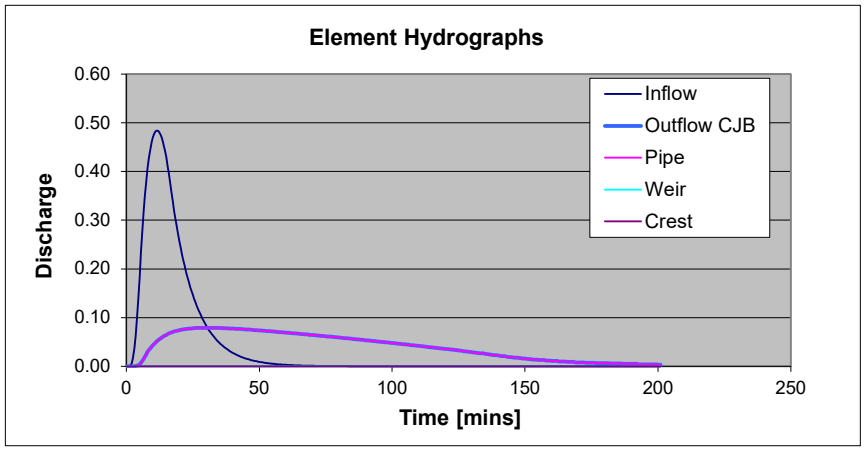
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	190	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.483 m^3/s		
Q_{out} CJB	0.079 m^3/s	Q_{pipe}	0.079 m^3/s
Q_{out} Puls	0.079 m^3/s	Q_{weir}	0.000 m^3/s
Stage	1.435 m	Q_{crest}	0.000 m^3/s
Stored Vol	366 m^3		





Project **Area #4 Riverside View X84** **2020/08/07**

Engineer Bradley Denysschen

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	16.6 min	0.3	hr
RI	**50**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.6	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	192.1 mm/h			
Rational C	0.68		Peak Rainfall Intensity	Triangular Hyetograph		
			384.2 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	582 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.180	0.45	m	Crest Lvl	1.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	175.0	
Invert Lvl	1.50		Invert Lvl	1.70	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	190	0
0.20	0.20	200	39
0.40	0.40	225	82
0.60	0.60	250	129
0.90	0.90	275	208
1.20	1.20	300	294
1.50	1.50	325	388
1.80	1.80	350	489

