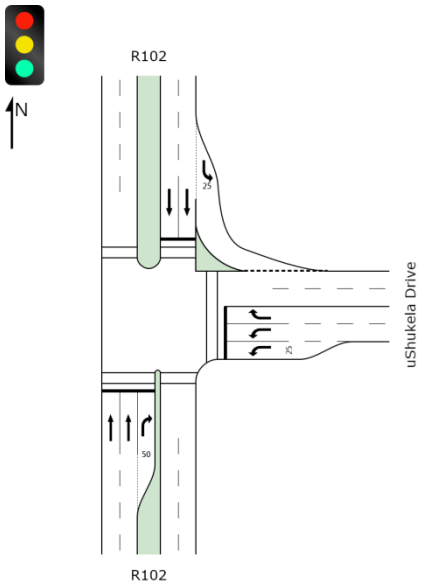
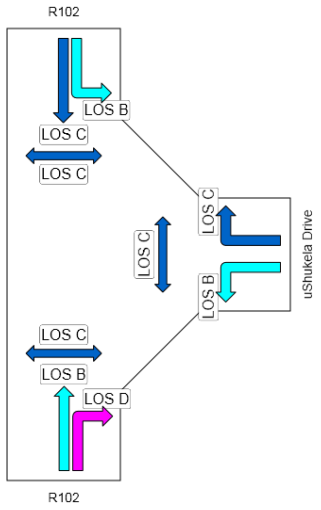
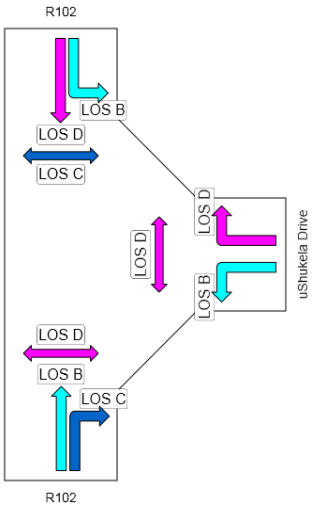
Upgrade of uShukela Drive and R102 Intersection



Intersection of uShukela Drive and R102



AM Peak – LOS Schematic



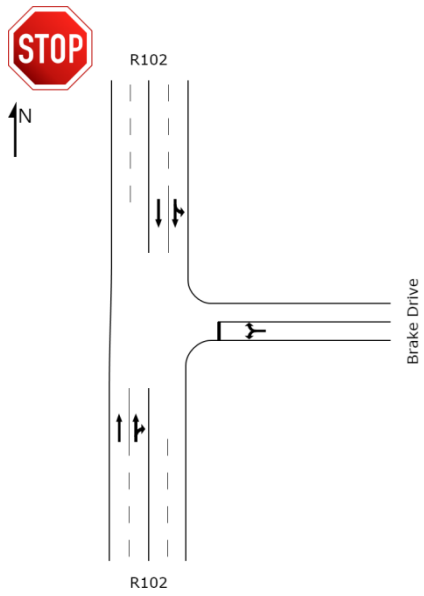
PM Peak – LOS Schematic

Table 19: R102 and uShukela Drive Intersection, Five Year Forecast plus Generated

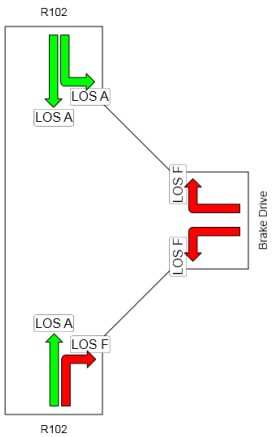
An exclusive right turning lane is required on the southern approach and a left slip lane is required on the northern approach as shown in **Table 19**. The proposed upgrades will improve the overall efficiency of this intersection as shown in SIDRA schematics above. The average delays will be 22.5 and 29.5 seconds for the AM and PM peak hours respectively. The average queue lengths will be 137.3 and 181.2 metres for the AM and PM peak hours respectively

7.7 R102 and Brake Drive Intersection

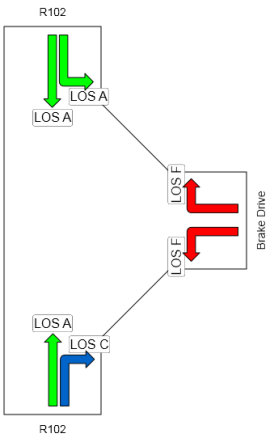
The SIDRA analysis of this intersection shows that complete failure (LOS F) will pervade on the Brake Drive approach during both the peak hours as shown in **Table 20**. This will be as a result of the high through volumes on the R102. The average delays will be 402.6 and 221.7 seconds for the AM and PM peak hours respectively. The average queue lengths will be 2073.5 and 1380.5 metres for the AM and PM peak hours respectively, As such, this intersection will require upgrading in the 5 year horizon.



Intersection of Brake Drive and R102



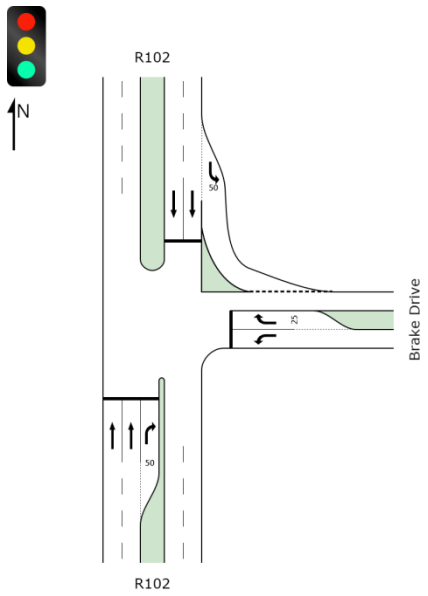
AM Peak – LOS Schematic



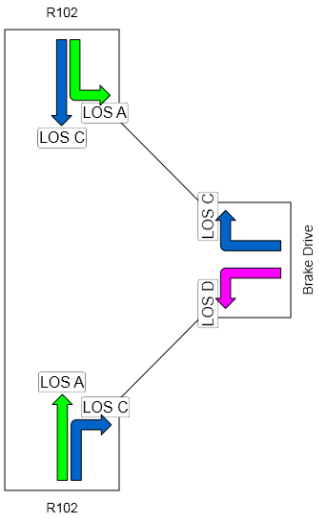
PM Peak – LOS Schematic

Table 20: R102 / Brake Drive Intersection, Five Year Forecast plus Generated

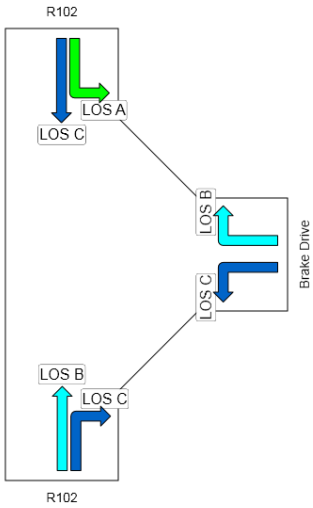
Upgrade of R102 and Brake Drive Intersection



Intersection of Brake Drive and R102



AM Peak – LOS Schematic

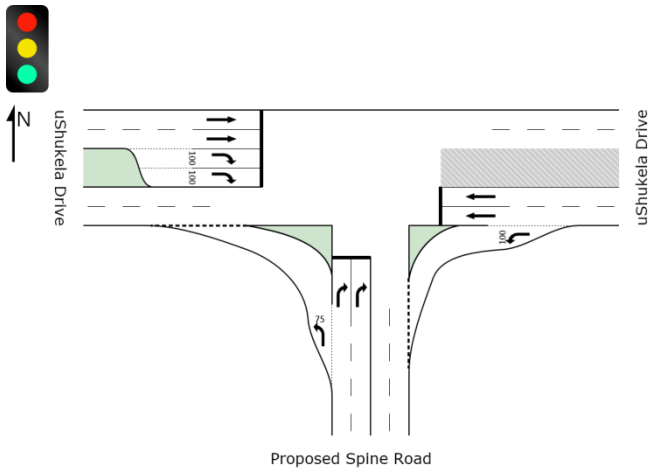


PM Peak – LOS Schematic

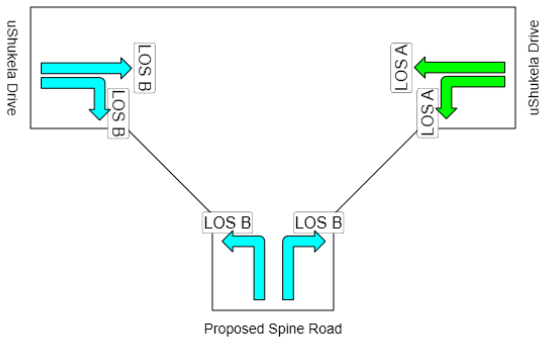
Table 21: Upgrade R102 / Brake Drive Intersection, Five Year Forecast plus Generate

This priority controlled intersection must be upgraded to a signalised intersection in the 5 year horizon. Furthermore, an exclusive right turning lane will be required on the southern approach and a left slip lane will be required on the northern approach. The eastern approach will require designated left and right turning lanes. The average delays will be 20.4 and 19.9 seconds for the AM and PM peak hours respectively. The average queue lengths will be 127.8 and 102.3 metres for the AM and PM peak hours respectively

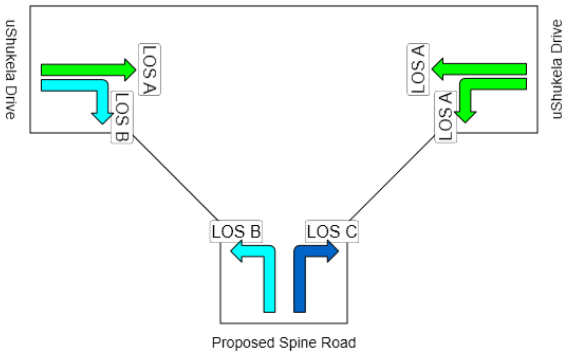
7.8 uShukela Drive and the uShukela Development Main Spine Road



Intersection of uShukela Drive and uShukela Main Spine Road



AM Peak – LOS Schematic



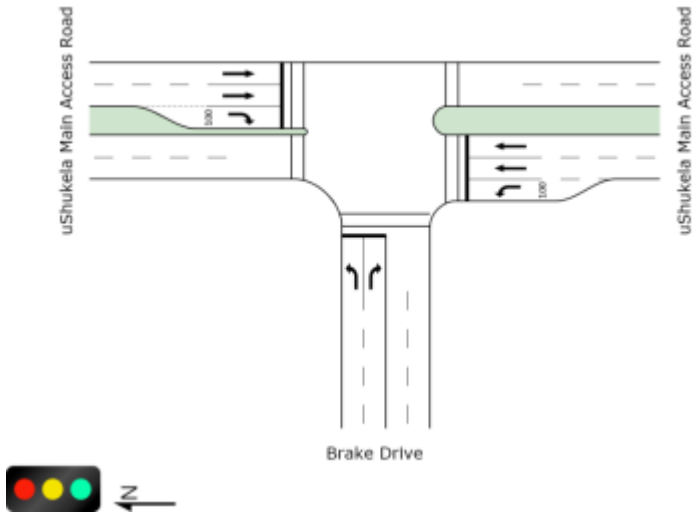
PM Peak – LOS Schematic

Table 22: Five Year Forecast plus Generated

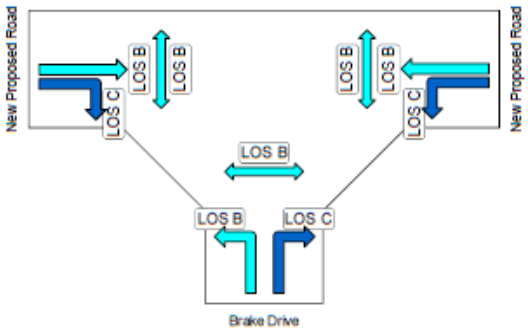
The intersection configuration shown in **Table 22** was proposed by TECHSO for the main access intersection between uShukela Drive and the main spine road through the proposed development. This intersection configuration was approved by KZN DOT. Hence this configuration was analysed in this section of the report. The SIDRA analysis revealed that this intersection layout will operate efficiently in the 5 year horizon as shown in **Table 22**. The average delays will be 11 and 10.2 seconds for the AM and PM peak hours respectively. The average queue lengths will be 75 and 50.4 metres for the AM and PM peak hours respectively. No upgrades will be required to this layout to accommodate the uShukela Development generated trips in the 5-year horizon.

