Ekurhuleni Metropolitan Municipality

Proposed Township Birchleigh North Ext. 4

Stormwater Management Plan Report

J33064C

FINAL

February 2015

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Proposed Township Birchleigh North Ext. 4
Stormwater Management Plan Report

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Appendices

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1 Introduction

The Ekurhuleni Human Settlement Department of The Ekurhuleni Metropolitan Municipality (EMM) appointed GIBB, under contract PS-HS 23-2013, to undertake all activities relating to the preparation of the township establishment application for Birchleigh North Extension 4 known as Esselen Park.

2 Scope of Works and Objectives

This document serves as the Stormwater Management Plan (SWMP) for the proposed development and describes the measures required to ensure that the development's stormwater runoff is managed according to the Ekurhuleni Metropolitan Municipalities standards.

This SWMP provides details of the rationale used for route planning and locating of stormwater drainage system elements in relation to the proposed roads and the physical characteristics of the site.

3 Catchment Characteristics

3.1 Locality

The proposed Esselen Park township development is located on portion 63 and the remainder of portion 39 of the Farm Witfontein 15 – I.R. An industrial area is located to the East of the development. Residential areas are located north, south and west of the site. The existing R25 road passes through the development.

Refer to **Appendix A** for a Locality Plan of the proposed township.

3.2 Catchment Description

The area falls under the Crocodile (West) and Marico River drainage system.

The site is located within quaternary sub-catchment A21B as designated by WRC Report Nos. 298/2.1/94 and 298/2.2/94 titled "Surface Water Resources of South Africa, 1990", First Edition 1994 by DC Midgely, WV Pitman and BT Middleton, published by the Water Research Commission (SWR90).

The site drains towards the Kaalspruit river located 5 km north west of the site.

3.3 Catchment Topography and Existing Flow Regime

The majority of the proposed development slopes gently south-west towards an existing watercourse located within the proposed development's boundary. The highest point is 1637m (MSL) and the lowest is 1599m (MSL).

There is an existing wetland located in the southern portion of the development, surrounding the existing watercourse mentioned above.

The remaining northern portion of the proposed development slopes north towards an existing wetland located north of the proposed development. The existing wetland is located next to the existing road (Link road) bordering the northern boundary of the development. The highest point on the aforementioned northern catchment is 1637m (MSL) and the lowest is 1528.5m (MSL).

The topography of the site can generally be regarded as moderately sloped with average slopes of between 0.5% and 3.5%.

3.4 Soil and Geohydrological Conditions

Available geological maps indicate that the area of investigation is underlain by granite of the Johannesburg Granite Dome.

Residual soils have developed from the weathering of the granite bedrock. Layers of transported hillwash or transported alluvium generally occur as the upper soil layers across the site.

Based on the fieldwork the site comprises five geological/geotechnical zones, as summarized below according to the National Home Builders Registration Council (NHBRC):

Zone C - Near surface hillwash / pebble marker overlying nodular ferricrete and/or hardpan ferricrete or overlying reworked residual granite or reworked residual quartzite, overlying granite or quartzite bedrock

Zone C1 - Near surface hillwash / pebble marker / nodular ferricrete overlying reworked residual granite / quartzite.

Zone C2 - Thick near surface hillwash / pebble marker / nodular ferricrete overlying reworked residual granite of poor consistency.

Zone H1/H2 - Transported hillwash / alluvium overlying expansive alluvial soils.

Zone P/C2 - Uncontrolled fill material overlying reworked residual granite soils of poor consistency.

Refer to **Appendix B** for a Layout Plan indicating the Geotechnical soil zones mentioned above.

Although a perched water table was encountered in only two of the test pits at the time of investigation, it is nevertheless possible for more widespread perched water table conditions to develop across the site during periods of high rainfall. This comment applies particularly to those portions of Zone C and Zone C1 where hardpan ferricrete horizons were encountered within test pit excavations. Furthermore, the portions of the site represented by Zone H1/H2 occur within an area characterised by seasonal flooding, and as such perched water conditions and/or seasonal streams are expected to develop in these areas during the rainy season. Allowance will therefore need to be made for such conditions in these portions of the site.

The Geotechnical information above was obtained from the Geotechnical report titled "*NHBRC Phase 1 Geotechnical Investigation for proposed Esselen Park housing development: Portions 63 & 39 Witfontein 15-IR*" compiled by Crossman, Pape and Associates Consulting Engineers and Engineering Geologists.

The hydrological soil classification for the catchment and development site is Group C, moderately high stormflow potential, in accordance with the "Generalised Soil Permeability Map of South Africa" as published in "Engineering Geology of Southern Africa Volume 4" by ABA Brink, dated 1985.

3.5 Present Development Land Use Scenario

The natural vegetation that currently occurs across the site is grasslands and according to *"Vegetation of South Africa, Lesotho and Swaziland"* published by the Department of Environmental Affairs & Tourism, dated February 1998 is "Egoli Granite Grassland" and "Carletonville Dolomite Grassland".

A layout indicating the current land use scenario of the site is attached in **Appendix C**. The current land use is considered the pre-development scenario.

3.6 Future Development Land Use Scenario

The future land use of the Development will consist mainly of Residential 1 to 5 as well as Business 2, Institutional and Educational zoning stands. In support of these stands, areas are also zoned for Public Transport, Pedestrian Boulevards, Public Open Space and New and Public Roads purposes.

The post-development scenario for the development is indicated on the Proposed Township Layout Plan attached in **Appendix D.** The proposed land use table is shown in Table 1 below:

Table 1: Land Use Table

Zoning	Area (Ha)	% of total
Residential 1	±15.043 Ha	8.82%
Residential 2	±4.202 Ha	2.46%
Residential 3	±12.327 Ha	7.22%
Residential 4	±9.446 Ha	5.54%
Residential 5	±11.525 Ha	6.75%
Business 2	±8.145 Ha	4.77%
Institutional	±5.434 Ha	3.18%
Educational	±18.123 Ha	10.62%
Public Transport	±3.377 Ha	1.98%
Pedestrian Boulevard	±4.035 Ha	2.36%
Public Open Space	±45.190 Ha	26.50%
New roads and Public roads	±33.764 Ha	19.80%
TOTAL	**±170.611 Ha**	**100.00%**

4 Stormwater Drainage Design

4.1 Design Standards

The selection of analysis, assessment and design standards was based on the following guidelines:

- Chapter 6, "Stormwater Management" of the **Red Book** ("Guidelines for Human Settlement Planning and Design", compiled under the patronage of the Department of Housing by the CSIR, Division of Building Technology, dated 2000),
- "**Drainage Manual**" by The South African National Roads Agency Limited (SANRAL) 5th Edition and
- Ekurhuleni Metropolitan Municipality "**General Stormwater Management Requirements"**, Version 1, January 2007.

The Recurrence Interval (RI)/Return Period (RP) is the average interval between storm events, and is usually expressed in years. This is equal to the reciprocal of the annual probability of the storm event occurring, e.g. a 1 in 50 year RI storm event has an annual probability of occurrence of 2 %.

Stormwater drainage systems are classified in the **"Red Book"** as follows:

- **Major drainage system** - a stormwater drainage system that caters for severe, infrequent storm events, supported by the minor drainage system.
- **Minor drainage system** - a stormwater drainage system which caters for frequent storms of a minor nature.

The applicable analysis, assessment and design standard will be those given in Tables 6.1 and 6.2 of the "Red Book" and reproduced in Table 2 and Table 3 below:

Table 2: Design Flood Frequencies for Major Stormwater Drainage Systems

Land-Use	Design Storm Return Period
Residential	50 years
Institutional (e.g. schools)	50 years
General Commercial and Industrial	50 years
High Value Central Business Districts	50 – 100 years

Source: Table 6.1 of the "Red Book"

Table 3: Design Flood Frequencies for Minor Stormwater Drainage Systems

Land-Use	Design Storm Return Period
Residential	1 – 5 years
Institutional (e.g. schools)	2 – 5 years
General Commercial and Industrial	5 years
High Value Central Business Districts	5 – 10 years

Source: Table 6.2 of the "Red Book"

In addition to these standards, Section 144 of the "National Water Act" (Act No. 36 of 1998) requires that the 1 in 100 year RP flood levels be indicated on a layout plan before establishing a township development. Similarly, the "Development Facilitation Act" (Act No 67 of 1995) requires that flood levels of the 1 in 50 year RP flood be indicated on a layout plan. This development **is affected by the 50 or 100 year floodline** from an existing non-perennial watercourse located in the central portion of the proposed development flowing from east to west. See Dwg no. J33064C-LAY-001 in **Appendix E** for a layout indicating the floodlines mentioned above.

4.2 Stormwater Infrastructure Design Criteria

The development will be served by a conventional stormwater drainage system consisting of surfaced roads, channels and pipe culverts.

The applicable design criteria are shown below in Table 4. These have been extracted and adapted from the **"Red Book"**.

Table 4: Design Criteria for Stormwater Infrastructure

Classification	Internal Roads
Recurrence Interval: Major	1:50 years
Recurrence Interval: Minor	1:5 years
Encroachment: Major	150 mm above the crown of the road
Encroachment: Minor	No kerb overtopping
Roadside Channels	Min. gradient 0.5%
	Max. velocity 3m/s
Channel Lining	Channels to preferably be grassed where possible. Concrete lined channels to be used where required.
Low points	1:25 years

Pipes: Minimum diameter - 450mm diameter.

Minimum 0.7m/s self-cleansing velocity

Minimum slope of 0.5%

Class 100D underneath roads

Class 75D alongside roads

Minimum pipe Cover - 600mm underneath roads

- 450mm alongside roads

Trenches: Widths to SABS 1200, Class B bedding, backfilling to 90% mod AASHTO or 93% mod AASHTO in road reserves.

4.3 Catchment Hydrologic Modelling

The **SCS Hydrology Method** was used for the runoff calculations, as it is widely accepted both internationally and locally for the estimation of storm runoff peak flows and volumes. The model was developed by the United States Department of Agriculture's Soil Conservation Service (SCS). The model has been adapted for South African use, originally by Schulze and Arnold in 1979, and most recently in Water Research Commission Report Nos. TT31/87, TT32/87 and TT33/87, titled "Flood Volume and Peak Discharge from Small Catchments in South Africa based on the SCS Technique" by J C Smithers and R E Schulze, Department of Agricultural Engineering, University of Natal, Pietermaritzburg, dated 1987.

The input parameters required to determine the runoff for each of the three catchments indicated on Dwg No. J33064C-CAT-001 in **Appendix F** is as discussed below:

(a) Catchment area:

Auto CAD was used to calculate the catchment areas. Refer to **Appendix F** for the catchment areas for the proposed Development.

(b) Runoff Curve Number:

This method uses a runoff Curve Number (CN) that represents the sub-catchment's storm runoff characteristics and is determined by the consideration of soil properties and land-use. The following CN values in Table 5 below were used based on the type C soil group identified in sub-section 3.4:

Table 5: Runoff Curve Numbers

Land Use	Curve number	Pre-dev. % area	Post-dev. % area for P1	Post-dev. % area for P2	Post-dev. % area for P3
Grasslands	77	100%			
Low Density Residential	81		-	13.00%	-
Medium Density Residential	83		6.12%	4.52%	2.52%
High Density Residential	90		6.53%	7.90%	8.76%

Land Use	Curve number	Pre-dev. % area	Post-dev. % area for P1	Post-dev. % area for P2	Post-dev. % area for P3
Commerce	94		1.94%	5.08%	0.96%
Institutional and Education	94		2.29%	7.25%	0.85%
Public Transport and Walkways	98		1.35%	4.89%	0.13%
Public Open Space	79		1.06%	3.62%	-
Roads (Including Servitude)	98		4.34%	14.26%	2.63%
Final Curve number		**77**	**90**	**90**	**91**

(c) Storm Rainfall:

(i) Storm Duration

The design storm duration is selected to exceed the catchment's time of concentration, which is the time required for a water particle to travel from the farthest point of the catchment to the outlet.

The time of concentration was determined using the method prescribed by the Rational method. The time of concentration is derived from the length of the longest watercourse, slope and nature of drainage (Sheet flow vs. Channel flow).

(ii) Rainfall Depth

The computer programme "Design Rainfall Estimation in South Africa" which accompanies the Water Research Commission Report titled "Design Rainfall and Flood Estimation in South Africa" by JC Smithers and RE Schulze, School of Bioresources Engineering and Environmental Hydrology, University of Natal, Pietermaritzburg, WRC Project No. K5/1060, dated December 2002 was used to complete a rainfall station locality search and to obtain storm rainfall depth data from the surrounding rainfall stations. The applicable rainfall data is determined by means of weighted average rainfall data from the surrounding rainfall stations. The weighting is based on the distance from the specified locality to the specific rainfall station.

A summary of the rainfall station search and related data is summarised in Table 6 on the next page. "Birchleigh" is not a rainfall station, the data provided in the last column is generated by the "Design Rainfall Estimation" programme based on the data from the surrounding rainfall stations:

Table 6: Rainfall Station Data

Station Name		Kempton Park (SAR)	Olifants-fontein	Springkell	Riet-fontein	Birchleigh[#]
*SAWS Station No :		0476396_W	0513417_W	0476246_W	0476309_W	n/a
Location	Latitude:	26° 06’	25° 57’	26° 06’	26° 09’	26° 02’
	Longitude:	28° 13’	28° 14’	28° 08’	28° 11’	28°14’
Mean Annual Precipitation, MAP (mm)		697	623	700	718	666
Altitude (mams):		1660	1515	1562	1075	1620
Distance from Catchment Centroid (km):		7.4	9.0	13.0	13.7	0
Length of Record (years)		92	53	76	44	n/a

Notes: 1. * Denotes SAWS – South African Weather Service
2. [#] Birchleigh is not a rainfall station, the data provided in this column is generated by the ”Design Rainfall Estimation” programme based on the data from the surrounding rainfall stations.

Table 7 below summarises the design rainfall depths obtained from the Rainfall station data mentioned above:

Table 7: Design Rainfall depths

Storm recurrence	5 year	25 year	50 year
24 hour Storm duration Rainfall depth	78 mm	115 mm	136 mm

4.4 Stormwater Drainage System

The minor stormwater system will consist of a network of pipe culverts sized to accommodate the minor storm event runoff. Runoff from major storm events (flows larger than 1 in 5 year runoff) will be accommodated by a combination of the network of pipe culverts and surface drainage along surfaced streets and shaped parking areas. The combined stormwater system will be designed to ensure that no flooding of properties occurs in the major flood event (1 in 50 year storm).