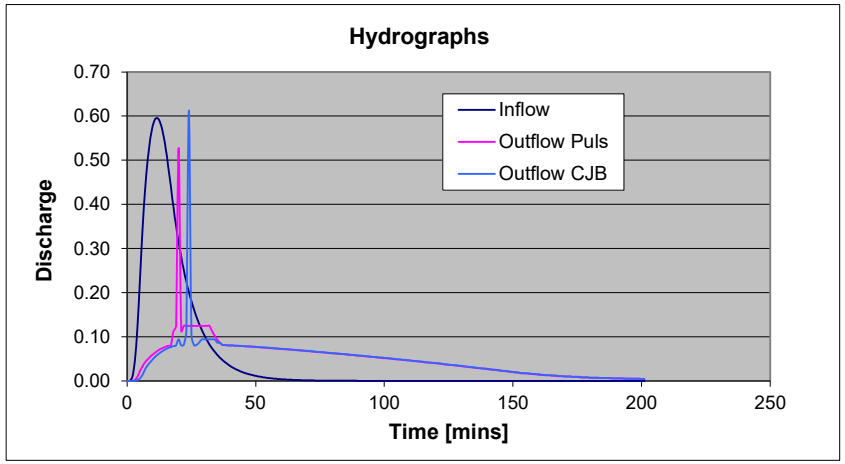
Initial Conditions

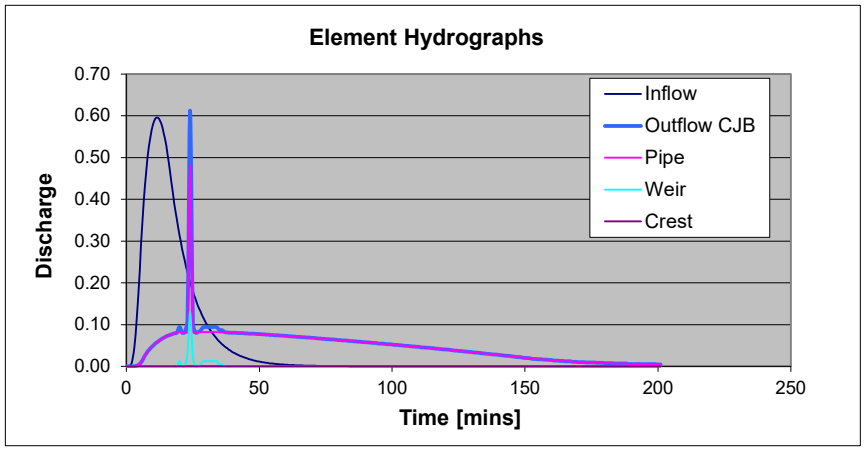
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	190	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.595 m^3/s		
Q_{out} CJB	0.613 m^3/s	Q_{pipe}	0.482 m^3/s
Q_{out} Puls	0.528 m^3/s	Q_{weir}	0.130 m^3/s
Stage	1.605 m	Q_{crest}	0.000 m^3/s
Stored Vol	422 m^3		





Annexure G5

Area #5 Pond Sizing and Hydrograph

Project **Area #5 Riverside View X84** **2020/08/07**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.1 min	0.3	hr
RI	**5**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	2.2	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	92.3 mm/h			
Rational C	0.43		Peak Rainfall Intensity Triangular Hyetograph			
			184.6 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	259 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.200	0.45	m	Crest Lvl	1.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	1.50		Invert Lvl	1.70	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	165	0
0.20	0.20	170	34
0.40	0.40	183	69
0.60	0.60	200	107
0.90	0.90	218	170
1.20	1.20	235	238
1.50	1.50	253	311
1.80	1.80	270	389

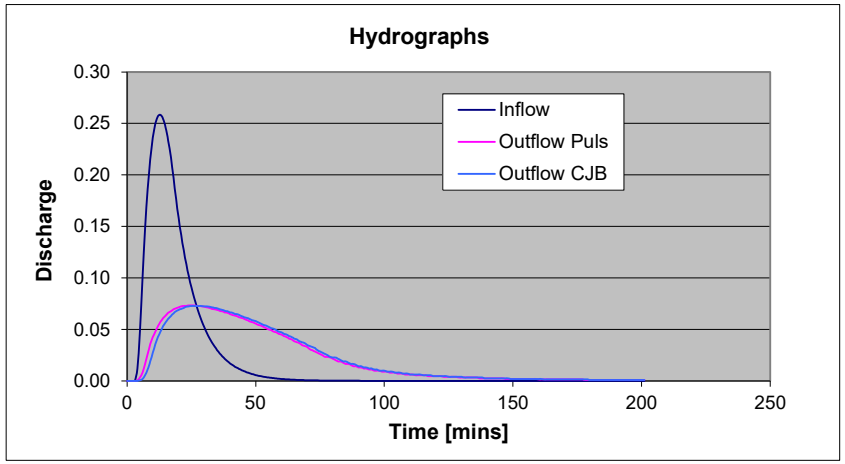
Initial Conditions

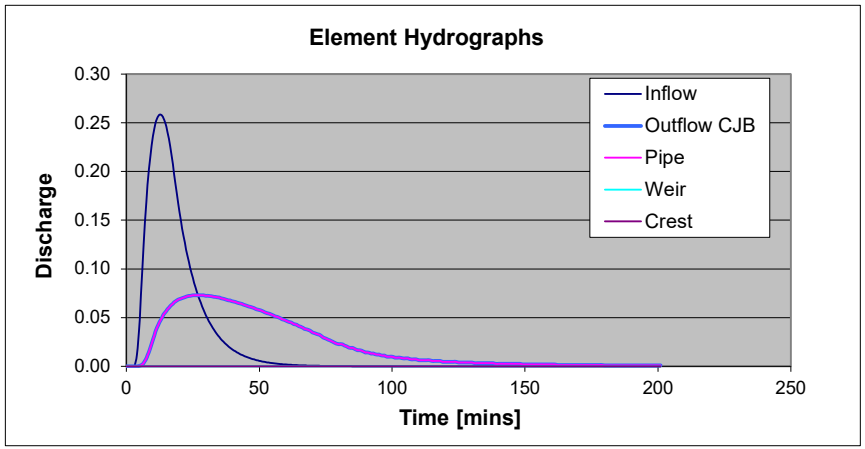
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	165	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.258 m^3/s		
Q_{out} CJB	0.073 m^3/s	Q_{pipe}	0.073 m^3/s
Q_{out} Puls	0.073 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.890 m	Q_{crest}	0.000 m^3/s
Stored Vol	166 m^3		