7.9 uShukela Main Spine Road and the New Brake Drive Link Intersection

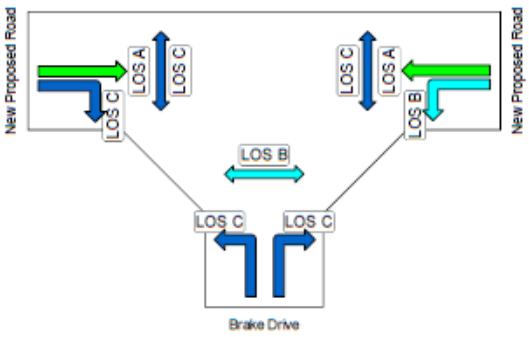
A new road will be required to link Brake Drive and the uShukela Main Spine Road. The intersection layout shown in **Table 23** is proposed for this junction. The analysis of this proposed layout yielded good operating conditions for the 5 year horizon during both the AM and PM peak hours as shown in **Table 23.** The average delays will be 15.7 and 15.2 seconds for the AM and PM peak hours respectively. The average queue length will be 70 metres for both the AM and PM peak hours respectively.



Intersection of uShukela Main Access Road and Brake Drive



AM Peak – LOS Schematic



PM Peak – LOS Schematic

Table 23: uShukela Main Access Road and Brake Drive Intersection, Five Year Forecast plus Generated Traffic

8. Ten Year Forecast plus Development Generated Traffic Volumes

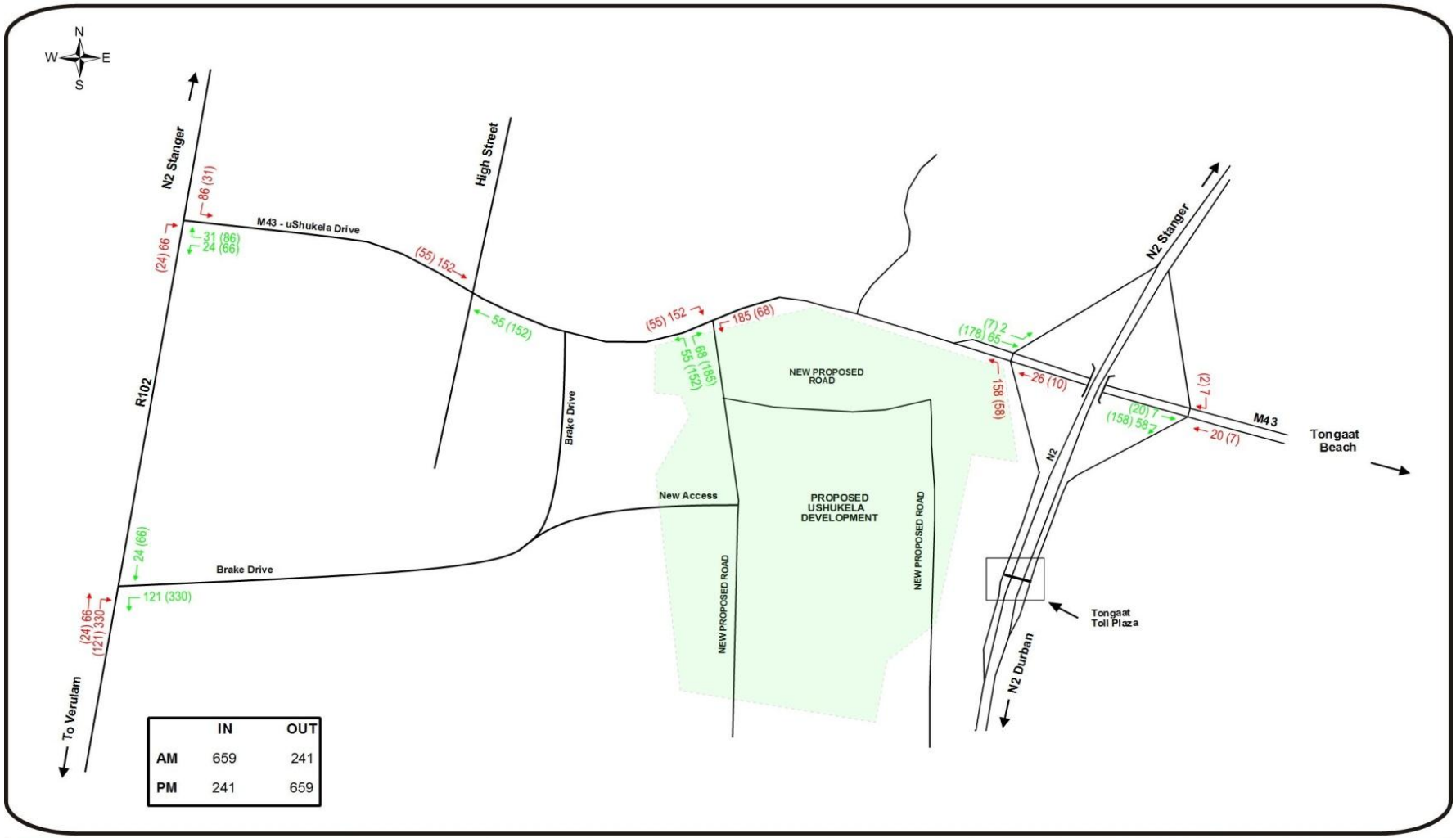
It is envisaged that the uShukela Development will attain 40% of its full developmental potential in the 10 year horizon i.e. in 2022. As such, the proposed uShukela Development will generate the peak traffic volumes shown in Table 24 below. The generated traffic volumes for the 2022 scenario at 40% completion are shown on **Figure 9**.

AM Peak Hour			PM Peak Hour		
Peak Total 2 way	**In**	**Out**	**Peak Total 2 way**	**In**	**Out**
900	659	241	900	241	900

Table 24: uShukela Development Generated Traffic Volumes in 2022

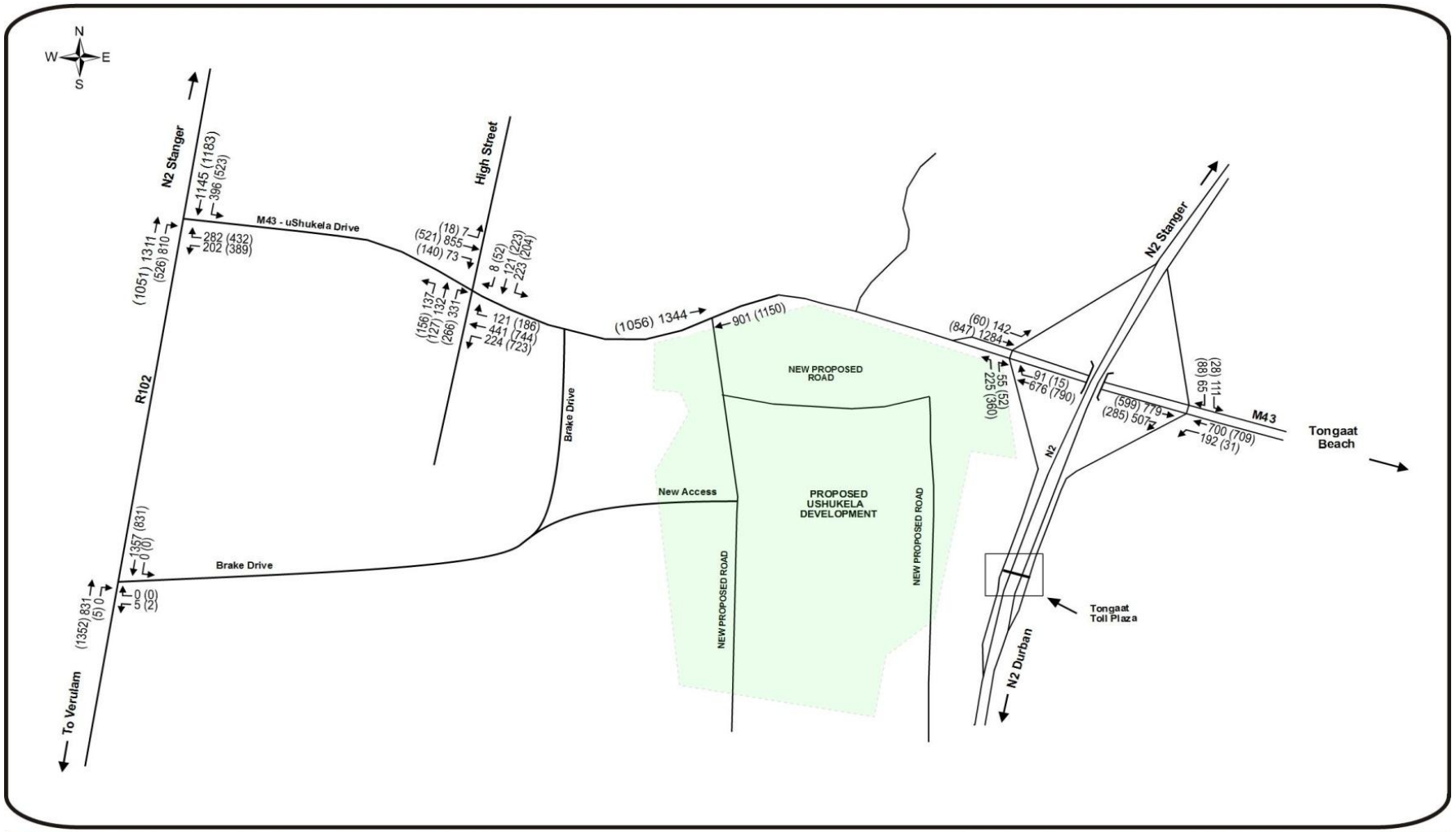
The South African Manual on Traffic Impact Studies recommends that in the case of multi-phase developments that generate in excess of 2 000 trips in the peak hour, the 10 year horizon period should be analysed. Since the uShukela Development will generate in excess of 2 000 vehicle trips, an analysis of the 10 year horizon was undertaken in this chapter. A growth rate of 5% was used to forecast the 10 year traffic volumes. The 10 year forecast on the existing traffic volumes is shown on **Figure 10** (no development-generated traffic).

The combined 10 year forecasted background traffic volumes plus the uShukela Development and DTP generated traffic volumes are shown in **Figure 11**. These combined traffic volumes were analysed to determine the accumulative impact on the surrounding road network in the 10 year horizon. The analysis of these combined traffic volumes on the surrounding road network is discussed hereafter.