On-site attenuation is proposed for several stands located throughout the proposed development, see **Appendix F**. On-site attenuation entails depression or storage facilities located within the stand to attenuate runoff. On-site attenuation details will be determined once the particular stand is developed at SDP (Site Development Plan) level.

Proposed Detention Pond 1 receives runoff from the northern portion of the site (Catchment area P1) and discharges attenuated runoff east of the northern wetland's buffer zone from where it will drain indirectly into the wetland. The residential stand located within the northern portion of the development drains through an existing culvert crossing the existing Link Road located on the northern boundary of the proposed development. This residential stand will attenuate on-site and discharge into the existing culvert at the pre-development flow rate for the different return periods up to and including the 25 year event.

An existing culvert crossing Strydom Street is located on the western boundary of the proposed development, draining the central catchment area (Catchment area P2). Proposed Detention Pond 2 will discharge north of the central wetland's buffer zone at a pre-development flow rate for the different return periods, up to and including the 25 year event. The attenuated runoff will flow naturally into the natural watercourse which in turns discharges through the culvert under Strydom Street. An existing man-made furrow is located adjacent and within the proposed development's western boundary. On provision of a formal stormwater system, the man-made furrow will become superfluous and should be filled to ensure overland flow is maintained along Strydom Street.

Proposed Detention Pond 3, receiving runoff from southern portion of the site (Catchment Area P3), will discharge the attenuated runoff immediately south of the central wetland's buffer zone. The attenuated runoff will then flow naturally towards the existing culvert in Strydom Street mentioned above. Outlets from the attenuation pond will be discharged into proposed swales in order to reduce the flow velocities and to trap large pollutants.

Refer to **Appendix E** for the proposed stormwater layout.

A typical detail for erosion protection at outlet structures is provided on Dwg no. J33064C-DET-004 in **Appendix G**. The purpose of the aforementioned erosion protection structure is to keep the velocity of the overland flow (at the outlet discharge) to a maximum of 1.5 m/s and thus prevent erosion.

5 Detention Pond Design

EMM requires that developments include flood detention facilities in order to ensure that an increase in runoff peaks due to development does not affect the downstream systems and/or natural watercourses and wetlands negatively.

Stormwater detention facilities were incorporated into the design and are each designed with a maximum outlet capacity equal to or less than the pre-development peak flow rate for all storm events up to the 1 in 25 year return period storm event, as per the Ekurhuleni Metropolitan Municipal requirements.

5.1 Detention Pond Design Criteria

The detention ponds have been sized and designed based on the following criteria:

i	Maximum storage time:	24 hrs
ii	Side slopes:	Maximum slope of 2.5 horizontal to 1 vertical
iii	Pond depth:	1.5 m to 2.0 m
iv	Attenuated Capacity:	up to 1:25 year
v	Emergency overflow:	1:50 year and above

The detention ponds will incorporate energy dissipation devices and silt removal traps downstream of the inlets. Low flow channels lined with Armorflex, geo-cells or similar, should be provided in the detention ponds from the inlet to the outlet to cater for frequent rainfall events, generally less than the 1 in 2 year event. The detention pond basins and embankment walls should be vegetated with suitable indigenous plants.

The outlets of the detention ponds will discharge into the existing watercourses or upstream of the wetlands via swales in such a manner as to keep the velocity of the overland flow (at the outlet discharge) to a maximum of 1.5 m/s by means of flow spreading or other suitable methods. The outlet configuration of the detention ponds will consist of a weir type outlet box which allows restricted flow into the ponds outlet culvert while a headwall and suitable erosion protection will be installed at the headwalls. A rectangular opening or pipe orifice (known as the primary outlet) will be constructed in the outlet box to regulate flows up to and including the 1 in 25 year event peak flows. The discharge of flows greater than the 1 in 25 year event up to the 50 year event will flow over the emergency spillway. The emergency spillways will discharge into the public open space areas provided.

A typical pond configuration detail drawing is attached in **Appendix G** as Dwg No. J33064C-PON-001.

Drawings No. J33064C-DET-001 to 003 in **Appendix G** indicate typical details for silt traps, high discharge energy dissipators and concrete inlet & outlet structures respectively.

5.2 Detention Pond Details

The pond catchment areas for the entire development are shown in **Appendix F**. The available areas for the proposed ponds are shown in Table 8 below:

Table 8: Detention Pond Catchment Area and Area available

Catchment No.	Discharge into Pond	Catchment Area (ha)	Pond Site Area Available (m^2)
P1	Pond 1	27.41	13,500
P2	Pond 2	70.18	48,000
P3	Pond 3	18.38	8,300

5.3 Hydrological Results

Table 9 below shows the calculated pre-development flows and the post-development unattenuated flows for the catchment area indicated in **Appendix F**.

Table 9: Catchment Stormwater Unattenuated Run-off

Catchment No.	PRE-DEVELOPMENT FLOWS (m^3/s)			POST-DEVELOPMENT FLOWS (m^3/s)		
	1:5	1:25	1:50	1:5	1:25	1:50
P1	2.57	5.34	7.01	4.89	8.02	9.78
P2	6.42	13.23	17.38	11.12	18.25	22.28
P3	1.82	3.75	4.93	3.13	5.06	6.14
TOTAL	**10.81**	**22.32**	**29.32**	**19.14**	**31.32**	**38.20**

5.4 Pond Hydraulic Modelling Results

The Detention Storage Design was done in the Hydrocad design software.

Table 10 on the next page shows the preliminary modelled results for the ponds. The table indicates the achieved volumes and attenuated outflows. More accurate figures will be determined at detail design stage. Hydrographs for the Pre-development, Post-development and Attenuated flows from the ponds have been provided in **Appendix H**. Pond data tables summarizing the information above are also provided in **Appendix H**.

Table 10: Modelled Pond Results

Pond No.	ATTENUATED OUTFLOWS (m^3/s)			#OUTLET SIZE [SLOPE] (mm)	MAX POND DEPTH (m)	ATTENUATION VOLUME REQUIRED (m^3)	ATTENUATION VOLUME PROVIDED (m^3)
	1:5	1:25	1:50				
Pond 1	0.97	4.82	7.69	1200x1200 [1%]	1.5	8,581	9,309
Pond 2	2.48	6.06	7.83	1500x1200 [1%]	2.0	26,238	28,417
Pond 3	1.56	3.39	5.14	1200x900 [1%]	1.5	3,761	4,341
Total	**4.40**	**15.31**	**25.99**				

Note: # - Outlet sized for the 1 in 25 year storm event. 1 in 50 year storm event discharged by the emergency spillway.

Table 9 and Table 10 above indicate that the total attenuated outflow from the three ponds is less than the total pre-development flow up to the flows resulting from a 1:25 year storm event from the three respective catchment areas. It is also apparent that the areas reserved for ponds in the township layout are adequate.

6 Stormwater Infrastructure Maintenance Activities

A synopsis of the required stormwater infrastructure and detention pond maintenance activities and frequencies is given below:

6.1 Stormwater Channels

- Routine cleaning and de-silting of channels.
- Removal of debris to prevent channel blockage.

6.2 Stormwater Culverts

- Routine cleaning and de-silting of culverts.
- Removal of debris to prevent culverts blockage.
- Repairs of embankment after overtopping of culvert structure.
- Routine inspection and repairs, if required, of approach channels and foundations.

6.3 Detention Ponds

To ensure optimal performance, the detention ponds shall require annual inspection, preferably at the start of the rainy season. The following is a brief list of the maintenance items that require consideration.

- All detention ponds must be accessible from the internal road network.
- Routine mowing and the possible trimming and / or removal of unwanted vegetation – twice per annum.
- The removal of debris and litter from the outlets to prevent clogging and from the basin area to improve aesthetics - three times a year. Firstly cleaning at the beginning of the summer rainy season (September, October), secondly after the first rains (November) and again towards the end of the rainy season (February).
- The condition of the structures, embankments, inlets and outlets must be inspected annually. This must include checking for animal burrows, cracking, bulging and subsidence of pond walls.
- We envisage that silt will need to be removed at least three times a year. First cleaning at the beginning of the summer rainy season (September, October), secondly after the first rains (November) and again towards the end of the rainy season (February). It is also likely that during the construction period more frequent silt removal will be required. Vehicular access into the pond will be provided to remove silt from the silt trap.
- The emergency spillway should be clear of obstructions at all times.

7 Stormwater Management During Construction

The existing stormwater infrastructure should be maintained during construction activities to prevent the deterioration and subsequent failure of current infrastructure.

Temporary berms should be constructed on the downstream perimeter of the site to channel runoff containing silt to a location where silt is allowed to settle prior to discharging into the existing stormwater infrastructure or natural watercourse.

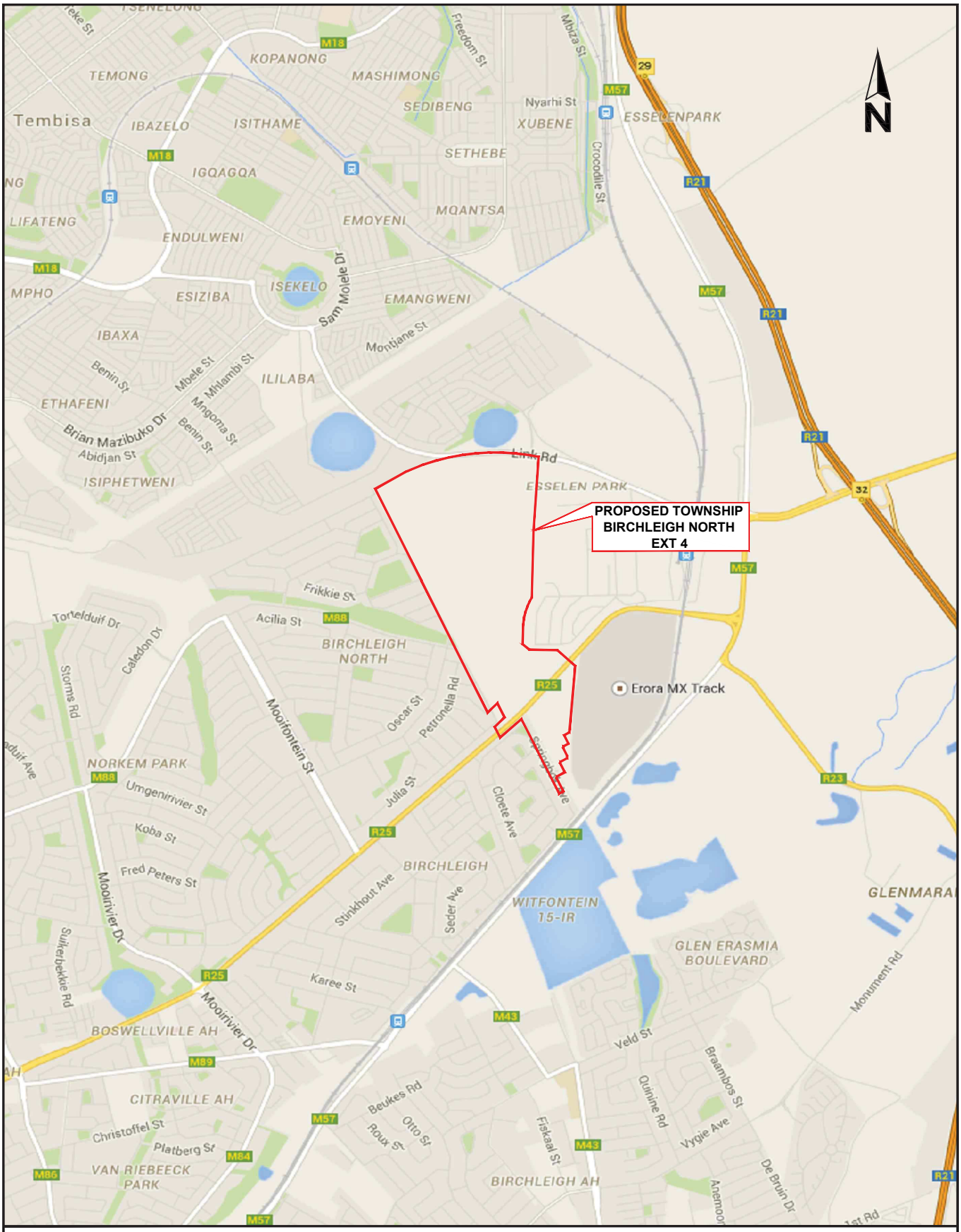
8 Conclusion

The purpose of the report and accompanying designs is to address the stormwater management of the proposed township, Birchleigh North Extension 4, both during and post construction. The goal of the proposed stormwater management system is to prevent erosion and flood damage to the environment, constructed buildings and infrastructure, whether existing or proposed. The design results indicate that the post-development flood can be attenuated sufficiently and discharged from the pond outlets at a rate equal to or less than the pre-development flood values up to and including the 25 year return period storm events. Storm events in excess of the 25 year storm event will be catered for with emergency overflow structures. The overflows will be diverted into the existing watercourse or via swales into the wetlands.

The proposed stormwater Management Plan meets the requirements and standards set by the EMM. As such, the site can accommodate the planned development.