Project **Area #5 Riverside View X84** **2020/08/07**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.1 min	0.3	hr
RI	**25**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	2.2	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	149.6 mm/h			
Rational C	0.43		Peak Rainfall Intensity Triangular Hyetograph			
			299.2 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	419 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.200	0.45	m	Crest Lvl	1.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	1.50		Invert Lvl	1.70	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	165	0
0.20	0.20	170	34
0.40	0.40	183	69
0.60	0.60	200	107
0.90	0.90	218	170
1.20	1.20	235	238
1.50	1.50	253	311
1.80	1.80	270	389

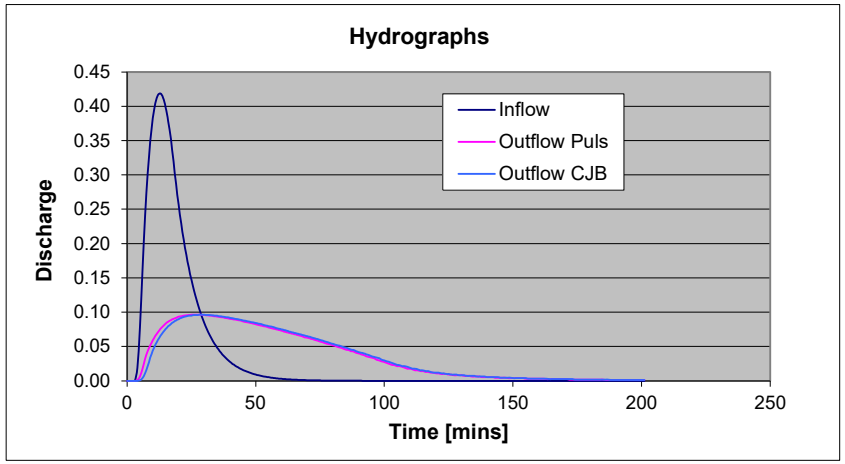
Initial Conditions

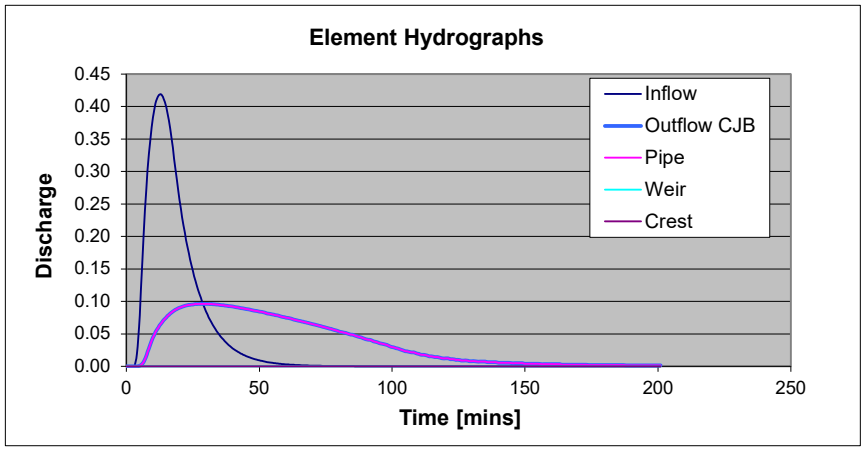
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	165	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.419 m^3/s		
Q_{out} CJB	0.096 m^3/s	Q_{pipe}	0.096 m^3/s
Q_{out} Puls	0.096 m^3/s	Q_{weir}	0.000 m^3/s
Stage	1.418 m	Q_{crest}	0.000 m^3/s
Stored Vol	290 m^3		





Project **Area #5 Riverside View X84** **2020/08/07**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.1 min	0.3	hr
RI	**50**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	2.2	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	184.2 mm/h			
Rational C	0.43		Peak Rainfall Intensity Triangular Hyetograph			
			368.4 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	516 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.200	0.45	m	Crest Lvl	1.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	350.0	
Invert Lvl	1.50		Invert Lvl	1.70	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	165	0
0.20	0.20	170	34
0.40	0.40	183	69
0.60	0.60	200	107
0.90	0.90	218	170
1.20	1.20	235	238
1.50	1.50	253	311
1.80	1.80	270	389