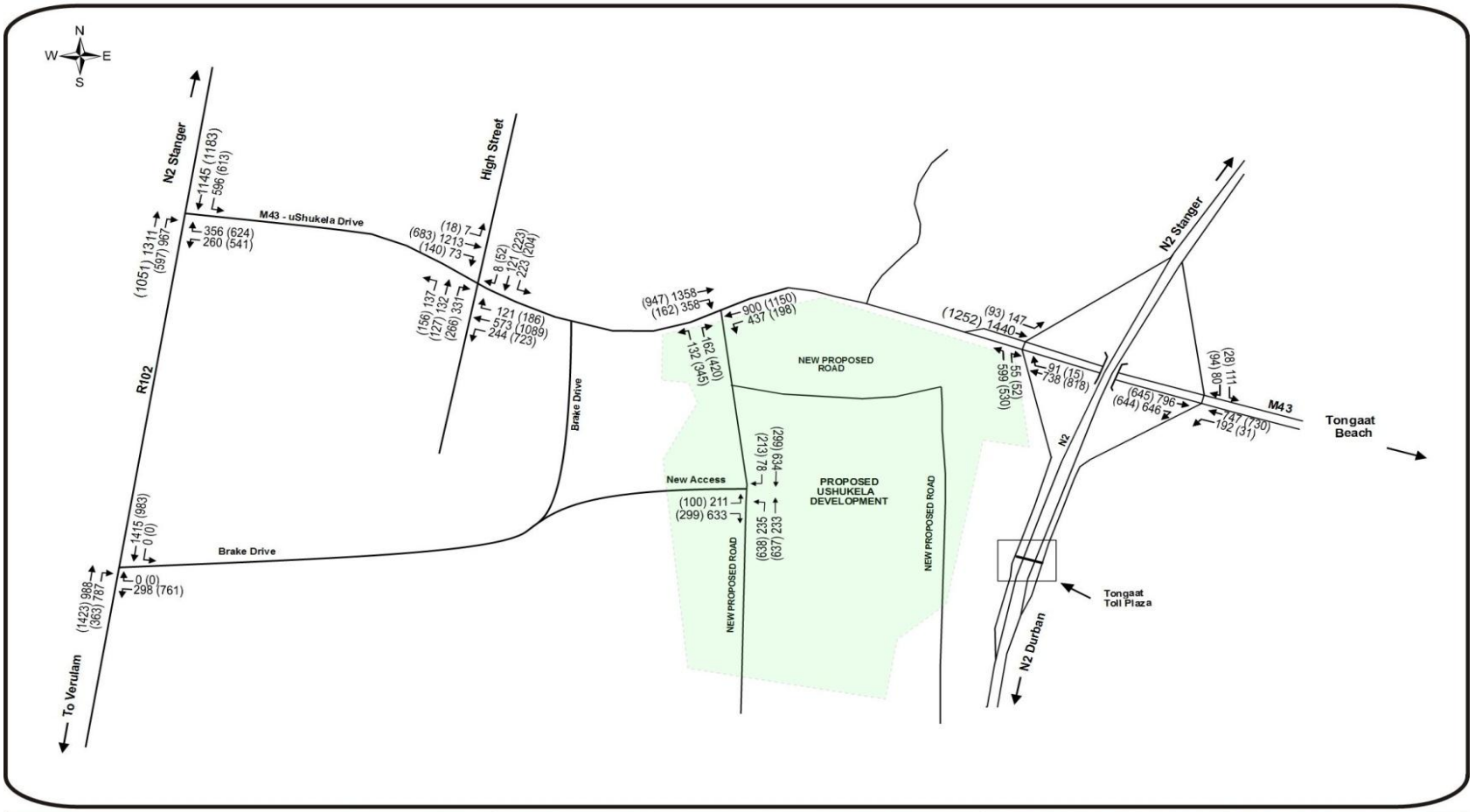
aurecon Leading. Vibrant. Global.	**DEVELOPMENT GENERATED AM & PM PEAK HOUR TRAFFIC VOLUMES IN 2022 (40% COMPLETION)** **Proposed uShukela Drive Precinct Development in the Tongaat Area**	**PROJECT:** 106521 **FIGURE:** 9
November 2012	**AURECON (PTY) LTD**	**SCALE:** Not to Scale

Figure 9: Development Generated Traffic Volumes at 40% completion in 2022



aurecon Leading. Vibrant. Global.	**10 YEAR FORECAST ON EXISTING WEEKDAY AM & PM PEAK HOUR TRAFFIC VOLUMES (2022)** **Proposed uShukela Drive Precinct Development in the Tongaat Area**	**PROJECT:** 106521
		FIGURE: 10
November 2012	**AURECON (PTY) LTD**	**SCALE:** Not to Scale

Figure 10: Ten Year Forecast on Existing Weekday AM and PM Peak Hour Traffic Volumes (2022)

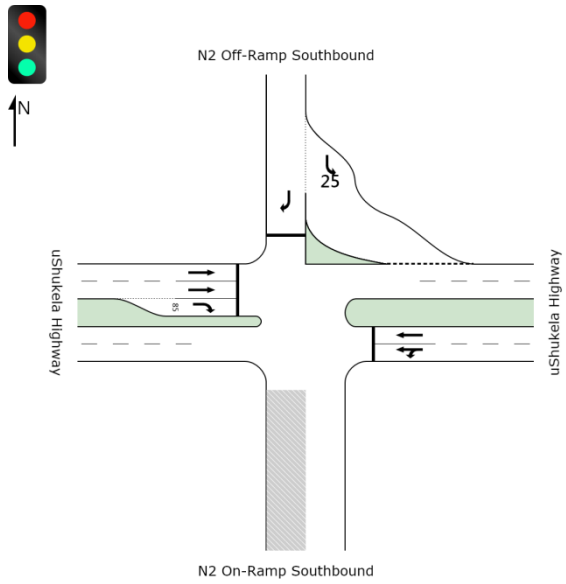


aurecon Leading. Vibrant. Global.	10 YEAR FORECAST PLUS DEVELOPMENT GENERATED TRAFFIC (40%) PLUS DTP GENERATED TRAFFIC VOLUMES (100%) 2022 Proposed uShukela Drive Precinct Development in the Tongaat Area	PROJECT: 106521
		FIGURE: 11
November 2012	AURECON (PTY) LTD	SCALE: Not to Scale

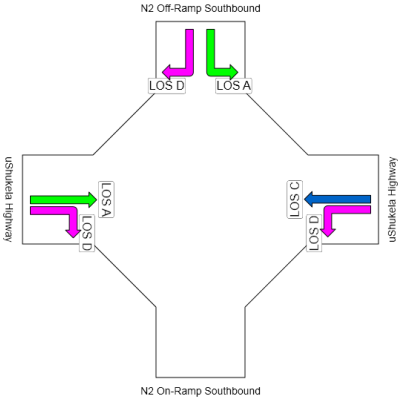
Figure 11: Ten Year Forecast plus Development Generated Traffic in 2022

8.1 N2 Interchange – Eastern Intersection

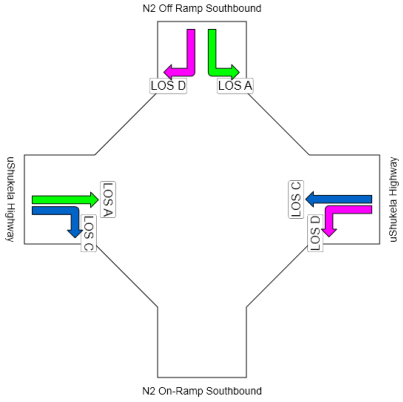
The SIDRA analysis of the combined traffic volumes revealed that all the movements at the eastern intersection (as upgraded in the 5-year horizon) will operate at a reasonable level of service during both the AM and PM peak hours. The through traffic on uShukela Drive operates fairly unconstrained by traffic on the ramps. The westbound traffic turning left onto the southbound on-ramp operates freely. The average delays will be 24.9 and 19.5 seconds for the AM and PM peak hours respectively. The average queue lengths will be 145.3 and 94.7 metres for the AM and PM peak hours respectively. The LOS schematics are shown in **Table 25**.



Eastern Intersection Geometric Layout



AM Peak – LOS Schematic

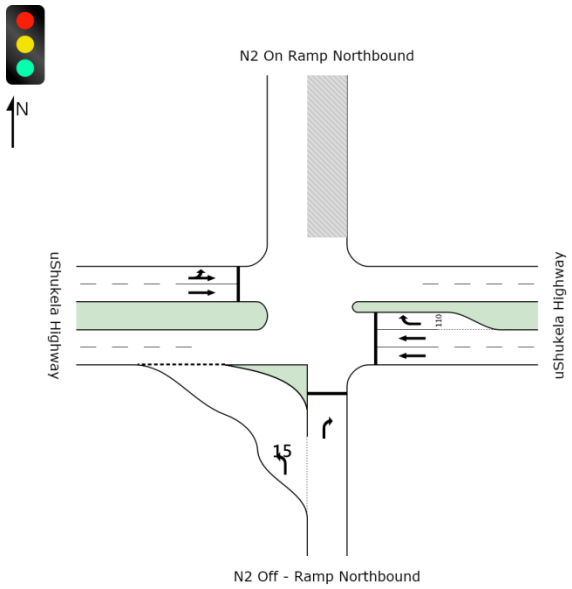


PM Peak – LOS Schematic

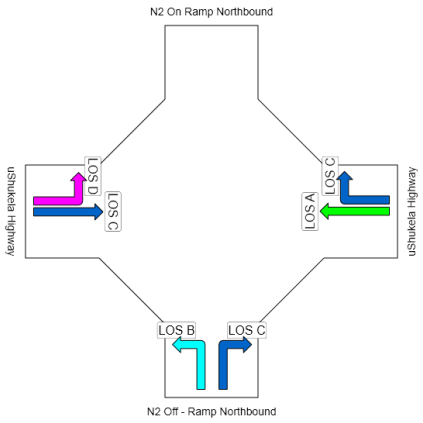
Table 25: N2 Interchange Eastern Intersection, Ten Year Horizon plus Generated Traffic

8.2 N2 Interchange – Western Intersection

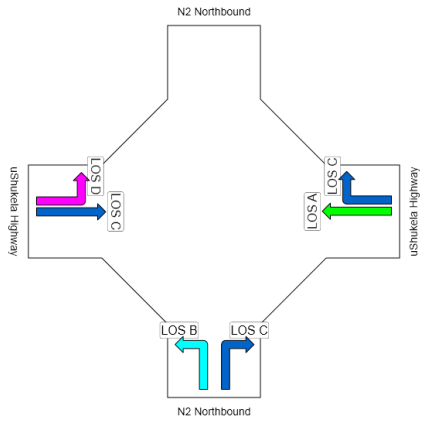
The through traffic on uShukela Drive will continue to operate at a good LOS in the 10 year horizon. The traffic turning left onto the northbound on-ramp operates freely. The average delays will be 22.1 and 21.7 seconds for the AM and PM peak hours respectively. The average queue lengths will be 179.3 and 128.5 metres for the AM and PM peak hours respectively. The LOS schematics are shown in **Table 26**.



Western Intersection Geometric Layout



AM Peak – LOS Schematic

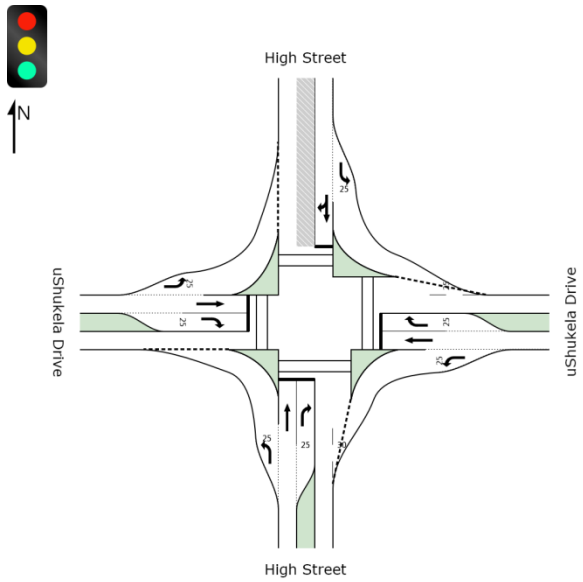


PM Peak – LOS Schematic

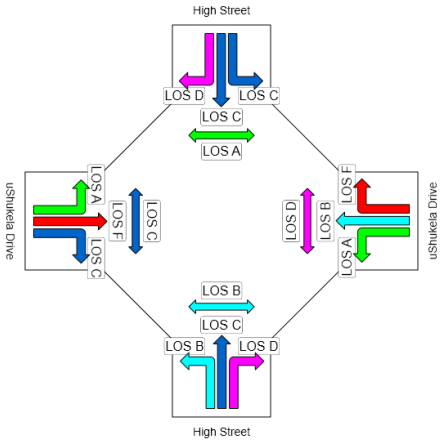
Table 26: N2 Interchange – Western Intersection, Ten Year Horizon plus Generated Traffic

8.3 uShukela Drive and High Street Intersection

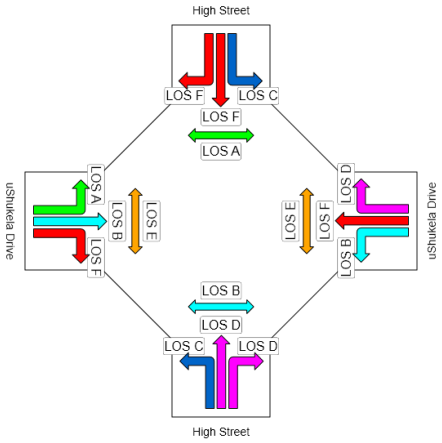
Table 27 shows that this intersection will encounter severe congestion on most approaches during the AM and PM peak hours. The average delays will be 100.8 and 94.6 seconds for the AM and PM peak hours respectively. The average queue lengths will be 1278.5 and 1342.7 metres for the AM and PM peak hours respectively. Therefore, geometric improvements will be required at this intersection in the 10 year horizon.