Appendix A

Locality Plan



PROJECT	PROPOSED TOWNSHIP BIRCHLEIGH NORTH EXT 4
DETAIL	LOCALITY PLAN

GIBB ENGINEERING & ARCHITECTURE

Drawn By	Designed By	Reviewed By	Scale	Date	Project No.	Drg.No.	Rev.
M VAN WYK		B BHIKA	N.T.S	FEB 2015	J33064C	LOC-001	A

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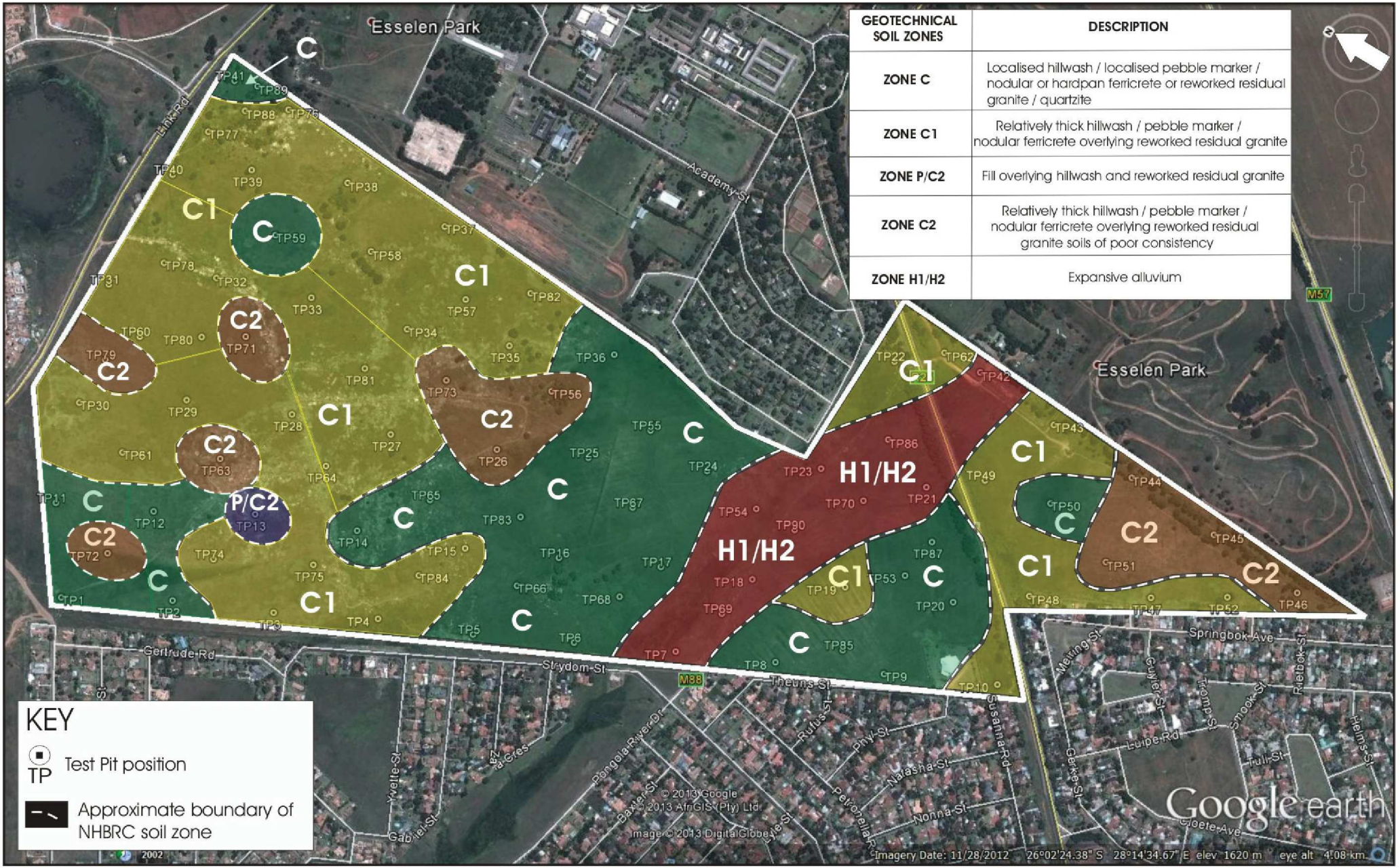
Appendix B

Geotechnical Soil Zones Layout Plan



GEOTECHNICAL SOIL ZONES	DESCRIPTION
ZONE C	Localised hillwash / localised pebble marker / nodular or hardpan ferricrete or reworked residual granite / quartzite
ZONE C1	Relatively thick hillwash / pebble marker / nodular ferricrete overlying reworked residual granite
ZONE P/C2	Fill overlying hillwash and reworked residual granite
ZONE C2	Relatively thick hillwash / pebble marker / nodular ferricrete overlying reworked residual granite soils of poor consistency
ZONE H1/H2	Expansive alluvium

PROJECT 13/123/VH: ESSELEN PARK HOUSING DEVELOPMENT

FIGURE 1: LOCALITY PLAN INDICATING APPROXIMATE POSITIONS OF TEST PITS AND GEOTECHNICAL SOIL ZONES

Crossman, Pape & Associates
Consulting Geotechnical Engineers & Engineering Geologists
PO Box 3557 Cramerview 2060. Tel: (011) 465- 1699. Fax: (011) 465- 4586. Cell 082 556 7302 & 076 968 8445

Scale: Not to scale

Date: SEPTEMBER 2013

Appendix C

Pre-Development Scenario

P:\J33064 Ekurhuleni Human Settlements\PHASE C - ESSELEN PARK\REPORTS\Technical Reports\Stormwater management plan\2015-02-05 Final\Drawings\J33064C-PRE-001-A.dwg | NATIE VAN DER MERWE | 06-Feb-15 7:04:14 AM

PROJECT	PROPOSED TOWNSHIP BIRCHLEIGH NORTH EXT 4
DETAIL	PRE-DEVELOPMENT SCENARIO

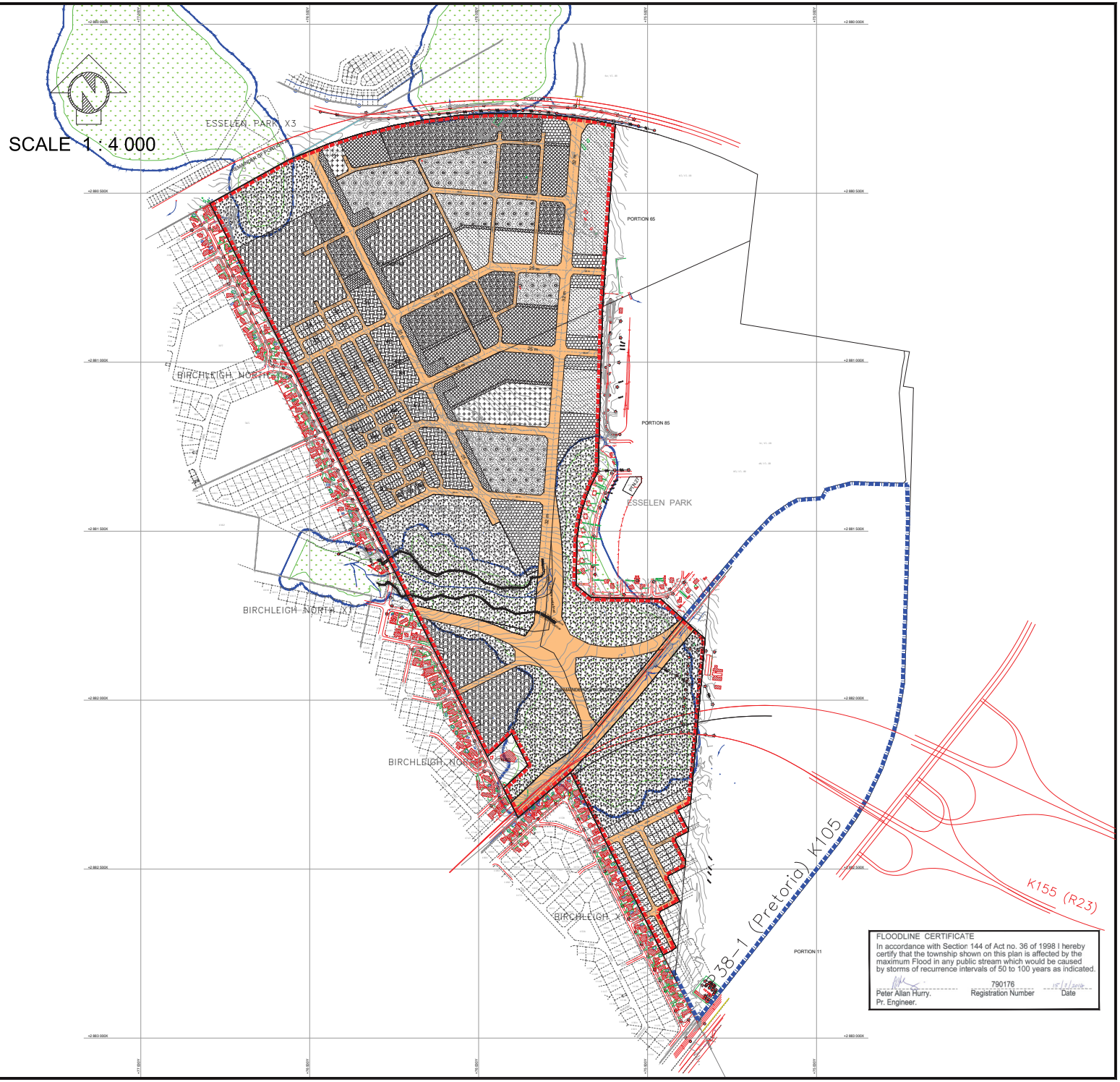
GIBB ENGINEERING & ARCHITECTURE

Drawn By	Designed By	Reviewed By	Scale	Date	Project No.	Drg.No.	Rev.
M VAN WYK		B BHIKA	N.T.S	FEB 2015	J33064C	PRE-001	A

Appendix D

Proposed Township Layout Plan

SCALE 1 : 4 000



FLOODLINE CERTIFICATE

In accordance with Section 144 of Act no. 36 of 1998 I hereby certify that the township shown on this plan is affected by the maximum Flood in any public stream which would be caused by storms of recurrence intervals of 50 to 100 years as indicated.

Peter Allan Hurry. Pr. Engineer. | 790176 Registration Number | Date

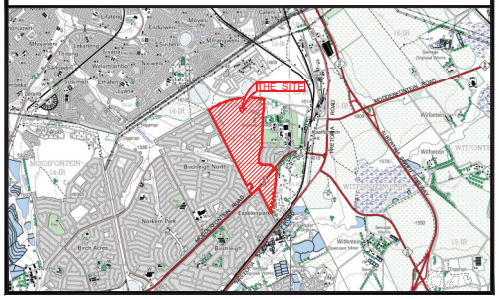
PROPOSED TOWNSHIP

BIRCHLEIGH NORTH EXT. 4

SITUATED ON PORTION 63 OF FARM WITFONTEIN 15 - I.R.

BEING THE FIGURE LETTERED A-B-C-D-E-F-G-H-J-K-L M-N-A, MEASURING ±170,6110 ha. IN EXTENT

LOCALITY PLAN N.T.S.



USE TABLE

ZONING	NOTATION	ERF No.	No. of ERVEN	AREAS (Ha.)	% of TOTAL
RESIDENTIAL 1				± 15,0430 Ha.	8,82%
RESIDENTIAL 2				± 4,2020 Ha.	2,46%
RESIDENTIAL 3				± 12,3270 Ha.	7,22%
RESIDENTIAL 4				± 9,4460 Ha.	5,54%
RESIDENTIAL 5				± 11,5250 Ha.	6,75%
BUSINESS 2				± 8,1450 Ha.	4,77%
INSTITUTIONAL				± 5,4340 Ha.	3,18%
EDUCATIONAL				± 18,1230 Ha.	10,62%
PUBLIC TRANSPORT				± 3,3770 Ha.	1,98%
PEDESTRIAN BOULEVARD				± 4,0350 Ha.	2,36%
PUBLIC OPEN SPACE				± 45,1900 Ha.	26,50%
NEW ROADS AND PUBLIC ROADS				± 33,7640 Ha.	19,80%
TOTAL			000	± 170,6110Ha.	100,00%

NOTES

1. Average size of Residential 1 erven : N/A Min. size of erven N/A.
2. Total length of streets :
3. Gradient of streets : Maximum - 1 : Minimum - 1 :
4. Contours are in accordance with Regulations 18 (1)(a)(i) of the Town Planning and Townships Ordinance 15 of 1986
5. Contours prepared by - Professional land Surveyors.
6. Datum of Contours - MSL
7. Co - ordinate grid reference are based on WG 29 system
8. All areas and dimensions are approximate and in metres and are subject to change.
9. No ingress or egress shall be permitted along the lines indicated thus on the plan.