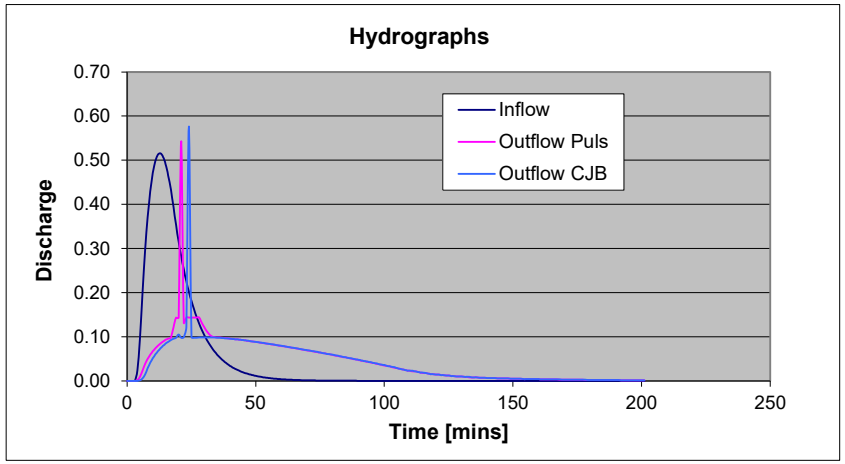
Initial Conditions

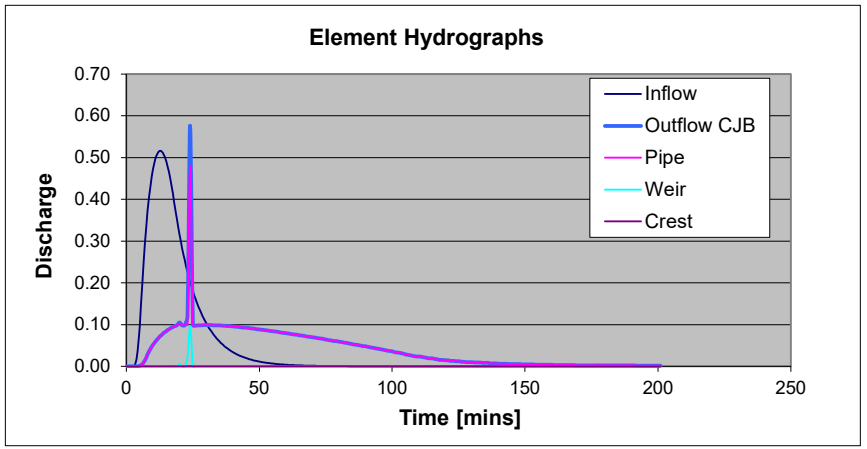
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	165	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.515 m^3/s		
Q_{out} CJB	0.576 m^3/s	Q_{pipe}	0.479 m^3/s
Q_{out} Puls	0.543 m^3/s	Q_{weir}	0.097 m^3/s
Stage	1.589 m	Q_{crest}	0.000 m^3/s
Stored Vol	333 m^3		





Annexure G6

Area #6 Pond Sizing and Hydrograph

Project **Area #5 Riverside View X84** **2020/08/11**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
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cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.0 min	0.3	hr
RI	**5**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.3	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	92.6 mm/h			
Rational C	0.45		Peak Rainfall Intensity Triangular Hyetograph			
			185.3 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	165 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.350	0.45	m	Crest Lvl	0.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	160.0	
Invert Lvl	0.60		Invert Lvl	0.80	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	530	0
0.10	0.10	750	64
0.30	0.30	570	196
0.50	0.50	600	313
0.60	0.60	620	374
0.70	0.70	640	437
0.80	0.80	660	502
0.90	0.90	680	569