Intersection of uShukela Drive and High Street



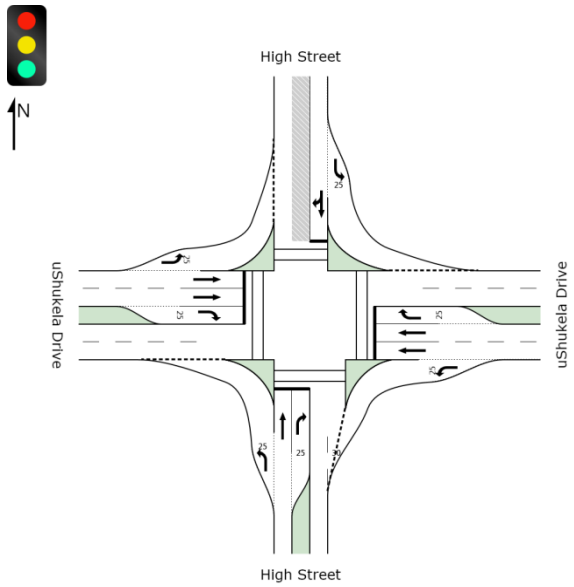
AM Peak – LOS Schematic



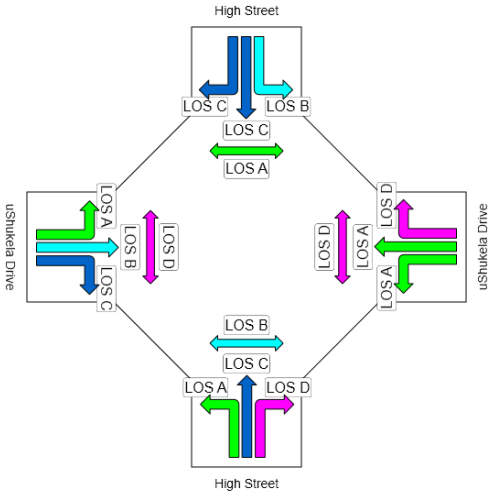
PM Peak – LOS Schematic

Table 27: High Street and uShukela Drive, Ten Year Horizon plus Generated Traffic

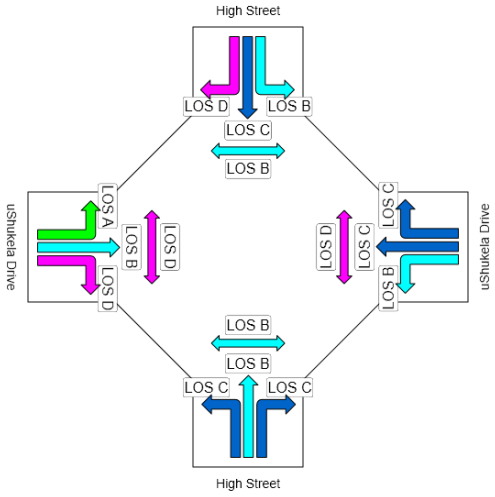
Upgrade Of uShukela Drive and High Street Intersection



Intersection of uShukela Drive and High Street



AM Peak – LOS Schematic



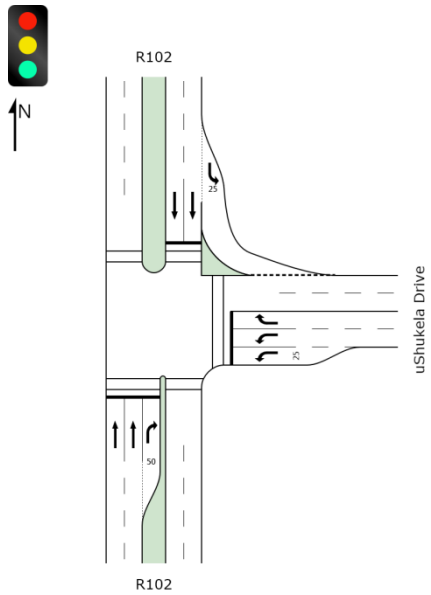
PM Peak – LOS Schematic

Table 28: Upgrade of High Street and uShukela Drive, Ten Year Horizon plus Generated Traffic

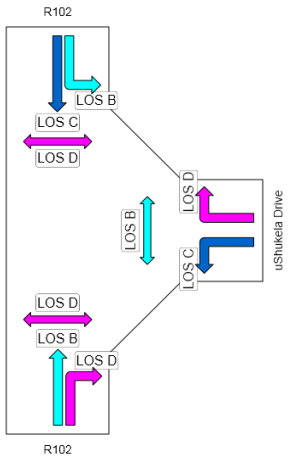
This intersection must be upgraded to the geometric configuration shown in **Table 28** in the 10 year horizon. The SIDRA analysis results show that this signalised intersection will operate at a good LOS during both the AM and PM peak hours despite the additional traffic volumes that will be imposed on it. The average delays will be 17.8 and 20.8 seconds for the AM and PM peak hours respectively. The average queue lengths will be 129.6 and 159.8 metres for the AM and PM peak hours respectively.

8.4 uShukela Drive and R102 Intersection

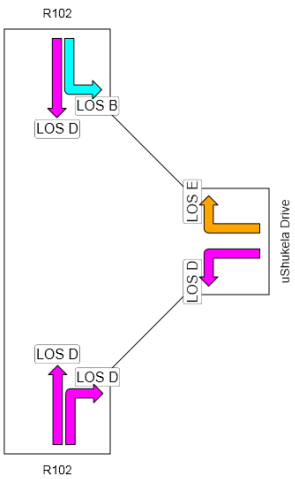
It can be seen from the LOS schematics shown in **Table 29** that all movements operate at acceptable levels of service in both peak hours. The average delays will be 23.2 and 45.3 seconds for the AM and PM peak hours respectively. The average queue lengths will be 247.8 and 356.7 metres for the AM and PM peak hours respectively. No improvements will be required at this intersection in the 10 year horizon.



Intersection of uShukela Drive and R102



AM Peak – LOS Schematic

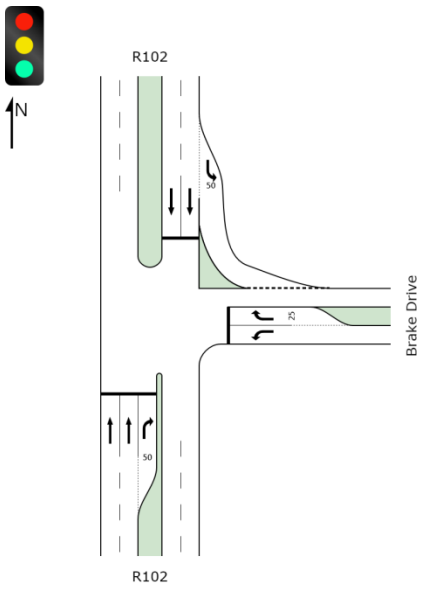


PM Peak – LOS Schematic

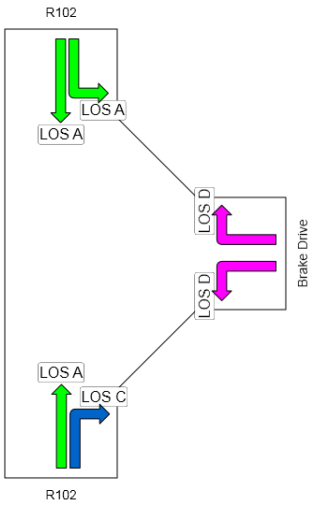
Table 29: R102 and uShukela Drive, Ten Year Horizon plus Generated Traffic

8.5 Brake Drive and R102 Intersection

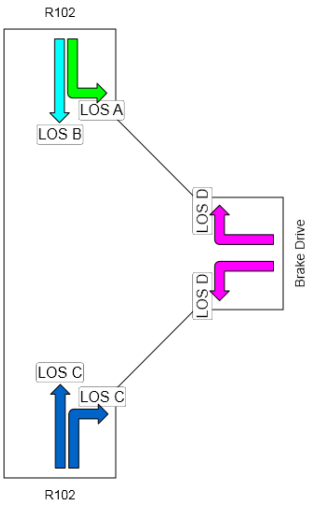
The geometric improvements that will be carried out at this intersection in the 5 year horizon will provide sufficient capacity to comfortably handle the additional trips in the 10 year horizon. The levels of service at this intersection will be acceptable in both peak hours negating any need for improvements. The average delays will be 13.5 and 29.4 seconds for the AM and PM peak hours respectively. The average queue lengths will be 139.8 and 254.7 metres for the AM and PM peak hours respectively – see **Table 30**.



Intersection of Brake Drive and R102



AM Peak – LOS Schematic

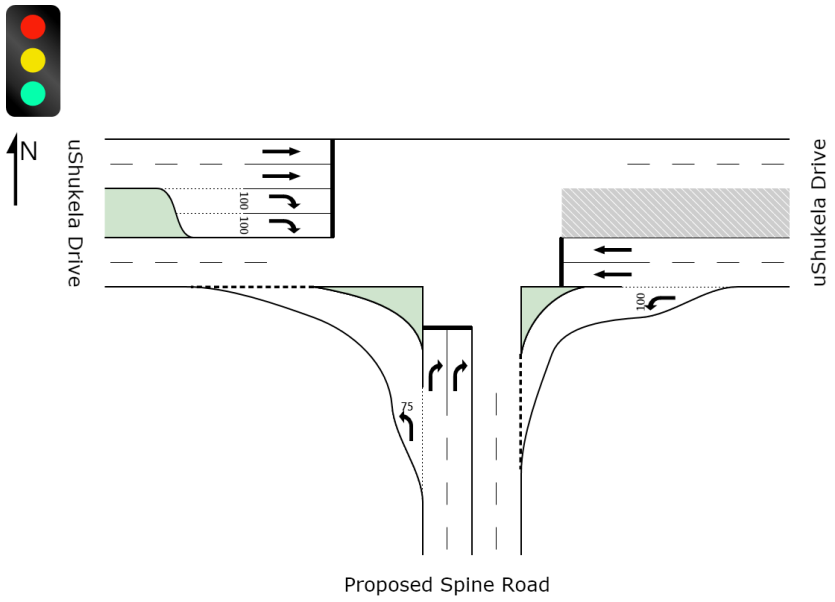


PM Peak – LOS Schematic

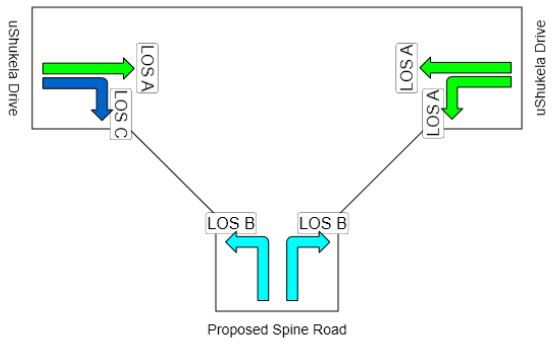
Table 30: Brake Drive and R102, Ten Year Horizon plus Generated Traffic

8.6 uShukela Drive and Main uShukela Spine Road Intersection

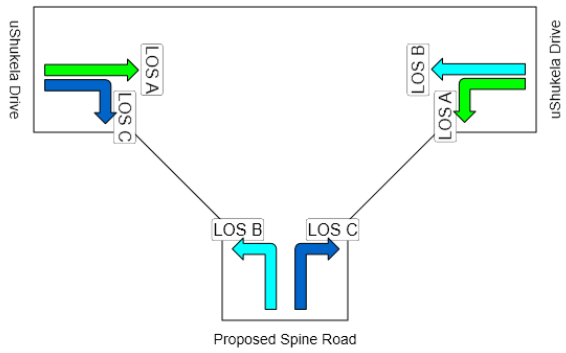
This access intersection will operate good levels of service in both the peak hours. The average delays will be 11 and 12.5 seconds for the AM and PM peak hours respectively. The average queue lengths will be 60.1 and 77.8 metres for the AM and PM peak hours respectively – see **Table 31**. No improvements will be required at this intersection in the 10 year horizon.