AMENDMENTS

DATE	PLAN No.	AMENDMENT	DATE	PLAN No.	AMENDMENT

GIBB ENGINEERING & ARCHITECTURE
Head Office
14 Eglin Road, Sunninghill 2191
P O Box 2700 Rivonia 2128
Fax: +27 11 807 5670
Web: www.gibb.co.za

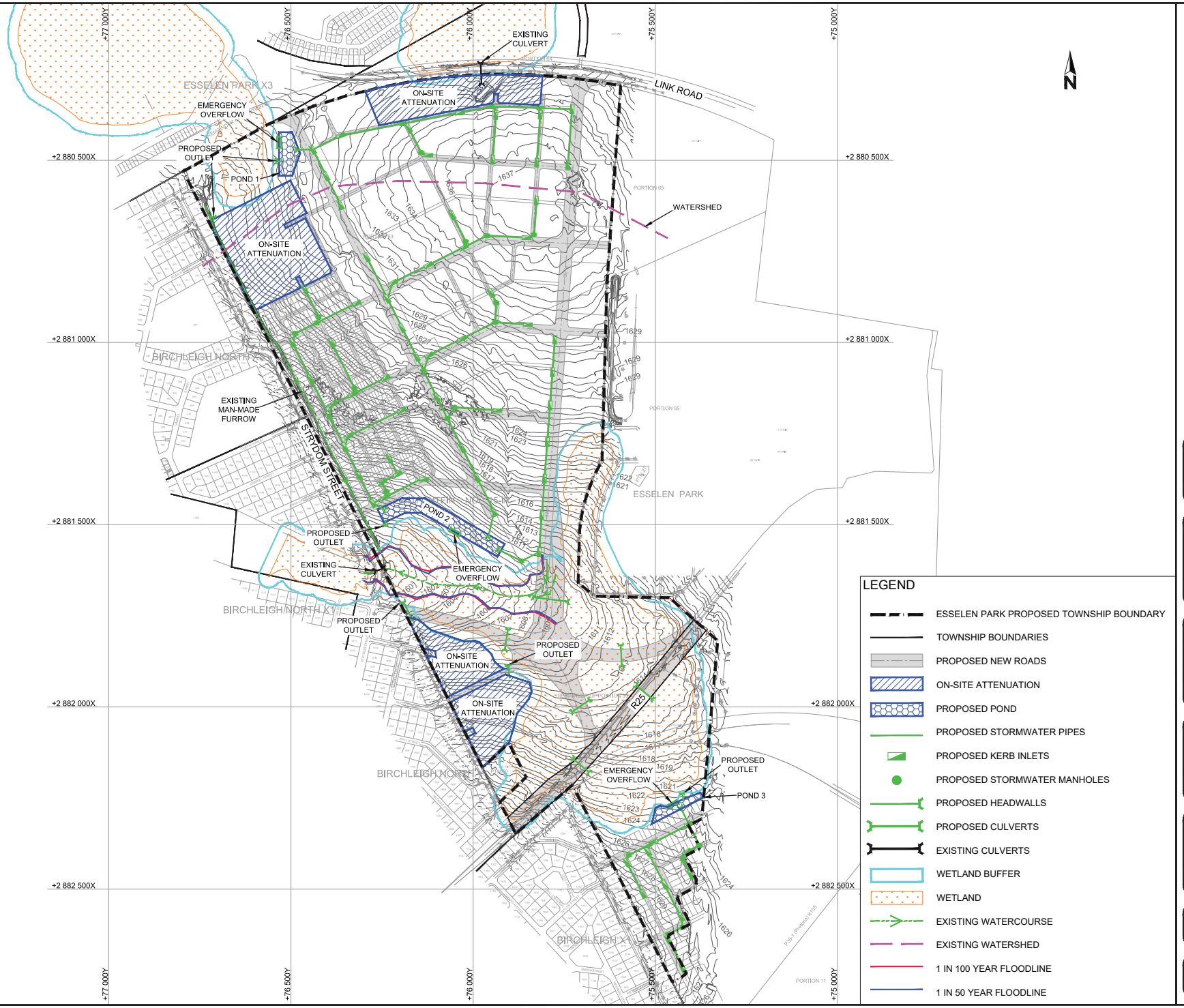
DATE : JUNE 2014

SCALE : 1 : 4 000 (A0)

PLAN No.J33064/Birch-leigh North/A/la

Appendix E

Proposed Stormwater Layout Plan



Notes

This drawing is not to be used in whole, or part, other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.

No	Date	Details	Chd	Appd

Revisions

Client

EKURHULENI METROPOLITAN MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By

Drawn By	Designed By	Reviewed By
M VAN WYK	N vd MERWE	B BHIKA

Project

PROPOSED TOWNSHIP
BIRCHLEIGH NORTH EXT 4

Description

GENERAL LAYOUT
PROPOSED STORMWATER

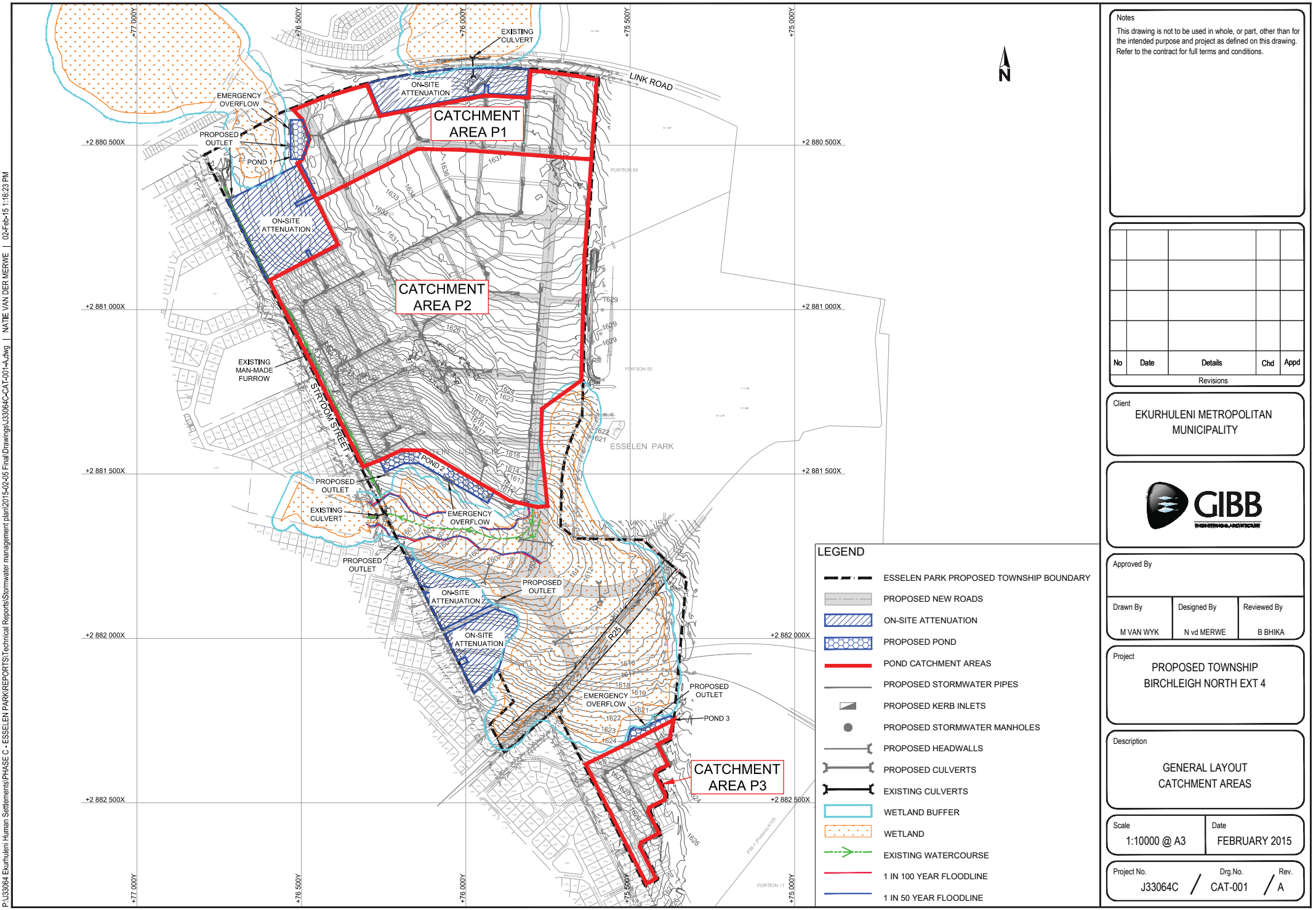
Scale	Date
1:10000 @ A3	FEBRUARY 2015

Project No.	Drg.No.	Rev.
J33064C	LAY-001	A

P:\J33064 Ekurhuleni Human Settlements\PHASE C - ESSELEN PARK\REPORTS\Technical Reports\Stormwater management plan\2015-02-05 Final\Drawings\J33064C_LAY-001-A.dwg | NATIE VAN DER MERWE | 02-Feb-15 1:16:49 PM

Appendix F

Catchment Layout Plan



Notes

This drawing is not to be used in whole, or part, other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.

No	Date	Details	Chd	Appd

Revisions

Client

EKURHULENI METROPOLITAN MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By

Drawn By	Designed By	Reviewed By
M VAN WYK	N vd MERWE	B BHIKA

Project

PROPOSED TOWNSHIP
BIRCHLEIGH NORTH EXT 4

Description

GENERAL LAYOUT
CATCHMENT AREAS

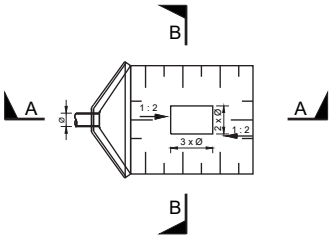
Scale	Date
1:10000 @ A3	FEBRUARY 2015

Project No.	Drg.No.	Rev.
J33064C	CAT-001	A

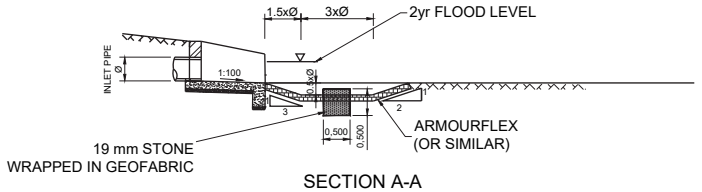
P:\J33064 Ekurhuleni Human Settlements\PHASE C - ESSELEN PARK\REPORTS\Technical Reports\Stormwater management plan\2015-02-05 Final\Drawings\J33064C-CAT-001-A.dwg | NATIE VAN DER MERWE | 02-Feb-15 1:16:23 PM

Appendix G

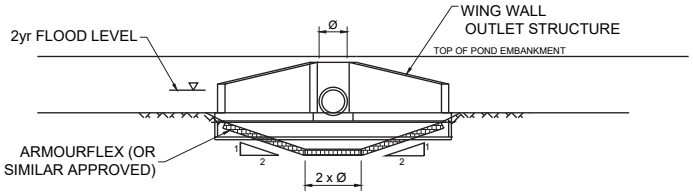
Proposed Typical Details



PLAN OF SILT TRAP

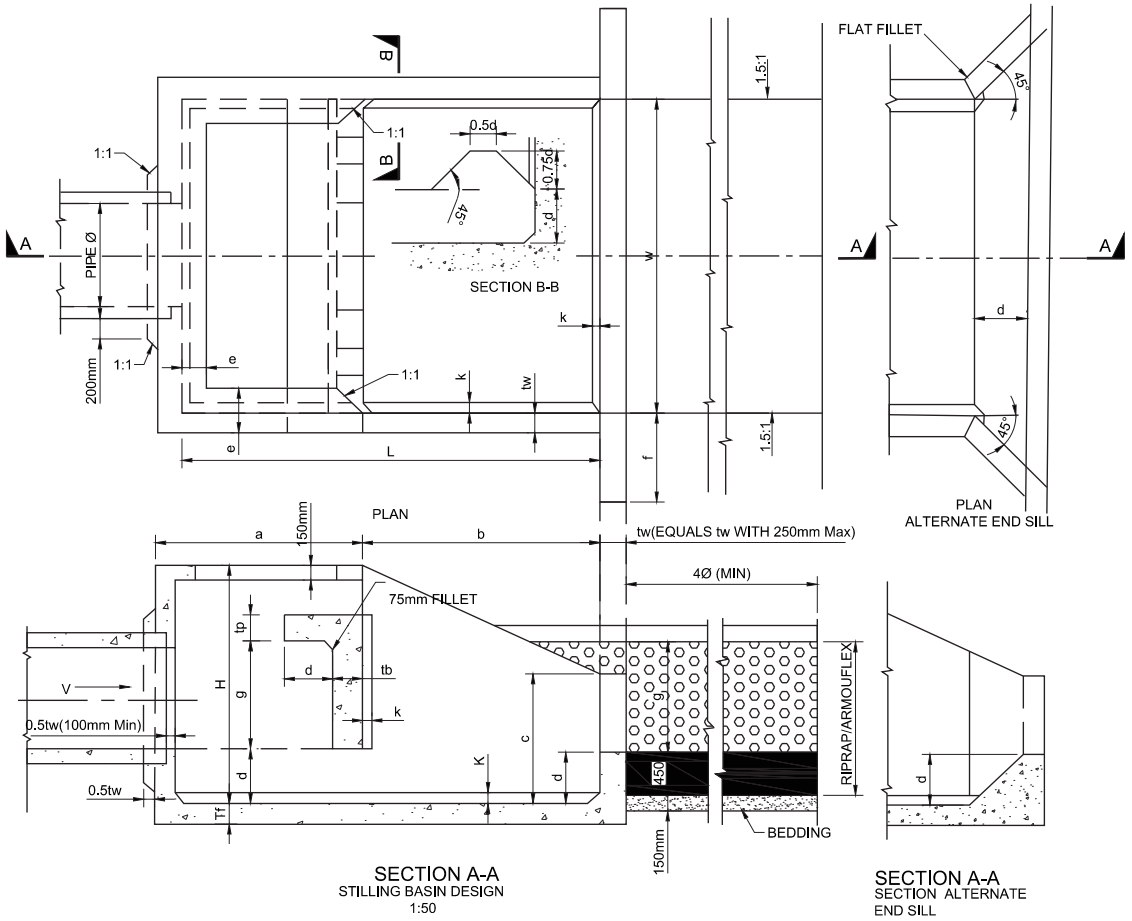


SECTION A-A
1:10



SECTION B-B
1:10

PROJECT	PROPOSED TOWNSHIP BIRCHLEIGH NORTH EXT 4 STORMWATER MANAGEMENT PLAN					
DETAIL	TYPICAL SILT TRAP DETAIL					
Prepared By	Checked By	Reviewed By	Scale	Date	Project No. / Drg.No. / Rev.	
M VAN WYK	N vd MERWE	B BHIKA	N.T.S	FEB 2015	J33064C / DET-001 / A	