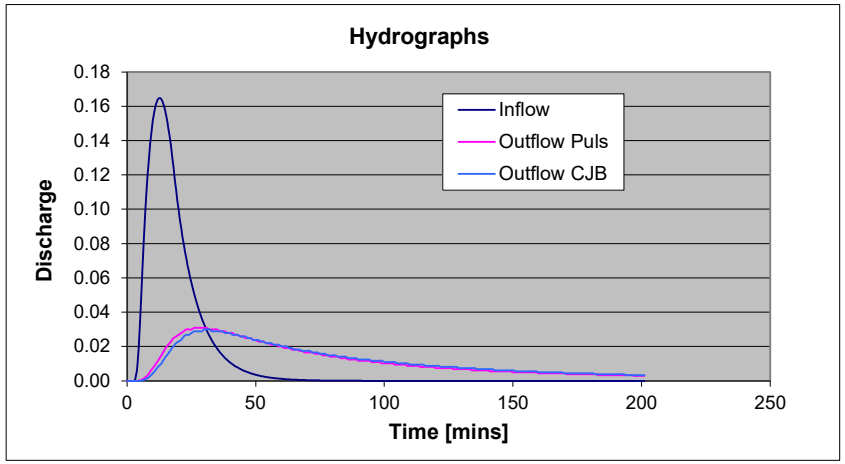
Initial Conditions

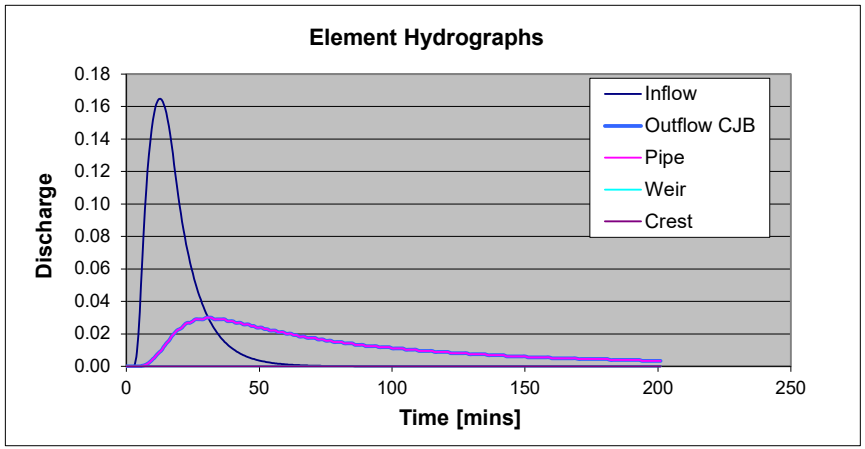
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	530	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.165 m^3/s		
Q_{out} CJB	0.030 m^3/s	Q_{pipe}	0.030 m^3/s
Q_{out} Puls	0.031 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.194 m	Q_{crest}	0.000 m^3/s
Stored Vol	126 m^3		





Project **Area #5 Riverside View X84** **2020/08/11**

Engineer Bradley Denysschen

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.0 min	0.3	hr
RI	**25**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.3	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	150.1 mm/h			
Rational C	0.45		Peak Rainfall Intensity Triangular Hyetograph			
			300.3 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	267 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.350	0.45	m	Crest Lvl	0.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	160.0	
Invert Lvl	0.60		Invert Lvl	0.80	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	530	0
0.10	0.10	750	64
0.30	0.30	570	196
0.50	0.50	600	313
0.60	0.60	620	374
0.70	0.70	640	437
0.80	0.80	660	502
0.90	0.90	680	569