Intersection of uShukela Drive and uShukela Main Access Road



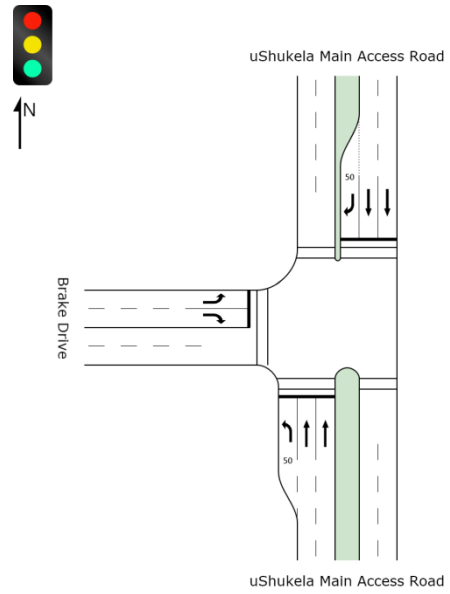
AM Peak – LOS Schematic



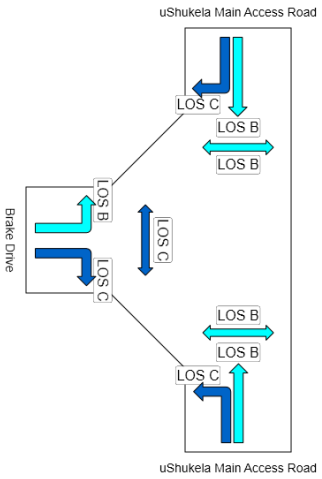
PM Peak – LOS Schematic

Table 31: uShukela Drive and Main uShukela Access Road Intersection, Ten Year Forecast plus Generated Traffic

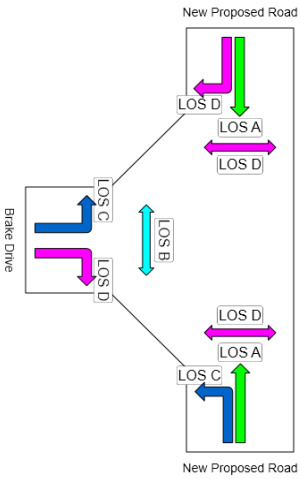
8.7 Brake Drive and Main uShukela Access Intersection



Intersection of uShukela Main Access Road and Brake Drive



AM Peak – LOS Schematic



PM Peak – LOS Schematic

Table 32: Brake Drive and Main Access Intersection, Ten Year Forecast plus Generated Traffic

This intersection will continue to operate at a good LOS in the 10 year horizon during the both the peak hours. No improvements will be required in the 10 year horizon. The average delays will be 13.5 and 29.4 seconds for the AM and PM peak hours respectively. The average queue lengths will be 139.8 and 254.7 metres for the AM and PM peak hours respectively.

9. Fifteen Year Forecast plus Development Generated Traffic

It is envisaged that by 2027 (15 years from present) the uShukela Development will attain 100% completion. As such, the proposed uShukela Development will generate the peak hour traffic volumes shown in the Table 33 below by 2027.

AM Peak Hour			PM Peak Hour		
Peak Total 2 way	**In**	**Out**	**Peak Total 2 way**	**In**	**Out**
3 112	2 263	849	3 112	2 263	849

Table 33: uShukela Development Generated Traffic Volumes in 2027

Using a compound growth rate of 5%, the background traffic volumes were forecasted over a 15 year period to attain their equivalent 2027 values. These 2027 forecasted traffic volumes are shown on **Figure 12**.

The generated traffic volumes for the 100% completion scenario were assigned onto the road network and shown on **Figure 13**.

The 15 year forecasted background traffic volumes plus the uShukela Development and DTP generated traffic volumes are shown in **Figure 14**. These combined traffic volumes were analysed to determine the cumulative impact on the surrounding road network in the 15 year horizon. The impact of these combined traffic volumes on the surrounding road network is discussed hereafter.

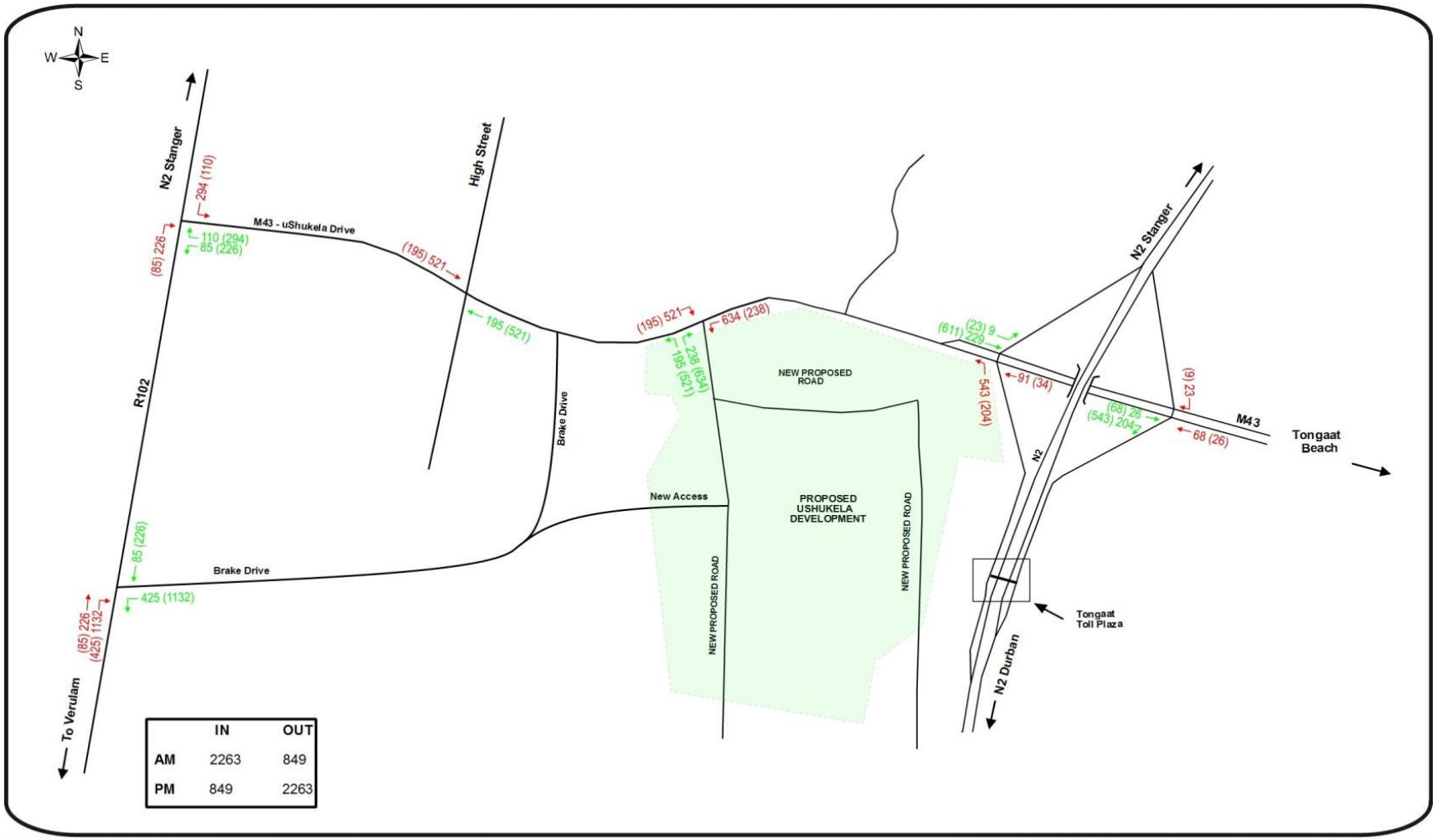
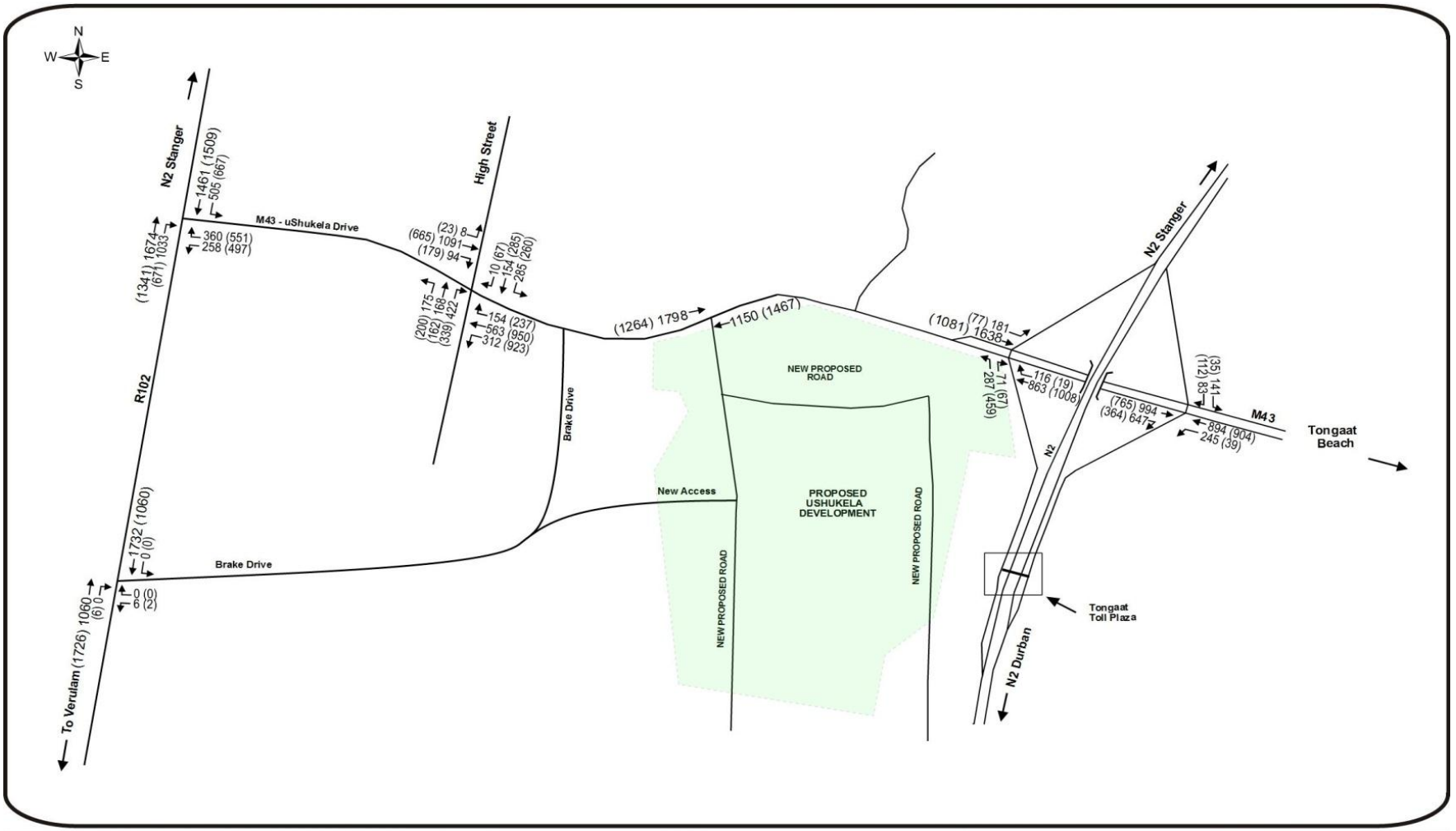
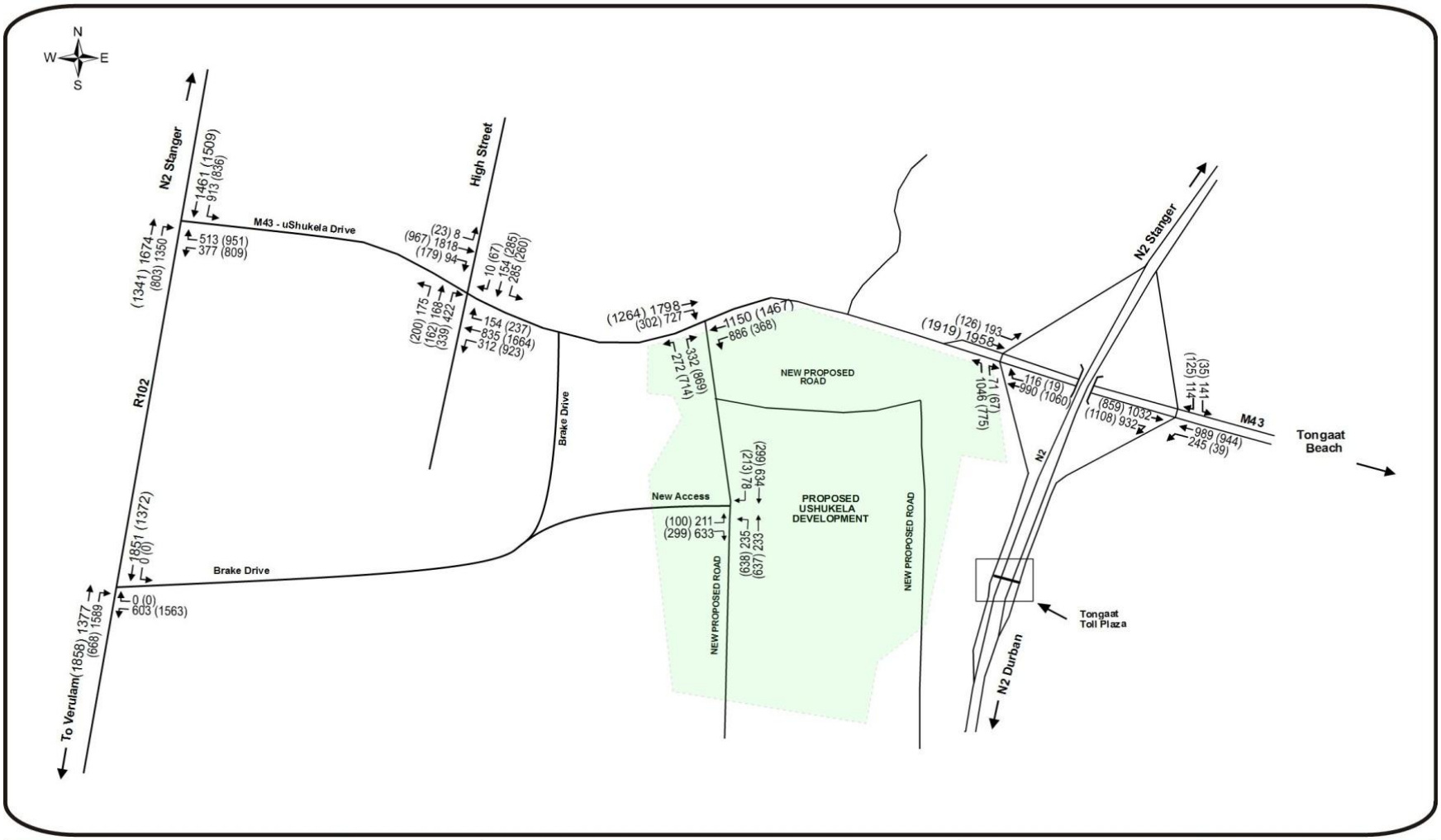