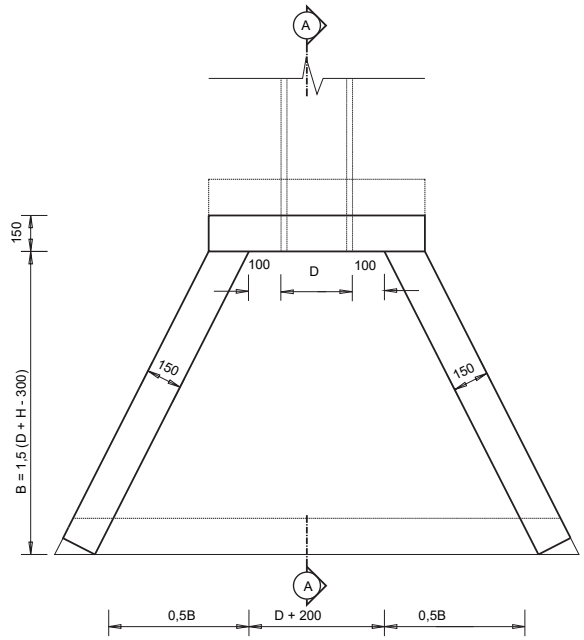
Pipe Size		Max. Discharge Q (m^3/s)	W	H	L	a	b	c	d	e	f	g	tw	tf	tb	tp	k	Suggested rip rap size
Dia mm (1)	Area (m^2) (2)		(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	
			m	m	m	m	m	m	m	m	m	m	mm	mm	mm	mm	mm	mm
450	0.16	0.588	1.675	1.295	2.235	0.990	1.246	0.710	0.275	0.150	0.455	0.635	152	165	152	152	76	102
600	0.29	1.064	2.055	1.600	2.745	1.190	1.550	0.860	0.355	0.150	0.610	0.760	152	165	152	152	76	178
750	0.48	1.652	2.440	1.905	3.250	1.395	1.855	1.015	0.405	0.200	0.780	0.915	152	165	178	178	76	218
900	0.66	2.380	2.820	2.210	3.760	1.600	2.160	1.165	0.480	0.200	0.915	1.065	178	191	203	203	76	229
1050	0.99	3.220	3.200	2.440	4.270	1.830	2.440	1.345	0.530	0.250	0.915	1.190	203	218	229	203	102	241
1200	1.17	4.228	3.580	2.745	4.775	2.055	2.715	1.495	0.610	0.250	0.915	1.345	229	241	254	203	102	267
1350	1.48	5.348	3.965	2.970	5.285	2.235	3.050	1.650	0.660	0.305	0.915	1.495	254	267	254	203	102	305
1500	1.83	6.608	4.345	3.275	5.795	2.440	3.355	1.800	0.735	0.305	0.915	1.625	279	292	279	203	152	330
1800	2.63	9.492	5.030	3.735	6.710	2.820	3.885	2.105	0.835	0.380	0.915	1.880	305	318	305	203	152	356

PROJECT: PROPOSED TOWNSHIP BIRCHLEIGH NORTH EXT 4
STORMWATER MANAGEMENT PLAN

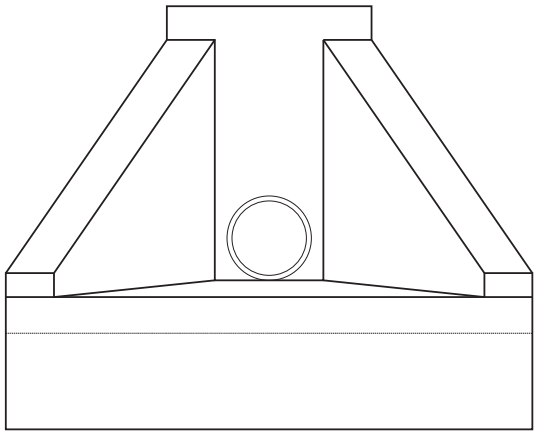
DETAIL: HIGH DISCHARGE ENERGY DISSIPATOR

GIBB ENGINEERING & ARCHITECTURE

Prepared By	Checked By	Reviewed By	Scale	Date	Project No.	Drg.No.	Rev.
M VAN WYK	N vd MERWE	B BHIKA	N.T.S	FEB 2015	J33064C	DET-002	A

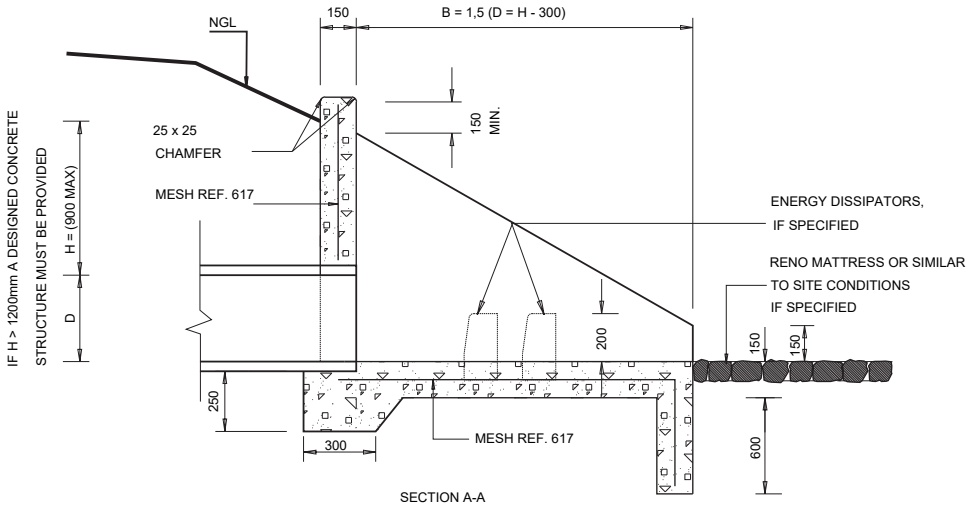


PLAN

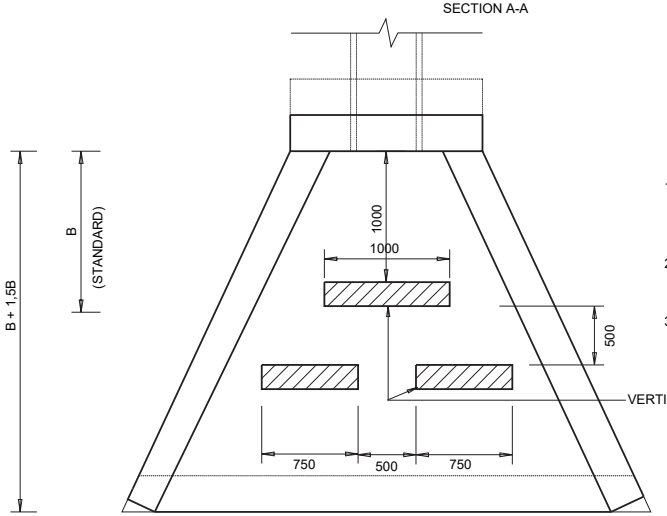


FRONT ELEVATION

INLET STRUCTURE



SECTION A-A



PLAN

(SPECIAL STORMWATER OUTLET FOR USE
WHEN OUTLET VELOCITY EXCEEDS 2,0 m/s)

NOTES:

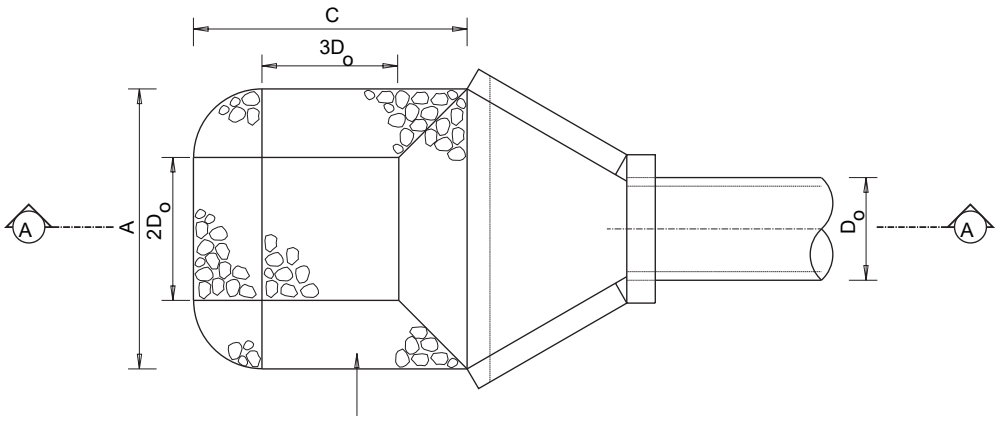
1. ALL CONCRETE IN INLET AND OUTLET STRUCTURE TO BE CLASS 20/19 WITH A WOOD FLOAT FINISH WITH 25 x 25 CHAMFER ON ALL EXPOSED EDGES.
2. MINIMUM COVER TO REINFORCEMENT = 25mm OR 4Omm ON THE GROUND.
3. ALL ROAD WORKS TO COMPLY WITH SABS 1200 SPECIFICATIONS.

OUTLET STRUCTURE

PROJECT	PROPOSED TOWNSHIP BIRCHLEIGH NORTH EXT 4 STORMWATER MANAGEMENT PLAN
DETAIL	DETAIL OF CONCRETE STORMWATER INLET & OUTLET STRUCTURES

GIBB
ENGINEERING & ARCHITECTURE

Prepared By	Checked By	Reviewed By	Scale	Date	Project No.	Drg.No.	Rev.
M VAN WYK	N vd MERWE	B BHIKA	N.T.S	FEB 2015	J33064C	DET-003	A



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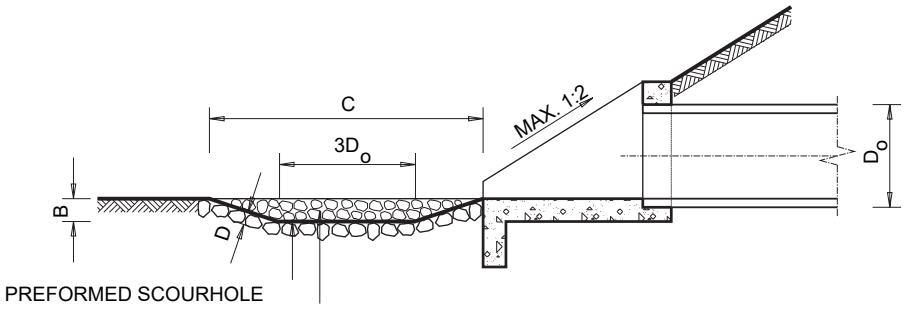


SECTION A-A

NOTES

1. REFER TO DRG. JRA-SD-S018 OR JRA-SD-S026 FOR DETAILS OF THE OUTLET STRUCTURE.
2. GROUTED STONE PITCHING TO BE DONE ACCORDING TO THE SABS 1200 STANDARDIZED SPECIFICATIONS.
3. D_o = HEIGHT OF OUTLET PIPE CULVERT/BOX CULVERT.

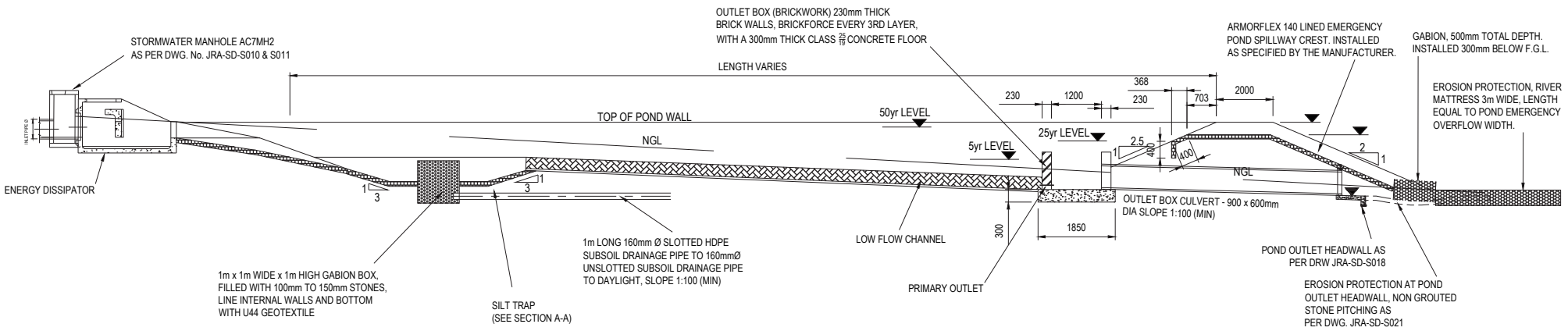
DIMENSIONS		
FOR SHALLOW STILLING BASIN (SEE NOTE)	DIMENSIONS	FOR DEEP STILLING BASIN (SEE NOTE)
$\frac{0{,}0552\ (Q)^{1{,}333}}{D_o^{2{,}333}}$ (m)	D_{50}	$\frac{0{,}0362\ (Q)^{1{,}333}}{D_o^{2{,}333}}$ (m)
$5D_o$ (m)	A	$8D_o$ (m)
$0{,}5\ D_o$ (m)	B	D_o (m)
$6D_o$ (m)	C	$9D_o$ (m)
$2D_{50}$(m)	D	$2D_{50}$(m)
NOTE: REFER TO THE "NATIONAL TRANSPORT COMMISSION HANDBOOK FOR ROAD DRAINAGE" FOR THE APPLICABILITY OF THE VARIOUS TYPES OF EROSION PROTECTION		

PROJECT: PROPOSED TOWNSHIP BIRCHLEIGH NORTH EXT 4
STORMWATER MANAGEMENT PLAN

DETAIL: EROSION PROTECTION AT OUTLET STRUCTURES

GIBB

Prepared By	Checked By	Reviewed By	Scale	Date	Project No.	Drg.No.	Rev.
M VAN WYK	N vd MERWE	B BHIKA	N.T.S	FEB 2015	J33064C	DET-004	A

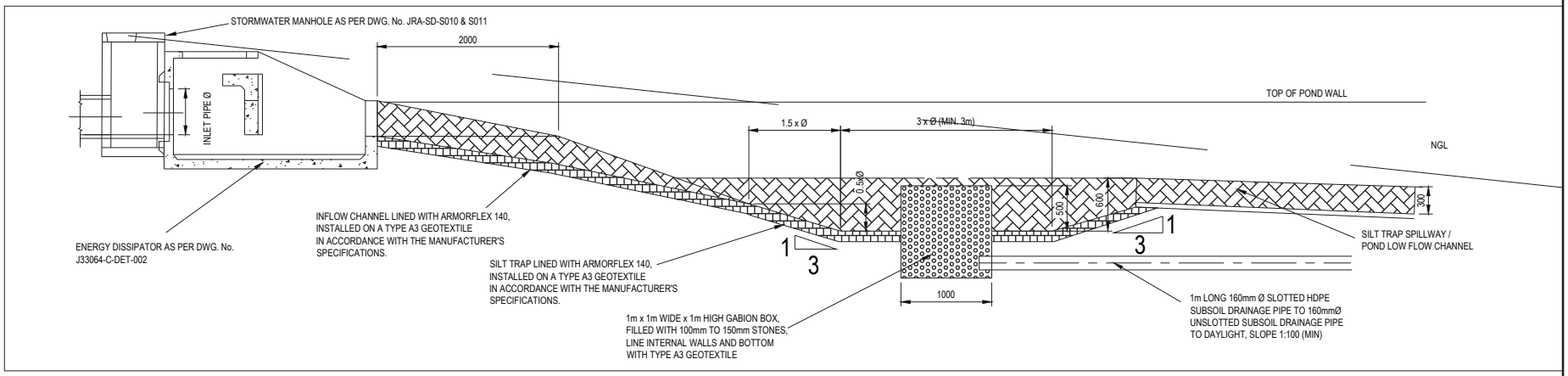


TYPICAL ATTENUATION POND SECTION

(SECTION FROM THE INLET HEADWALL, ALONG THE LOW FLOW CHANNEL UP TO THE POND OUTLET BOX INDICATING THE OUTLET PIPE AND EMERCENCY OVERFLOW DETAILS)