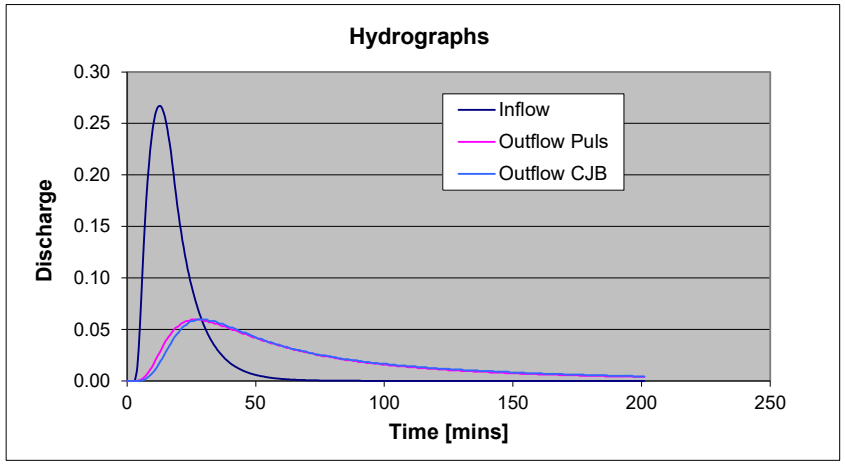
Initial Conditions

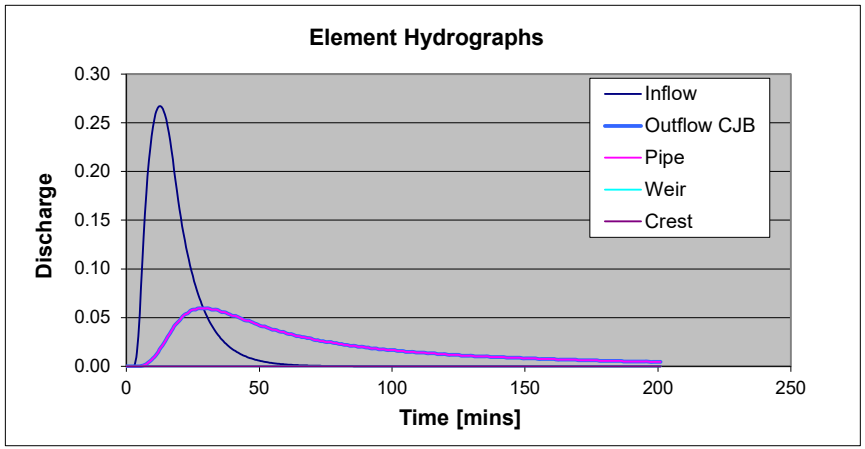
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	530	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

Q_{in}	0.267 m^3/s		
Q_{out} CJB	0.059 m^3/s	Q_{pipe}	0.059 m^3/s
Q_{out} Puls	0.059 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.309 m	Q_{crest}	0.000 m^3/s
Stored Vol	200 m^3		





Project **Area #5 Riverside View X84** **2020/08/11**
Engineer Bradley Denysschen
Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng
Version 5.0
Chris Brooker & Associates
cbrooker@iafrica.com

cba SPECIALIST ENGINEERS

	Input		Computed			
Region						
MAP	750	mm/year	Storm Td	18.0 min	0.3	hr
RI	**50**	**year**	= concentration time plus time to start runoff			
Catchment			Average Rainfall Intensity			
Area	1.3	ha	Op ten Noord & Stephenson	Inland		
Conc time Tc	15	min	184.8 mm/h			
Rational C	0.45		Peak Rainfall Intensity Triangular Hyetograph			
			369.7 mm/h	At time	5	mins
Storm						
Time to peak	0.3	ratio	Runoff Vol	329 m^3	= C x P x A	
Time step	1	min				

Reservoir and Outlet Data

Pipe	**U/S**	**D/S**		**Tower**			
No off	1	1	No	Crest Len	4 m	$C_{d(unsub)}$	0.75
Dia	0.350	0.45	m	Crest Lvl	0.5 m	$C_{d(sub)}$	0.62
Invert Lvl	0	0	m			C_h	0.85

Spillway			**Crest**		
Cd	1.60	for Q = Cd x L x $h^{1.5}$	Cd	1.40	for Q = Cd x L x $h^{1.5}$
Width	2.5		Width	160.0	
Invert Lvl	0.60		Invert Lvl	0.80	
Free board	0.20		Free board	0.10	

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	530	0
0.10	0.10	750	64
0.30	0.30	570	196
0.50	0.50	600	313
0.60	0.60	620	374
0.70	0.70	640	437
0.80	0.80	660	502
0.90	0.90	680	569