Figure 12: Development Generated Traffic Volumes in 2027



aurecon Leading. Vibrant. Global.	**15 YEAR FORECAST ON EXISTING WEEKDAY AM & PM PEAK HOUR TRAFFIC VOLUMES (2027)** **Proposed uShukela Drive Precinct Development in the Tongaat Area**	**PROJECT:** 106521
		FIGURE: 13
November 2012	**AURECON (PTY) LTD**	**SCALE:** Not to Scale

Figure 13: Fifteen Year Forecast on Existing Traffic Volumes



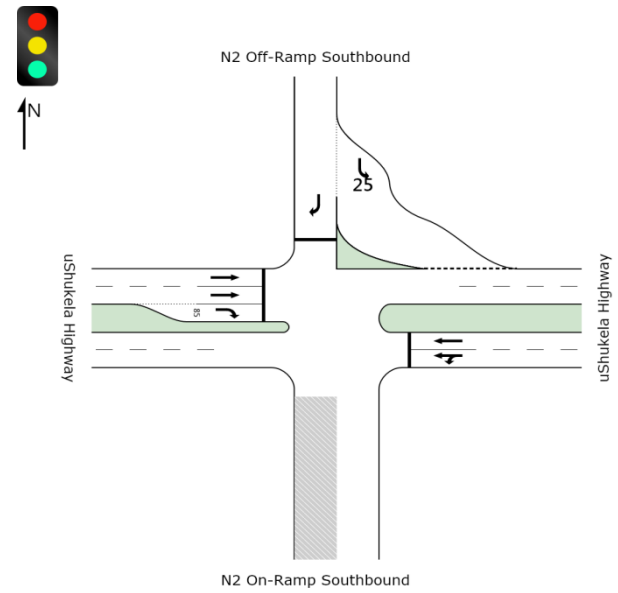
aurecon Leading. Vibrant. Global.	**15 YEAR FORECAST PLUS DEVELOPMENT GENERATED TRAFFIC (100%) PLUS DTP GENERATED TRAFFIC VOLUMES (100%) 2027** **Proposed uShukela Drive Precinct Development in the Tongaat Area**	**PROJECT:** 106521
		FIGURE: 14
November 2012	**AURECON (PTY) LTD**	**SCALE:** Not to Scale

Figure 14: Fifteen Year Forecast plus Development Generated Traffic plus DTP Generated Traffic Volumes 2027

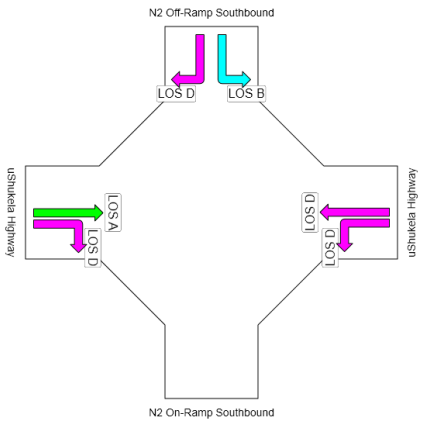
9.1 N2 Interchange – Eastern Intersection

The SIDRA analysis of the combined traffic volumes revealed that all the movements at the eastern intersection will operate at a reasonable level of service during both the AM and PM peak hours. The through traffic on uShukela Drive operates fairly unconstrained by traffic on the ramps. The westbound traffic turning left onto the southbound on-ramp operates freely. The average delays will be 16.2 and 17.8 seconds for the AM and PM peak hours respectively. The average queue lengths will be 178.2 and 138.6 metres for the AM and PM peak hours respectively.

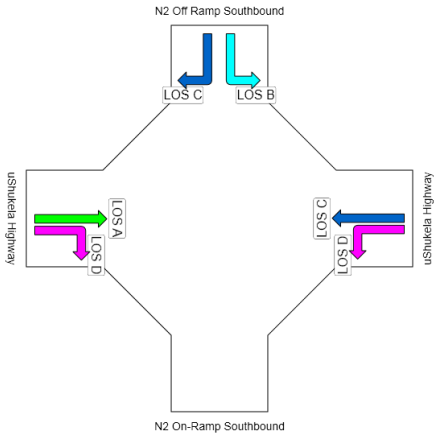
No upgrades will be required in the 15 year horizon.



Eastern Intersection Geometric Layout



AM Peak – LOS Schematic



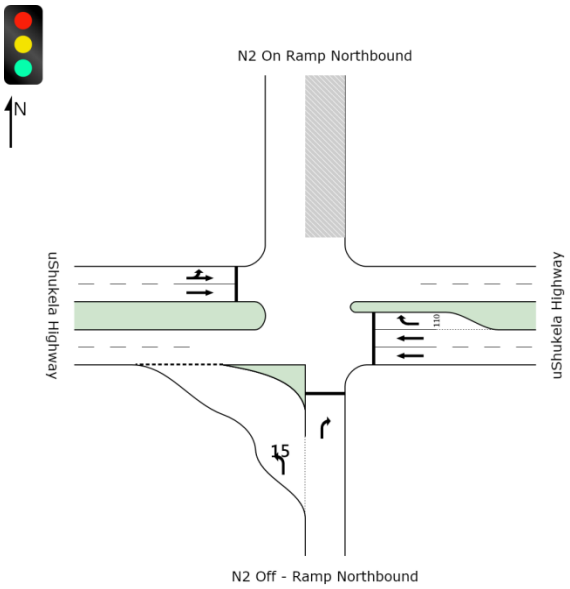
PM Peak – LOS Schematic

Table 34: N2 Interchange Eastern Intersection, 15 Year Horizon plus Generated Traffic

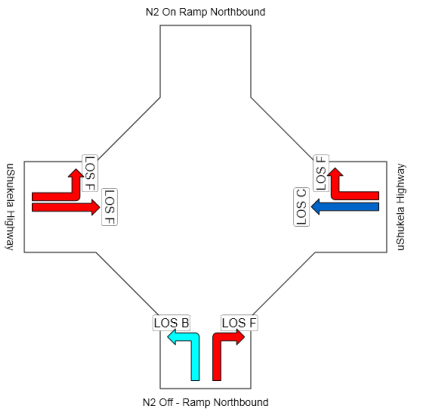
9.2 N2 Interchange – Western Intersection

The SIDRA analysis results show that this signalised off-ramp intersection will operate at a poor LOS during both the AM and PM peak hours due to the additional traffic volumes that will be imposed on it. The average delays will be 274.7 and 74.5 seconds for the AM and PM peak hours respectively. The average queue lengths will be 1727.3 and 829.6 metres for the AM and PM peak hours respectively.

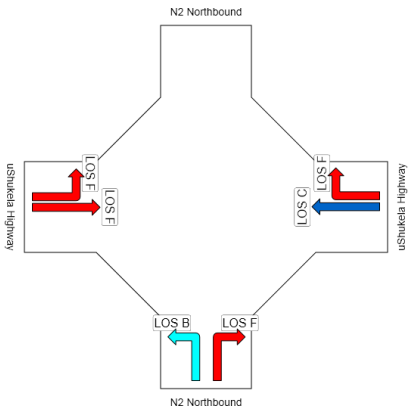
Therefore, upgrades will be required in the 15 year horizon.



Western Intersection Geometric Layout



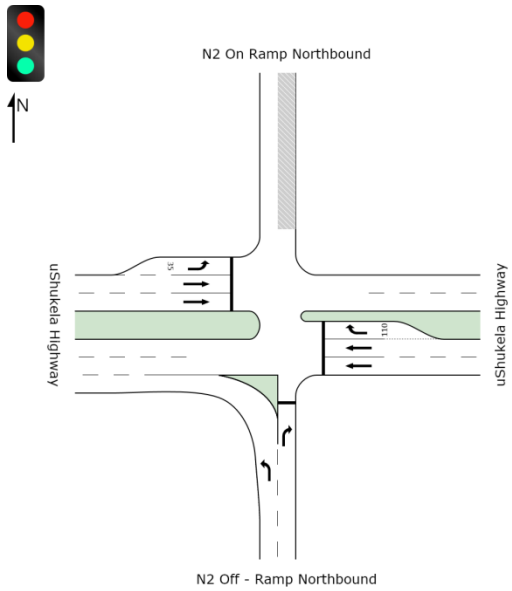
AM Peak – LOS Schematic



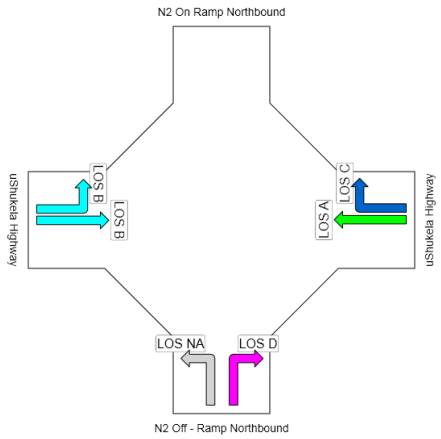
PM Peak – LOS Schematic

Table 35: N2 Interchange – Western Intersection, 15 Year Horizon plus Generated Traffic