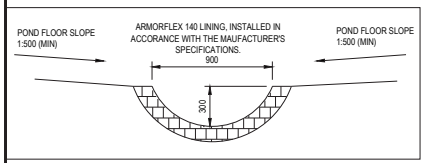
GENERAL NOTES:

1. POND LAYOUT DESIGN RESTRICTIONS:
   SITE , ERF AND ROAD RESERVE BOUNDARIES
2. POND DESIGNED TO ATTENUATE 1:5 AND 1:25 YEAR STORMS.
3. PRINCIPALS FOR POND OUTLET SIZING:
   OUTFLOW EQUAL TO PRE-DEVELOPMENT 1:5 AND 1:25 YR FLOW ALLOW MAXIMUM ATTENUATION STORAGE VOLUME LOW FLOW SPREADING (POND SPILLWAY OUTFLOW)
4. SILT TRAPS DESIGNED TO ACCOMMODATE ESTIMATED ANNUAL SILT YIELD FROM SITE AFTER DEVELOPMENT.
5. SILT TRAP AND POND MUST BE MAINTAINED AS DESCRIBED IN THE STORMWATER MANAGEMENT PLAN REPORT SECTION 6.3



SECTION A-A

SILT TRAP SECTION DETAIL



SECTION B-B

TYPICAL LOW FLOW CHANNEL SECTION

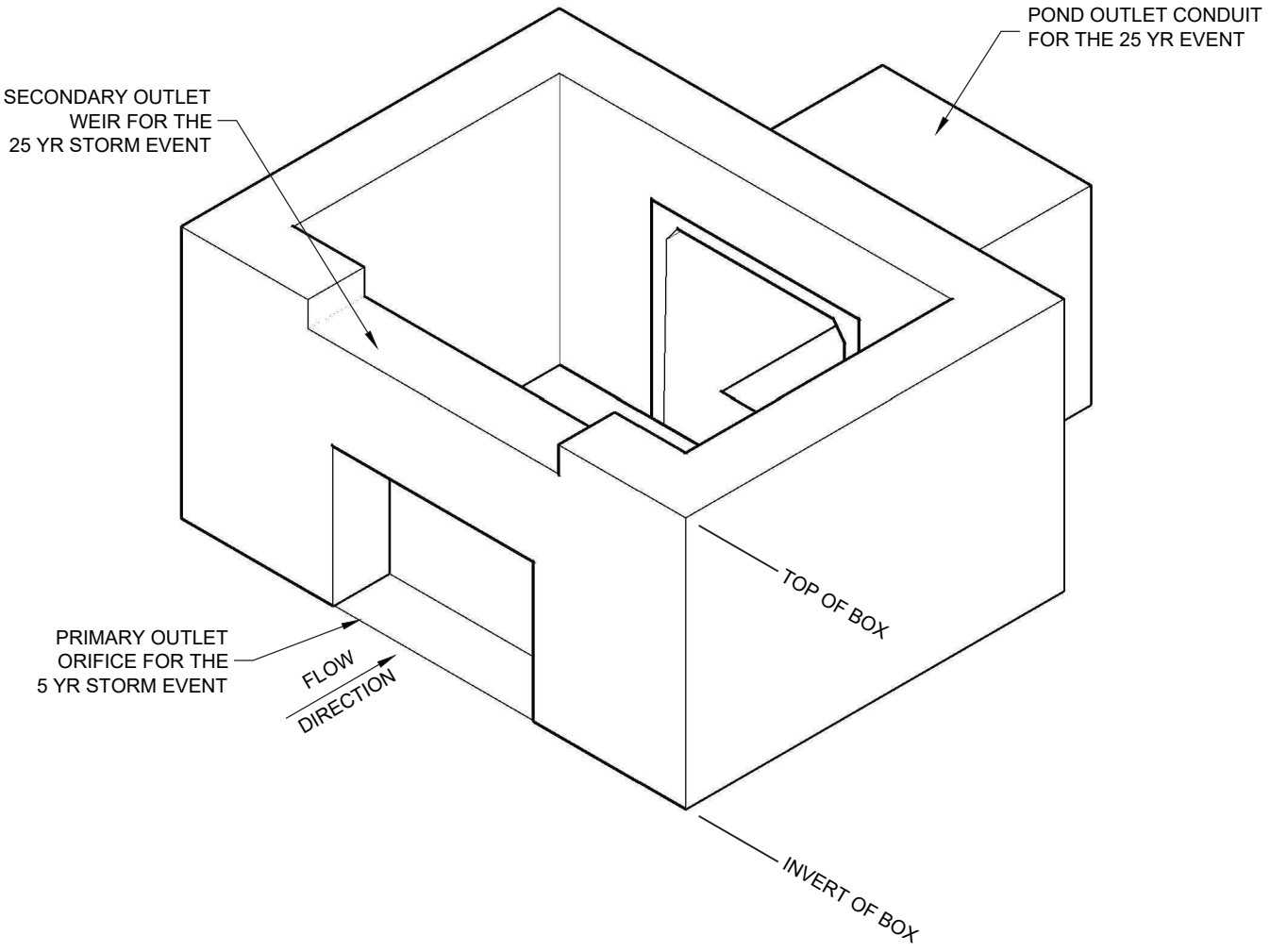
CONSTRUCTION NOTES:

1. STRIP LOOSE TOPSOIL OVER THE ENTIRE ATTENUATION AREA TO A TYPICAL DEPTH OF 150MM AND STOCKPILE FOR RE-USE. STRIP AND STOCKPILE SEPARATELY FROM THE TOPSOIL, THE UNDERLYING 150 TO 250MM OF LOOSE HILLWASH AND PEBBLE MARKER SOILS. BELOW THE EMBANKMENT ONLY, RIP THE IN SITU SOILS TO A DEPTH OF 150MM AND RE-COMPACT TO A DENSITY OF 95% PROCTOR DENSITY AT A MOISTURE CONTENT BETWEEN OMC AND +3%OMC.
2. EXCAVATE THE BASIN (CUT TO FILL)
3. CONSTRUCT THE EMBANKMENT USING STOCKPILED HILLWASH AND PEBBLE MARKER SOIL AND SELECTED SOILS FROM THE BASIN EXCAVATION. COMPACT IN LAYERS NOT EXCEEDING 150MM IN THICKNESS, TO A DENSITY OF 100% PROCTOR DENSITY AT A MOISTURE CONTENT BETWEEN OMC AND +3%OMC.
   THE TOP SURFACE OF EACH LAYER SHALL BE SUFFICIENTLY ROUGH TO ENSURE PROPER BONDING WITH THE SUCCEEDING LAYER, BY LIGHT SCARIFICATION TO A DEPTH OF 25MM. THE SUCCEEDING LAYER SHALL BE PLACED IMMEDIATELY AFTER THE LIGHT SCARIFICATION.
   SHOULD THE MATERIAL OF THE TOP LAYER OF COMPACTED MATERIAL BE TOO WET (FROM RAIN OR OTHER CAUSES), TO ALLOW THE NEXT LAYER TO BE PLACED, IT SHALL BE HARROWED AND ALLOWED TO DRY TO THE SPECIFIED MOISTURE CONTENT AND RECOMPACTED. SHOULD THE TOP LAYER OF THE COMPACTED MATERIAL DRY AND FORM SHRINKAGE CRACKS, IT SHALL BE HARROWED, REWETTED AND RECOMPACTED.
   FILL MATERIAL SHALL BE PLACED AT LEAST 500MM WIDER THAN THE RELEVANT WIDTH SHOWN ON THE DRAWINGS TO ENSURE PROPER COMPACTION ON THE SLOPES, AND THEN TRIMMED. THE BASIN-SIDE SLOPES ARE TO BE AT AN ANGLE OF 1 VERTICAL TO 2,5 HORIZONTAL, AND THE OUTSIDE-SLOPES 1 VERTICAL TO 2 HORIZONTAL. THE CREST IS TO HAVE A CROSS-FALL TOWARDS THE BASIN.
   SOILS CONSIDERED SUITABLE FOR EMBANKMENT CONSTRUCTION INCLUDE HILLWASH, PEBBLE MARKER AND RESIDUAL GRANITE. THESE CLASSIFY AS GC, GM, SC AND SM IN TERMS OF THE UNIFIED SOIL CLASSIFICATION SYSTEM. SOILS UNSUITABLE FOR EMBANKMENT CONSTRUCTION INCLUDES RESIDUAL GREENSTONE, RESIDUAL DIABASE, ALLUVIAL SAND, ROCK WITH LITTLE OR NO FINES.
4. NOMINALLY LEVEL AND COMPACT THE BASIN FLOOR AND SIDE SLOPES (AFTER TRIMMING TO CORRECT LEVELS AND PROFILE).
   TOPSOIL AND HYDROSEED/ RE-VEGETATE WITH GRASS WITH A LAYER OF 150MM IN THICKNESS.

PROJECT	PROPOSED TOWNSHIP BIRCHLEIGH NORTH EXT 4 STORMWATER MANAGEMENT PLAN
DETAIL	TYPICAL ATTENUATION POND LAYOUT & DETAIL

GIBB ENGINEERING & ARCHITECTURE

Prepared By	Checked By	Reviewed By	Scale	Date	Project No.	Drg.No.	Rev.
M VAN WYK	N vd MERWE	B BHIKA	1:1000	DEC 2014	J33064C	PON-001	A



PROJECT: PROPOSED TOWNSHIP BIRCHLEIGH NORTH EXT 4
STORMWATER MANAGEMENT PLAN

DETAIL: TYPICAL ATTENUATION POND
OUTLET BOX DETAIL

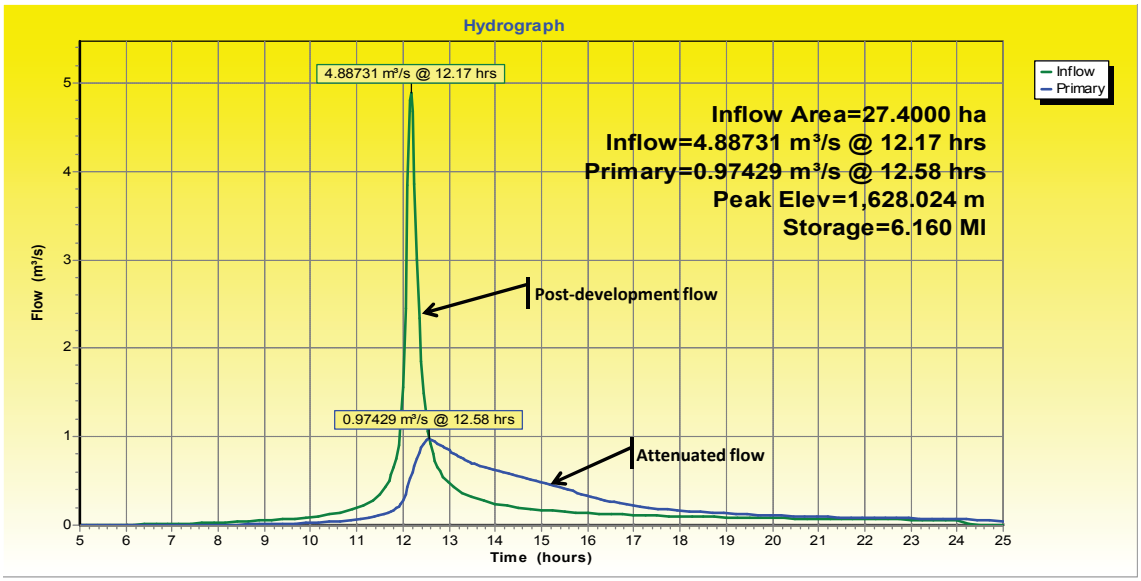
GIBB
ENGINEERING & ARCHITECTURE

Drawn By	Designed By	Reviewed By	Scale	Date	Project No.	Drg.No.	Rev.
N VD MERWE			NTS	FEB 2015	J33064C	PON-002	A