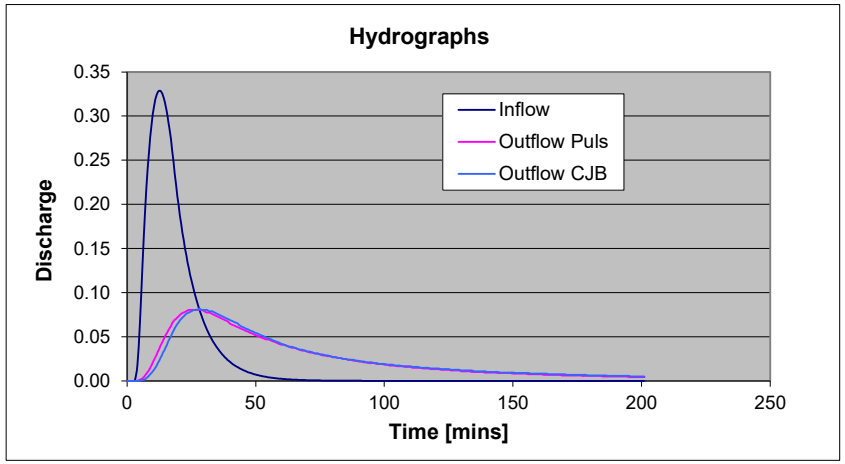
Initial Conditions

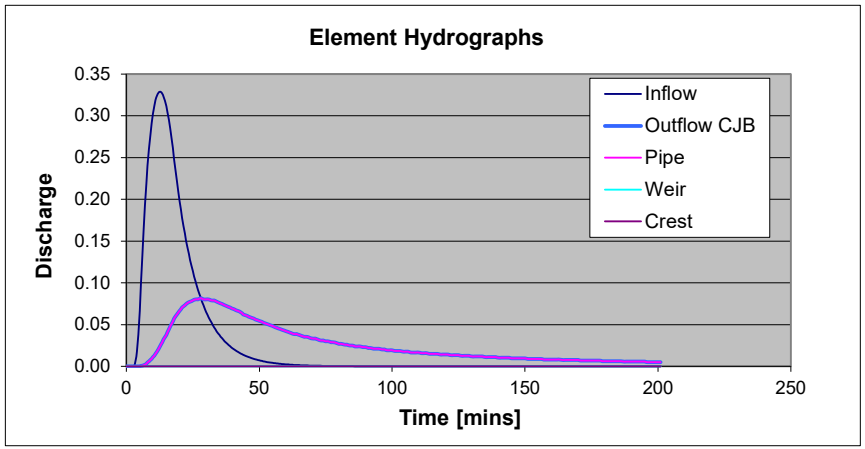
Stage	0.00	m
Depth	0.00	m
Vol	0	m^3
Area	530	m^2
Discharge	0.00	m^3/s

Results Summary

Peaks

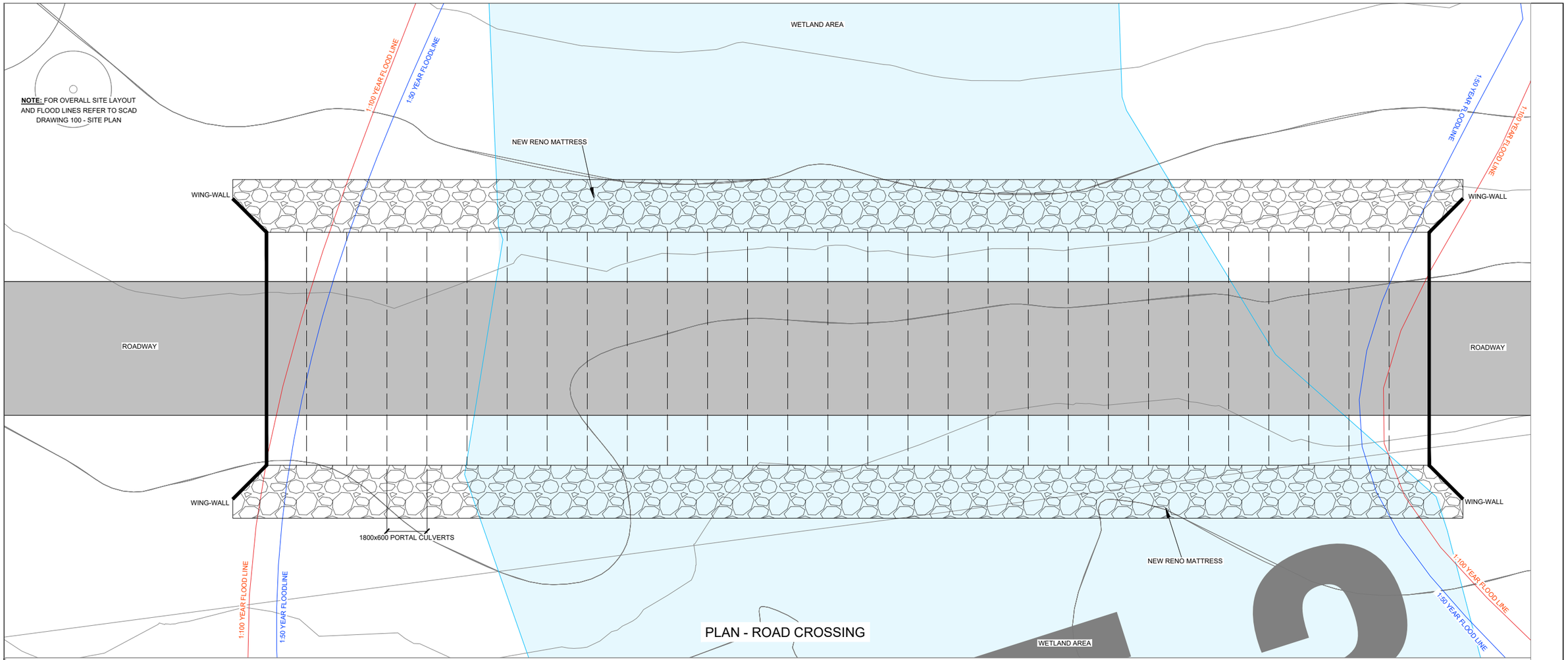
Q_{in}	0.329 m^3/s		
Q_{out} CJB	0.082 m^3/s	Q_{pipe}	0.082 m^3/s
Q_{out} Puls	0.080 m^3/s	Q_{weir}	0.000 m^3/s
Stage	0.378 m	Q_{crest}	0.000 m^3/s
Stored Vol	242 m^3		