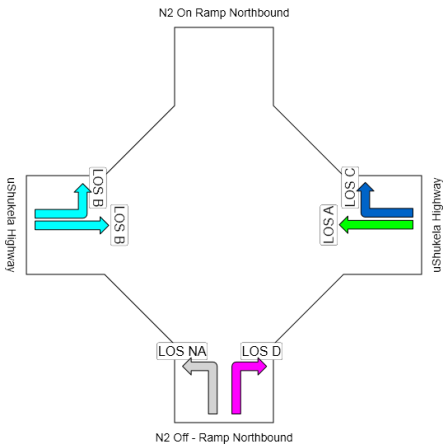
Upgrade of N2 Interchange – Western Intersection



Western Intersection Geometric Layout



AM Peak – LOS Schematic



PM Peak – LOS Schematic

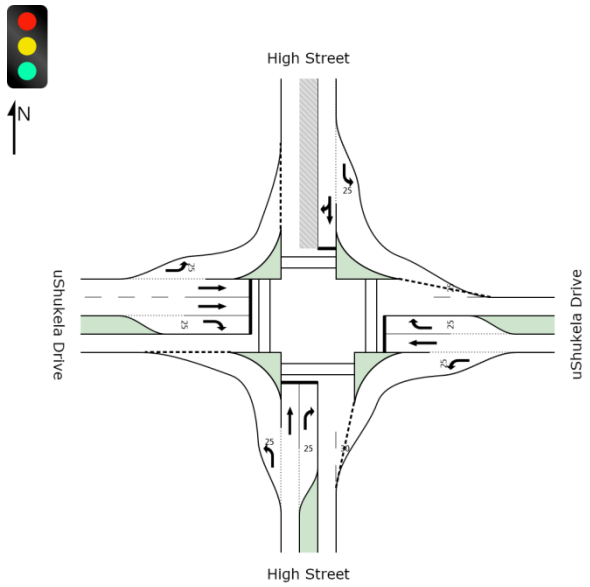
Table 36: Upgrade N2 Interchange – Western Intersection, 15 Year Horizon plus Generated Traffic

This intersection must be upgraded to the geometric configuration shown above in order to improve its overall operational efficiency. The average delays will be 13.8 and 13.2 seconds for the AM and PM peak hours respectively. The average queue lengths will be 248.3 and 265.2 metres for the AM and PM peak hours respectively.

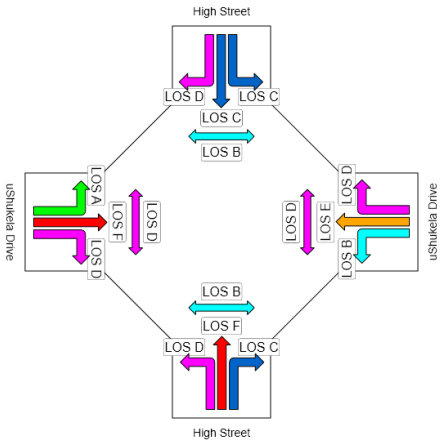
9.3 uShukela Drive and High Street Intersection

Table 37 shows that this intersection exhibits complete failure (LOS F) at several of the movements during the AM and PM peak hours. The average delays will be 471.4 and 1175.3 seconds for the AM and PM peak hours respectively. The average queue lengths will be 3993.5 and 8483.5 metres for the AM and PM peak hours respectively.

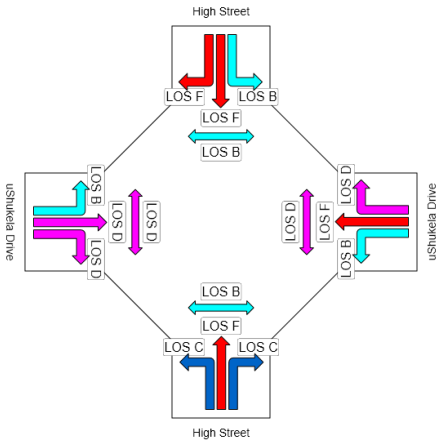
Upgrades will certainly be required in the 15 year horizon.



Intersection of uShukela Drive and High Street



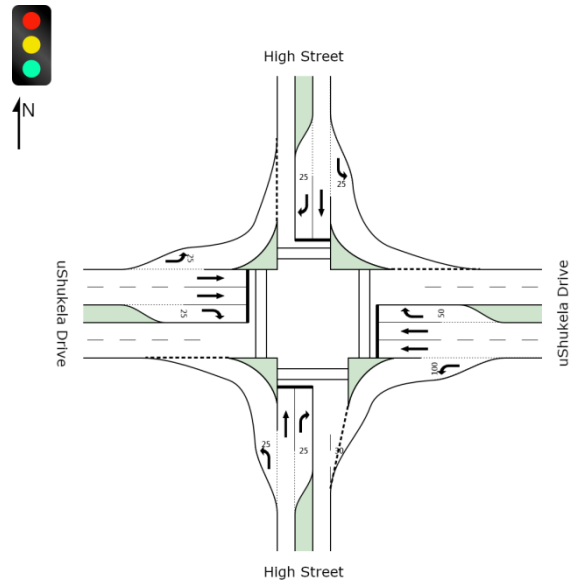
AM Peak – LOS Schematic



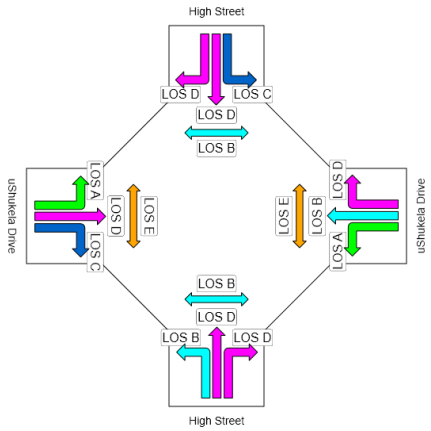
PM Peak – LOS Schematic

Table 37: High Street and uShukela Drive, 15 Year Horizon plus Generated Traffic

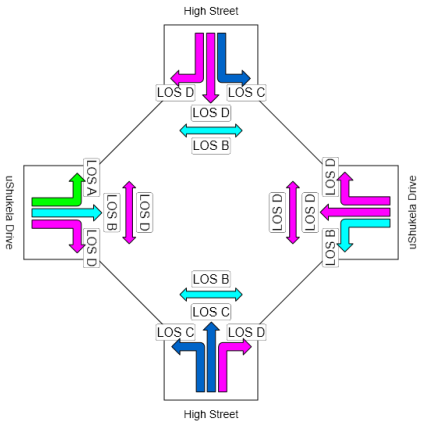
Upgrade of uShukela Drive and High Street Intersection



Intersection of uShukela Drive and High Street



AM Peak – LOS Schematic



PM Peak – LOS Schematic

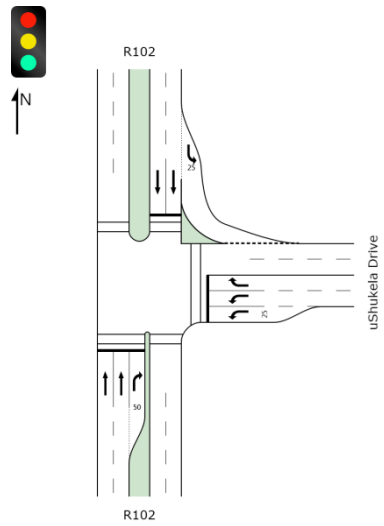
Table 38: Upgrade High Street and uShukela Drive, 15 Year Horizon plus Generated Traffic

This intersection must be upgraded to the geometric configuration shown for it to operate at a better LOS. After the upgrading of this intersection, the average delays will be 36.8 and 29.9 seconds for the AM and PM peak hours respectively. The average queue lengths will be 454 and 326.5 metres for the AM and PM peak hours respectively.

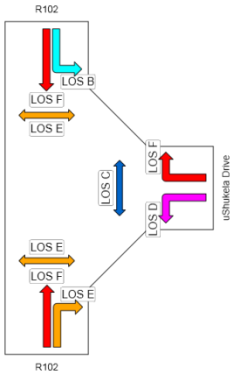
9.4 uShukela Drive and R102 Intersection

It is evident from **Table 39** that this intersection will encounter immense levels of congestion in the 15 year horizon and will require desperate upgrading in 2027. However, there is no

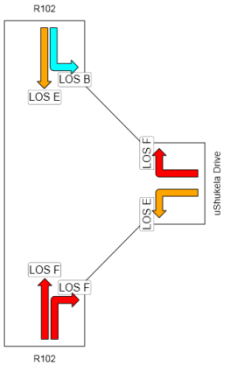
space available adjacent to this intersection to allow for any improvements due to the intense urban development alongside all three approaches to this intersection. As such, this intersection cannot be upgraded any further in 2027. The average delays will be 212.4 and 284.5 seconds for the AM and PM peak hours respectively. The average queue lengths will be 1991.6 and 1869.9 metres for the AM and PM peak hours respectively. In mitigation of the above congestion problem, it can be reasonably argued that once this intersection exhibits major signs of distress, motorists coming from the southern Tongaat area will naturally change their travel patterns and use the Brake Drive / R102 intersection to enter the uShukela Development. This redistribution of trips will alleviate the pressure placed on the uShukela Drive and R102 intersection. No further analysis will carried out at this intersection.



Intersection of uShukela Drive and R102



AM Peak – LOS Schematic



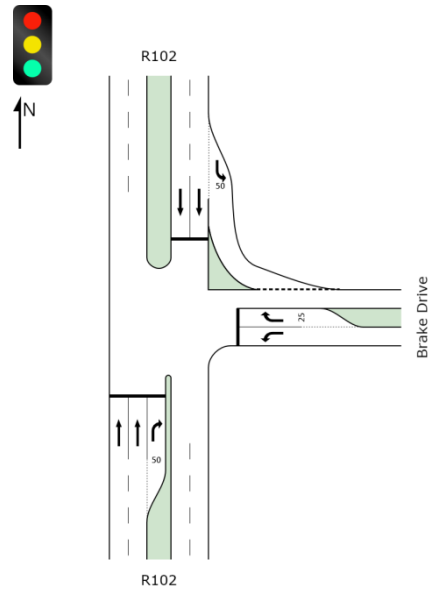
PM Peak – LOS Schematic

Table 39: R102 and uShukela Drive, 15 Year Horizon plus Generated Traffic

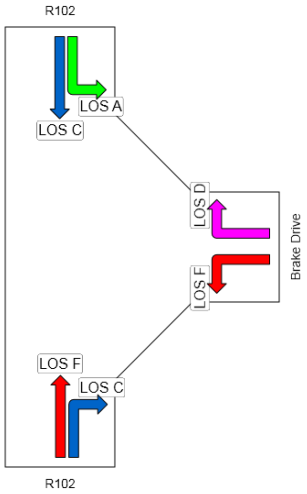
9.5 Brake Drive and R102 Intersection

This intersection operates poorly and fails at many of the movements in both the AM and the PM – see **Table 40**. The average delays will be 261.4 and 1003.2 seconds for the AM and PM peak hours respectively. The average queue lengths will be 2280.9 and 4568.3 metres for the AM and PM peak hours respectively.

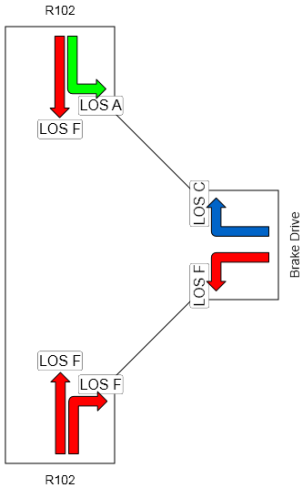
Upgrades will be required in the 15 year horizon.