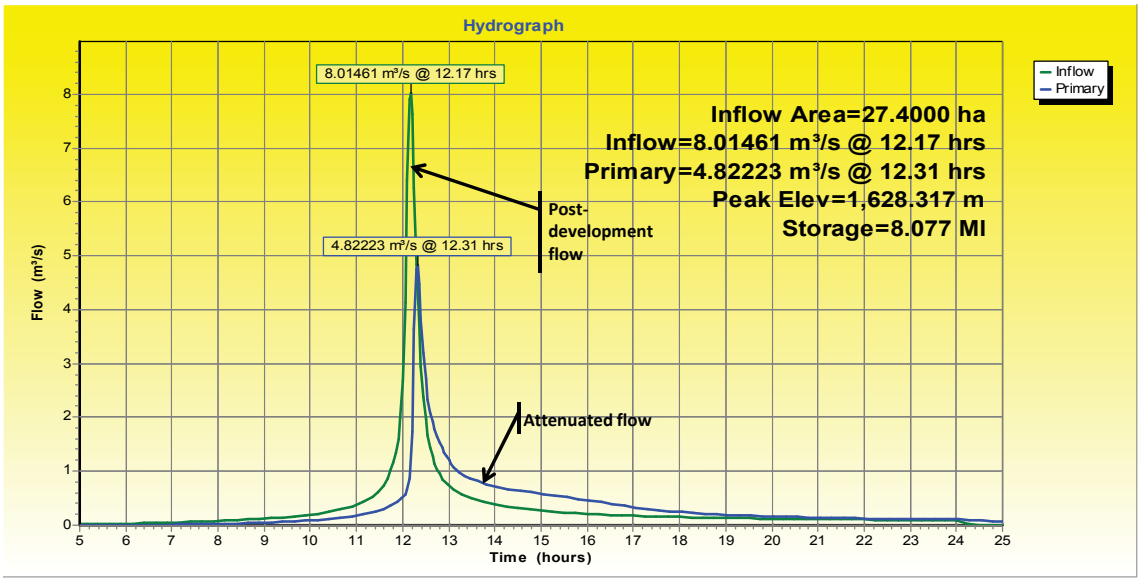
Appendix H

Pond Hydrographs and Data Tables

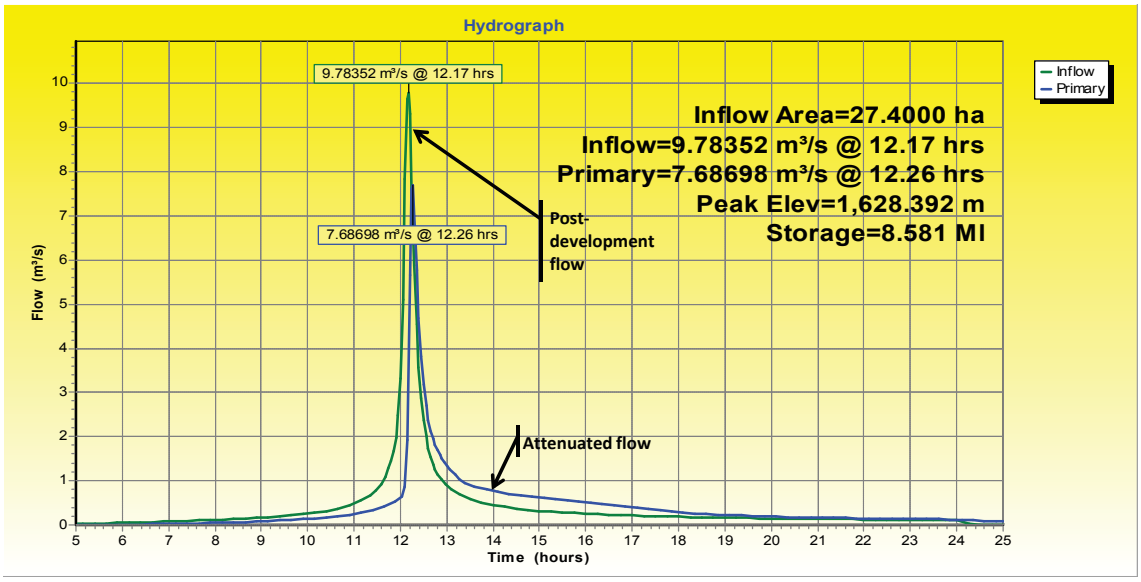
POND 1 HYDROGRAPHS



1:5 YEAR POST ATTENUATED HYDROGRAPH



1:25 YEAR POST ATTENUATED HYDROGRAPH



1:50 YEAR POST ATTENUATED HYDROGRAPH

Stormwater Ref. No.:	CATCHMENT P1: POND 1 POST-DEVELOPMENT
Stormwater Management Facility Type & Function:	Detention Pond

Catchment Hydrological Data and Analysis Results

Catchment

Catchment Area: Refer to Pond 1 on Dwg no. CAT-001 for catchment details	*Area (ha)*	*Area (km^2)*
	27.407	0.2741

Land Use Data		*Pre-development (%)*	*Post-development (%)*
	Natural	100	
	Streets		24%
	Business		8%
	Educational		6%
	Institutional		4%
	Housing		54%
	P.O.S		5%
	Average Associated SCS curve Number (CN)	**77**	**90**

Storm Event Return Period	*5yr.*	*25yr.*	*50yr.*
Post Development Peak Flow (m^3/s):	4.887	8.015	9.784
Pre Development Peak Flow (m^3/s):	2.565	5.336	7.013

Outlet Configuration

		Dia. / Depth (mm)	**Width (mm)**	**Invert Level (mamsl)**
Inlet box:	Rectangular Box Structure (Plan dimensions)	1,000	2000mm x 1500mm	1,627.00
	5 yr Orifice	400	800	1,627.00
	25 yr Weir	200	1,000	1,627.80
Conduit:	1 x Concrete SW Box Culvert	1,200	1,200	1,627.00
Spillway:	50 yr Weir	300	30,000	1,628.20

Detention Pond and Analysis Results

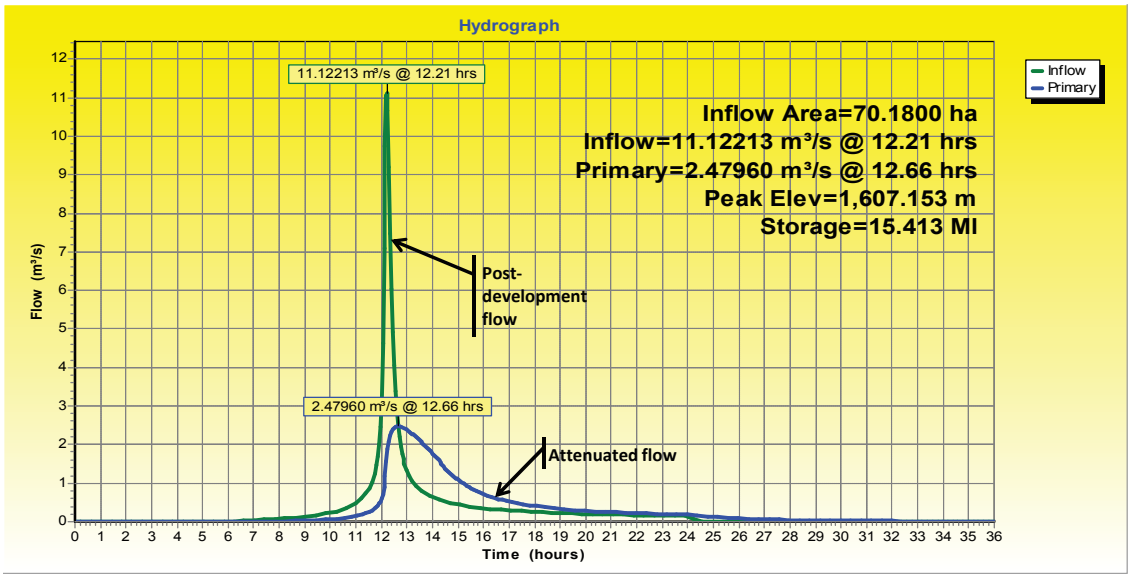
Attenuation Storage Data	*Level (mamsl)*	*Depth (m)*	*Area (m^2)*	*Stage Volume (m^3)*	*Cumulative Volume (m^3)*	
	1,627.00	0.00	5625	0.00	0.00	
	1,627.20	0.20	5702	1129.00	1129.00	
	1,627.40	0.40	5775	1158.00	2287.00	
	1,627.60	0.60	5850	1188.00	3475.00	
	1,627.80	0.80	5926	1219.00	4694.00	
	1,628.00	1.00	6004	1250.00	5944.00	
	1,628.20	1.20	6082	1282.00	7226.00	
	1,628.40	1.40	6160	1313.00	8539.00	
	1,628.50	1.50	6200	668.00	9207.00	

Storm Event Return Period	*5yr.*	*25yr.*	*50yr.*
Post Development Peak Flow (m^3/s):	4.887	8.015	9.784
Max. Water Level (mamsl)	1628.024	1628.317	1628.392
Attenuation Volume (m^3)	6,160.00	8,077.00	8,581.00
Flow Attenuation (%)	263%	111%	91%
Peak Outflow (m^3/s)	0.974	4.822	7.687

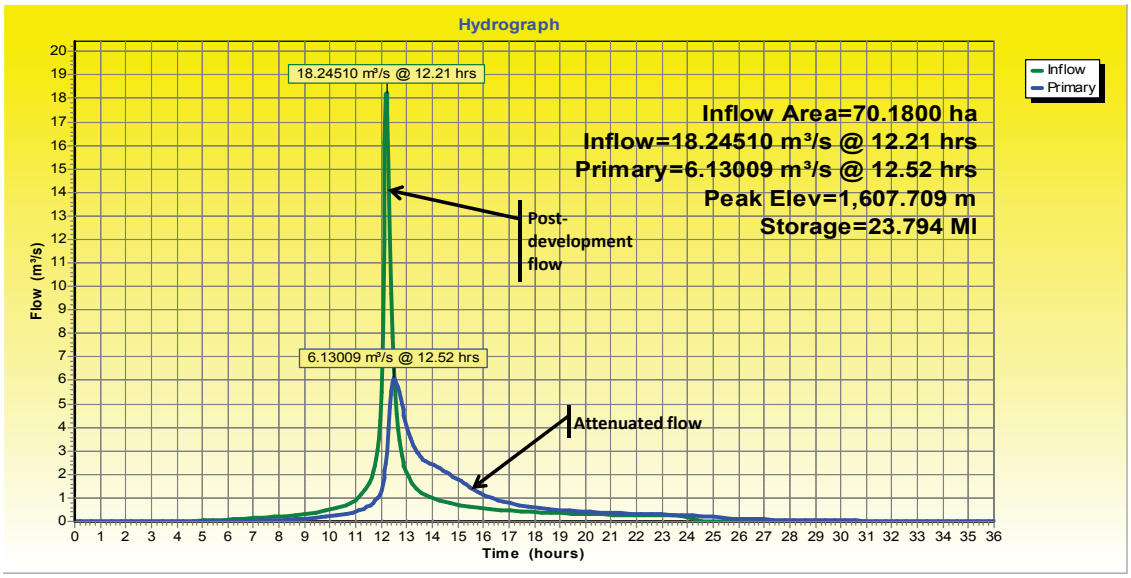
Detention Pond Analysis Results

Notes & Comments:	Pond 1 successfully attenuates incoming flows due to sufficient volume available.