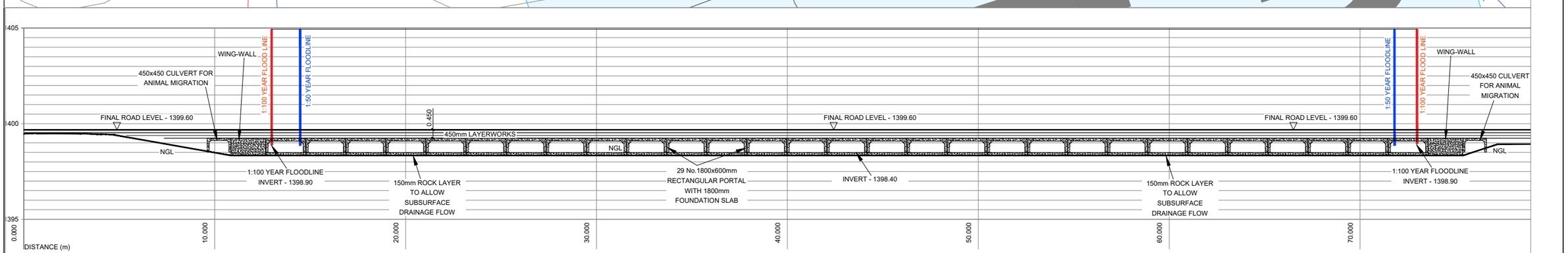


Annexure H

Drawing 1574/84/320 – Proposed Bridge Crossing



PLAN - ROAD CROSSING



ELEVATION - ROAD CROSSING CULVERTS

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APPROVED:
Pr. Eng. No.:
DATE:

Dwg No. 1574/84/320SW | Rev No. A

		REV	AMENDMENTS	DATE
SURVEYED				
DESIGNED	B DENYSSCHEN			
DRAWN	B DENYSSCHEN			
CHECKED	A COMLEY			
CO-ORDINATE SYSTEM	WGS 29			
GEOTECHNICAL INVESTIGATION				
SERVITUDES				
APPROVED				
		A	ISSUED FOR INFORMATION	18/06/2019

RIVERSIDE VIEW EXT 84

CULVERT BRIDGE CROSSING
LAYOUT PLAN

STEYN CITY INVESTMENTS (PTY) LTD

Johannesburg Roads Agency
PRIVATE BAG X 70, BRAAMFONTEIN, JOHANNESBURG, 2017 GAUTENG, SOUTH AFRICA
TEL: 011-407-6487
FAX: 011-339-1607

1574/84/310SW PROJECT No. | A REV.
A1 ORIGINAL PAGE SIZE | SHEET 1 OF 1
FILE No.