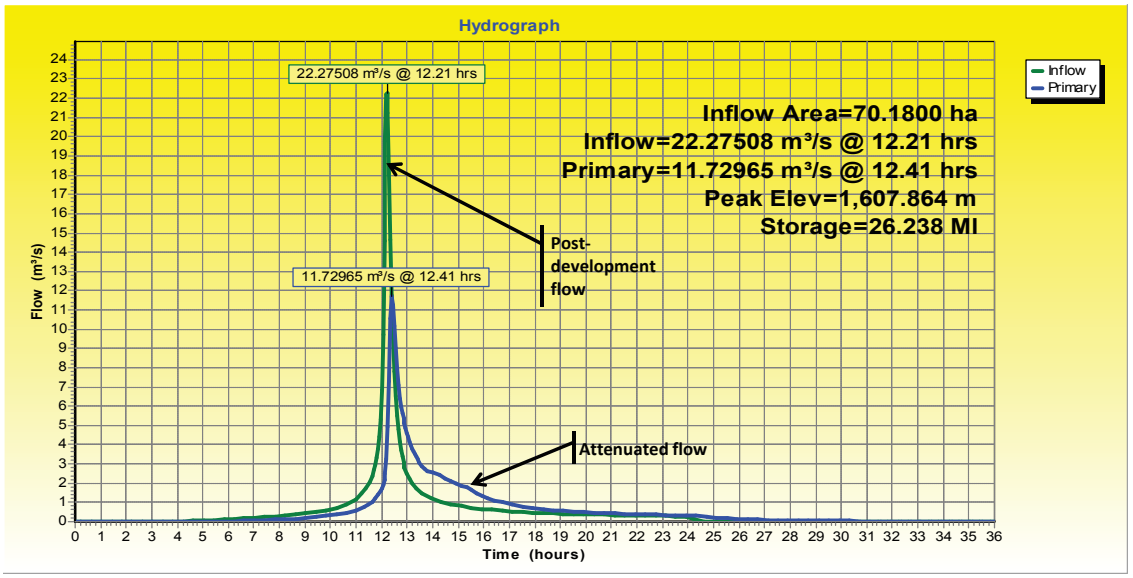
POND 2 HYDROGRAPHS



1:5 YEAR POST ATTENUATED HYDROGRAPH



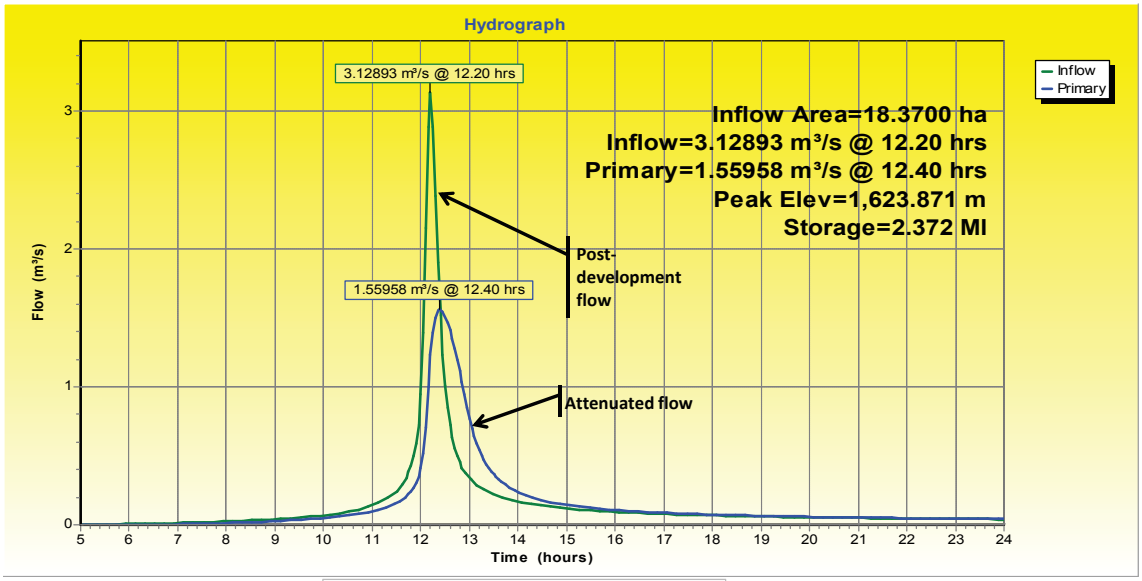
1:25 YEAR POST ATTENUATED HYDROGRAPH



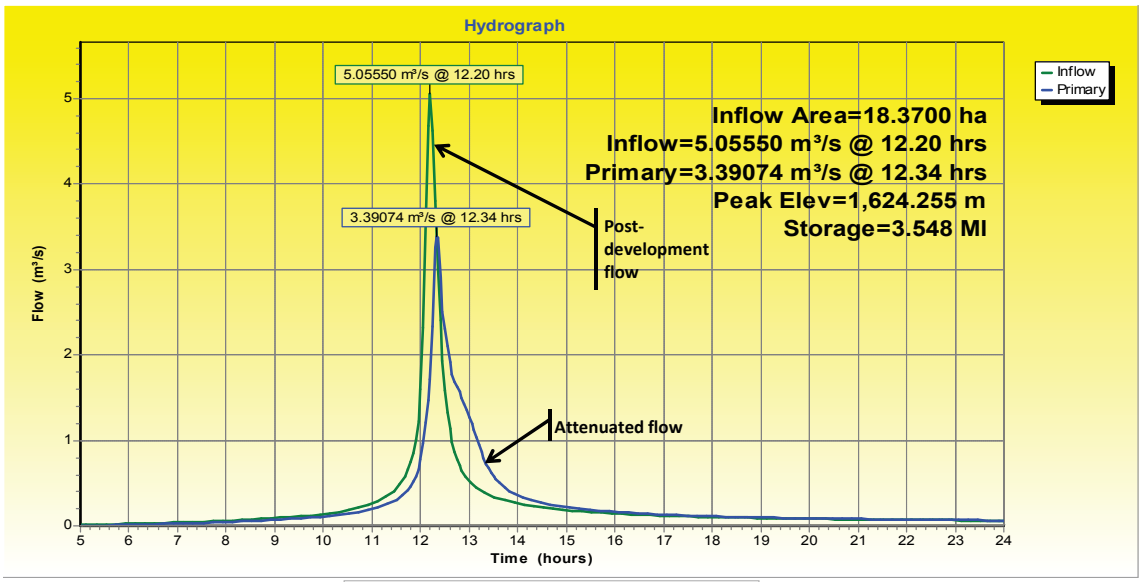
1:50 YEAR POST ATTENUATED HYDROGRAPH

Stormwater Ref. No.:	CATCHMENT P2: POND 2				
Stormwater Management Facility Type & Function:	Detention Pond				
Catchment Hydrological Data and Analysis Results					
Catchment					
Catchment Area: Refer to Pond 2 on Dwg no. CAT-001 for catchment details				*Area (ha)*	*Area (km^2)*
				70.182	0.7018
Land Use Data				*Pre-development (%)*	*Post-development (%)*
	Natural			100	
	Streets				32%
	Business				8%
	Educational				6%
	Institutional				6%
	Housing				42%
	P.O.S				6%
	Average Associated SCS curve Number (CN)			**77**	**90**
Storm Event Return Period			*5yr.*	*25yr.*	*50yr.*
Post Development Peak Flow (m^3/s):			11.122	18.245	22.275
Pre Development Peak Flow (m^3/s):			6.421	13.232	17.380
Outlet Configuration					
			Dia. / Depth (mm)	**Width (mm)**	**Invert Level (mamsl)**
Inlet box:	Rectangular Box Structure (Plan dimensions)		1,250	2000mm x 1500mm	1,606.00
	5 yr Orifice		700	1,500	1,606.00
	25 yr Weir		200	5,000	1,607.25
Conduit:	1 x Concrete SW Box Culvert		1,500	1,200	1,606.00
Spillway:	50 yr Weir		300	40,000	1,607.70
Detention Pond and Analysis Results					
Attenuation Storage Data	*Level (mamsl)*	*Depth (m)*	*Area (m^2)*	*Stage Volume (m^3)*	*Cumulative Volume (m^3)*
	1,606.00	0.00	12250	0.00	0.00
	1,606.20	0.20	12445	2,489.00	2,489.00
	1,606.40	0.40	12638	2,566.00	5,055.00
	1,606.60	0.60	12830	2,643.00	7,698.00
	1,606.80	0.80	13025	2,722.00	10,420.00
	1,607.00	1.00	13221	2,801.00	13,221.00
	1,607.20	1.20	13417	2,879.00	16,100.00
	1,607.40	1.40	13614	2,959.00	19,059.00
	1,607.60	1.60	13811	3,039.00	22,098.00
	1,607.80	1.80	14010	3,119.00	25,217.00
	1,608.00	2.00	14209	3,200.00	28,417.00
Storm Event Return Period				*5yr.*	*25yr.*	*50yr.*
Detention Pond Analysis Results	*Post Development Peak Flow (m^3/s):*			11.122	18.245	22.275
	Max. Water Level (mamsl)			1607.153	1607.709	1607.864
	Attenuation Volume (m^3)			15,413	23,794	26,238
	Flow Attenuation (%)			259%	216%	148%
	Peak Outflow (m^3/s)			2.480	6.130	11.730
Notes & Comments:	Pond 2 successfully attenuates incoming flows due to sufficient volume available.					

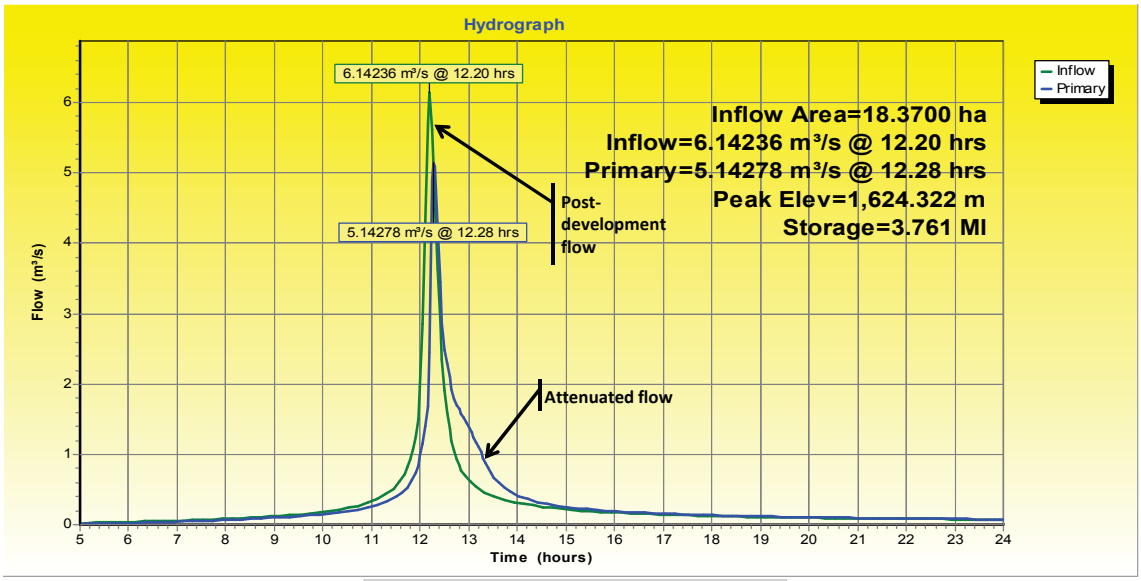
POND 3 HYDROGRAPHS



1:5 YEAR POST ATTENUATED HYDROGRAPH

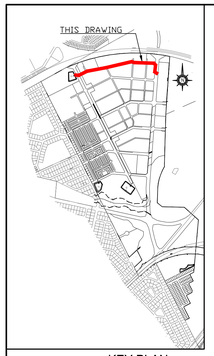


1:25 YEAR POST ATTENUATED HYDROGRAPH



1:50 YEAR POST ATTENUATED HYDROGRAPH

Stormwater Ref. No.:	CATCHMENT P3: POND 3				
Stormwater Management Facility Type & Function:	Detention Pond				
Catchment Hydrological Data and Analysis Results					
Catchment					
Catchment Area: Refer to Pond 4 on Dwg no. CAT-001 for catchment details				*Area (ha)*	*Area (km^2)*
				18.377	0.1838
Land Use Data				*Pre-development (%)*	*Post-development (%)*
	Natural			100	
	Streets				17%
	Business				5%
	Institutional				5%
	Housing				71%
	Average Associated SCS curve Number (CN)			**77**	**91**
Storm Event Return Period			*5yr.*	*25yr.*	*50yr.*
Post Development Peak Flow (m^3/s):			3.129	5.056	6.142
Pre Development Peak Flow (m^3/s):			1.819	3.752	4.929
Outlet Configuration					
			Dia. / Depth (mm)	**Width (mm)**	**Invert Level (mamsl)**
Inlet box:	Rectangular Box Structure (Plan dimensions)		1000	2000mm x 1000mm	1,623.00
	5 yr Orifice		500	1,500	1,623.00
	25 yr Weir		200	4,000	1,624.00
Conduit:	1 x Concrete SW Box Culvert		900	1,200	1,623.00
Spillway:	50 yr Weir		300	30,000	1,624.20
Detention Pond and Analysis Results					
Attenuation Storage Data	*Level (mamsl)*	*Depth (m)*	*Area (m^2)*	*Stage Volume (m^3)*	*Cumulative Volume (m^3)*
	1,623.00	0.00	2500	0.00	0.00
	1,623.20	0.20	2551	505.00	505.00
	1,623.40	0.40	2601	525.00	1030.00
	1,623.60	0.60	2652	545.00	1575.00
	1,623.80	0.80	2703	566.00	2141.00
	1,624.00	1.00	2756	587.00	2728.00
	1,624.20	1.20	2809	609.00	3337.00
	1,624.40	1.40	2862	630.00	3967.00
	1,624.60	1.50	2890	324.00	4291.00
Storm Event Return Period				*5yr.*	*25yr.*	*50yr.*
Detention Pond Analysis Results	*Post Development Peak Flow (m^3/s):*			3.129	5.056	6.142
	Max. Water Level (mamsl)			1623.871	1624.255	1624.322
	Attenuation Volume (m^3)			2,372.00	3,548.00	3,761.00
	Flow Attenuation (%)			117%	111%	96%
	Peak Outflow (m^3/s)			1.560	3.391	5.143
Notes & Comments:	Pond 3 successfully attenuates incoming flows due to sufficient volume available.					



KEY PLAN

LEGEND

- PROPOSED STORMWATER LINE
- PROPOSED KERB INLET
- PROPOSED STORMWATERMANHOLE
- 30m BUFFER LINE
- 50 YEAR FLOOD LINE
- 100 YEAR FLOOD LINE
- CONSTRUCTION BOUNDARY

STORMWATER LAYOUT
SCALE 1:2500

IF IN DOUBT ASK

REV	DATE	REVISION DESCRIPTION	BY	CHKD
A	2018-09-25	ISSUED FOR PRELIMINARY REPORT	FG	LF
B	2018-11-16	ISSUED FOR DETAILED DESIGN	FG	LF

ASSOCIATED DWG No.	DRAWING DESCRIPTION

GENERAL NOTES
CITY OF EKURHULENI MUST BE NOTIFIED
1. BEFORE ANY CONSTRUCTION WORKS RELATED TO THE INSTALLATION OF WATER OR STORMWATERMAY BE COMMENCED. ALL CONSTRUCTION WORK SHALL COMPLY WITH THE RELEVANT SABS 1200 SPECIFICATION
2. ALL MATERIALS USED IN THE INSTALLING OF STORMWATERAND WATER MAIN SHALL COMPLY WITH THE RELEVANT SABS SPECIFICATION
3. AND THE MINIMUM REQUIREMENTS OF CITY OF EKURHULENI THE POSITION AND AND DEPTH OF ALL EXISTING SERVICES ON THE SITE AND OFF SITE WHERE AFFECTED BY THE WORKS
4. SHALL BE CONFIRMED PRIOR TO ANY CONSTRUCTION WORK ON THE INSTALLATION OF WATER AND STORMWATERMAINS BEING COMMENCED. CITY OF EKURHULENI SHALL BE NOTIFIED WHEN THERE IS A NEED TO CONNECT INTO EXISTING WATER AND STORMWATER
5. MANHOLES AND MAINS. NOTE THAT A MINIMUM OF 2 WEEKS NOTICE SHALL BE GIVEN TO CITY OF EKURHULENI STAFF TO ATTEND SITE INSPECTIONS, MEETINGS AND ANY OTHER NECESSARY ON SITE LIAISON.

PROJECT NOTES
SETTING OUT DIMENSIONS AND LEVELS TO BE CONFIRMED ON SITE PRIOR TO CONSTRUCTION . ANY DISCREPANCIES TO
1. BE REPORTED TO THE ENGINEER. ALL SITE ACTIVITIES ARE TO COMPLY WITH THE REQUIREMENT OF THE OSH ACT. 1993 AND CONSTRUCTION REGULATIONS 2003.
2. ALL SITE ACTIVITIES ARE TO COMPLY WITH THE REQUIREMENT OF THE OSH ACT. 1993 AND CONSTRUCTION REGULATIONS 2003.

RELEVANT STANDARDS:
1. SABS 1200 A - GENERAL
2. SABS 1200 AA - GENERAL (SMALL WORKS)
3. SABS 1200 D - EARTHWORKS
4. SABS 1200 DA - EARTHWORKS (SMALL WORKS) 5. SABS 1200 DB - EARTHWORKS (PIPE TRENCHES) 6. SABS 1200 G - CONCRETE (STRUCTURAL)
7. SABS 1200 GA - CONCRETE (SMALL WORKS)
8. SABS 1200 LB - BEDDING (PIPES)
9. SABS 1200 LF - ERF CONNECTIONS
10. SABS 1200 LN - STEEL PIPE AND LININGS

LOCALITY PLAN

client

City of Ekurhuleni

engineers

LEBASH CONSORTIUM
11 WILLOWBROOK OFFICE PARK
VAN HOOF STREET
RUIMSIG, 1735
TEL: +27 11 958 0437
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E-mail: : admin@lebasharchitects.co.za

project title

PROPOSED TOWNSHIP
BIRCHLEIGH NORTH EXTENSION 4

ISSUED FOR DETAILED DESIGN

drawing title

STORMWATER GENERAL LAYOUT)

REF. NO.	N/A	designed	FG
scale	AS SHOWN	drawn	SC
date	NOVEMBER 2018	checked	LF
type number	DETAILED DESIGN	PAPER SIZE	A0
drawing number	18017/C/SW/900	REVISION	B