Intersection of Brake Drive and R102



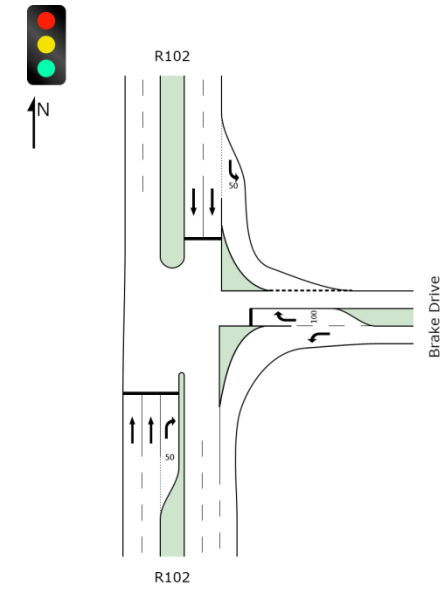
AM Peak – LOS Schematic



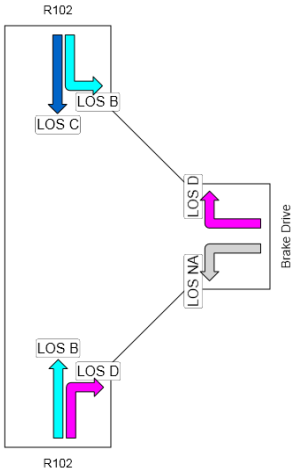
PM Peak – LOS Schematic

Table 40: Brake Drive and R102, 15 Year Horizon plus Generated Traffic

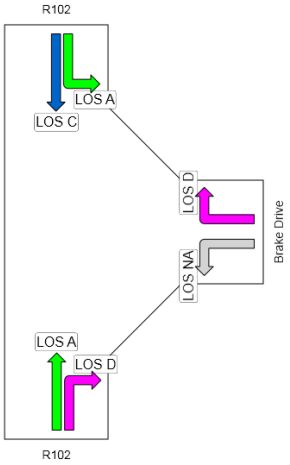
Upgrade of Brake Drive and R102 Intersection



Intersection of Brake Drive and R102



AM Peak – LOS Schematic



PM Peak – LOS Schematic

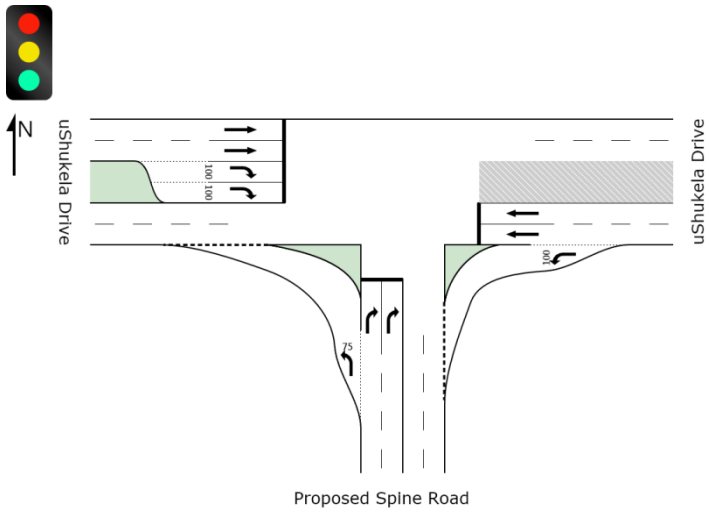
Table 41: Upgrade Brake Drive and R102, 15 Year Horizon plus Generated Traffic

Upgrades will predominantly be required on the eastern approach. A dedicated left continuous slip lane will be needed on the eastern approach. Furthermore, the exclusive right turning bay must be extended from 25m to 100m. Following the upgrades the average delays at this intersection will be 22.7 and 12 seconds for the AM and PM peak hours respectively. The average queue lengths will be 410.7 and 196.6 metres for the AM and PM peak hours respectively.

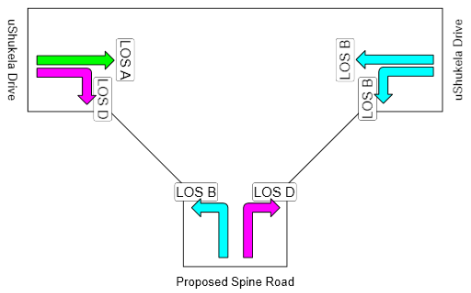
9.6 uShukela Drive and Main uShukela Access Intersection

This intersection will operate at acceptable levels of service in both the AM and PM peak hours – see **Table 42**. The average delays will be 17.7 and 28.5 seconds for the AM and PM peak hours respectively. The average queue lengths will be 143.3 and 244.8 metres for the AM and PM peak hours respectively.

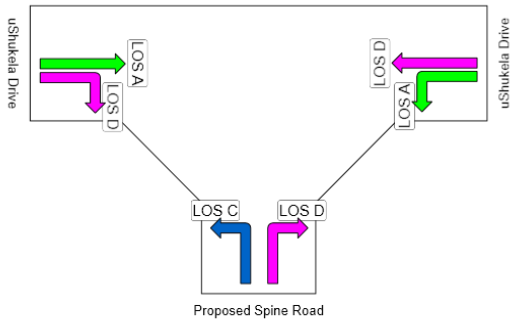
No upgrades will be required in the 15 year horizon.



Intersection of uShukela Drive and uShukela Main Access Road



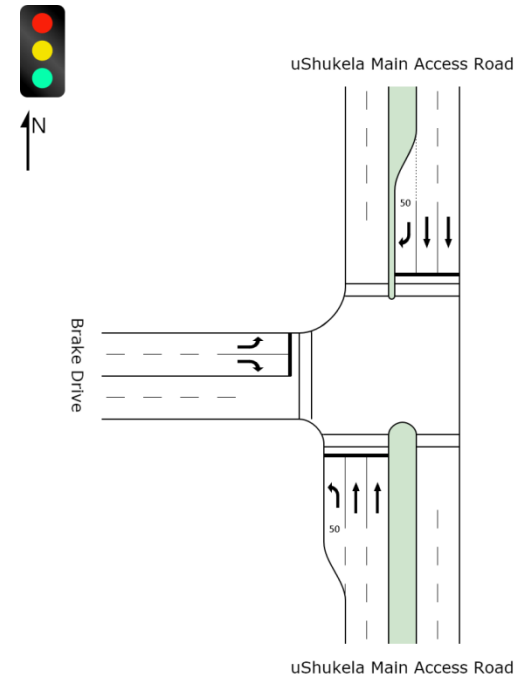
AM Peak – LOS Schematic



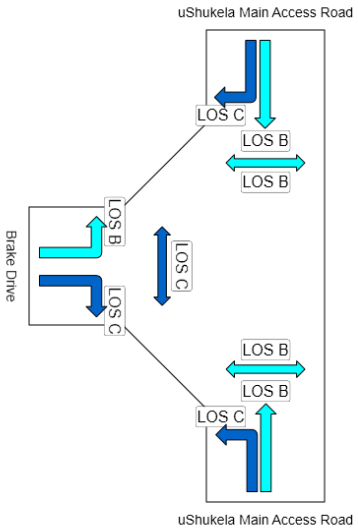
PM Peak – LOS Schematic

Table 42: uShukela Drive and Main uShukela Access Road Intersection, 15 Year Forecast plus Generated Traffic

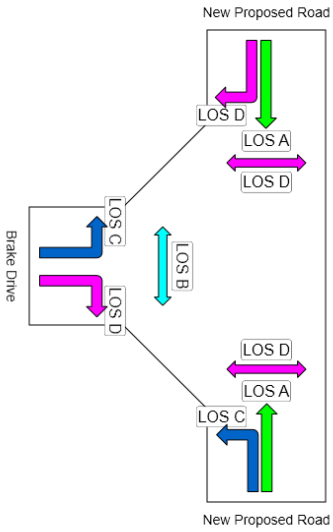
9.7 Brake Drive and Main uShukela Access Intersection



Intersection of uShukela Main Access Road and Brake Drive



AM Peak – LOS Schematic



PM Peak – LOS Schematic

Table 43: Brake Drive and Main Access Intersection, Ten Year Forecast plus Generated Traffic

It is evident from **Table 43** that this intersection will have the capacity to handle the envisaged traffic volumes in the 15 year horizon. No upgrades will be required in the 15 year horizon. The average delays will be 17.7 and 28.5 seconds for the AM and PM peak hours respectively. The average queue lengths will be 143.3 and 244.8 metres for the AM and PM peak hours respectively.

10. Recommended Upgrades to the Surrounding Road Network

10.1 Base Year

The purpose of the base year analysis was to identify any pre-existing operational problems on the road network. This analysis revealed the following:

- The base year analysis has shown that the R102 and the uShukela Drive links encounter mounting pressure during the peak hours and are currently operating at LOS E, under the prevailing traffic conditions in the base year.
- The west to south right turn movement at the N2 interchange eastern intersection is also operating at a poor LOS of E.
- The uShukela Drive / High Street intersection is operating poorly with several movements at LOS E.

On the other hand, the remaining intersections within the study area currently operate at fairly acceptable levels of service in the base year.

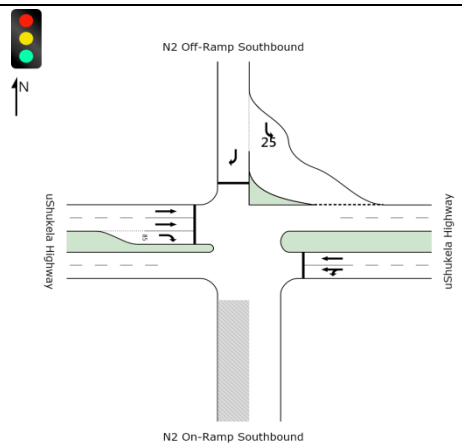
10.2 Five Year Horizon

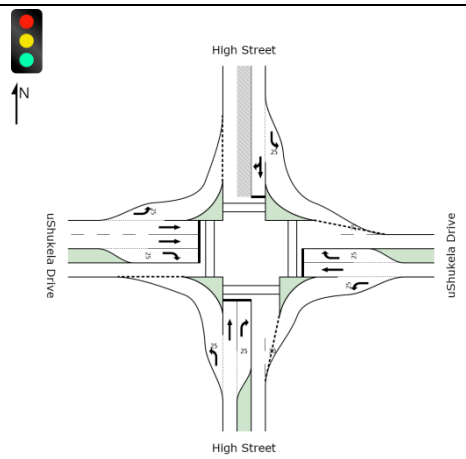
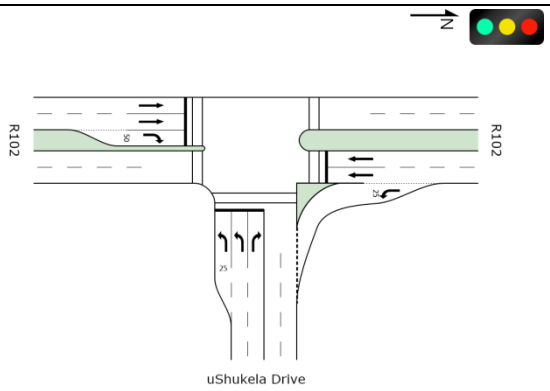
The analysis of the 5 year forecasted traffic volumes reveals that the R102 and uShukela Drive links will experience severe congestion in the 5 year horizon, before any development-generated traffic is imposed onto the road network. The conclusion to this is that each of these roads will need to be upgraded to dual carriageway in the short term.

Furthermore, the inclusion of the Brake Drive access on the R102 south of Tongaat in the 5 year horizon will be highly beneficial as the uShukela Development generated traffic volumes from the south will utilise this access and not enter Tongaat as in previous scenarios.

All recommendations hereafter are based on the assumption that these upgrades are in place. The upgrades recommended for the 5 year horizon are tabulated hereafter for ease of reference.

Network Element	Proposed Upgrade	Time Horizon
uShukela Drive	Must be upgraded to a dual carriageway road with two lanes in each direction.	Prior 2017
R102 south of Tongaat	Must be upgraded to a dual carriageway road with two lanes in each direction	Prior 2017

Brake Drive	• Brake Drive must be upgraded/constructed to provide access into the uShukela Development for the generated traffic volumes approaching from the south. • In addition a new link road will be required linking Brake Drive and the Main Spine Road through the uShukela Development.	2017
N2 Interchange – Eastern Intersection	 • A left slip lane must be added to the northern approach. • Signal warrants must be checked and if the warrants are met then the intersection must be signalised.	2017
N2 Interchange – Western Intersection	• A left slip lane must be added to the southern approach. • Signal warrants must be checked and if the warrants are met then the intersection must be signalised.	2017

uShukela Drive / High Street Intersection	 • Slip lanes will be required on all approaches to the intersection. • An additional through lane will be required in the eastbound direction. • The above intersection configuration will adequately cater for the envisaged traffic volumes in 2017.	2017
R102 / uShukela Drive Intersection	 • A left slip lane is required on the northern approach. • An exclusive right turning lane is required on the southern approach.	2017

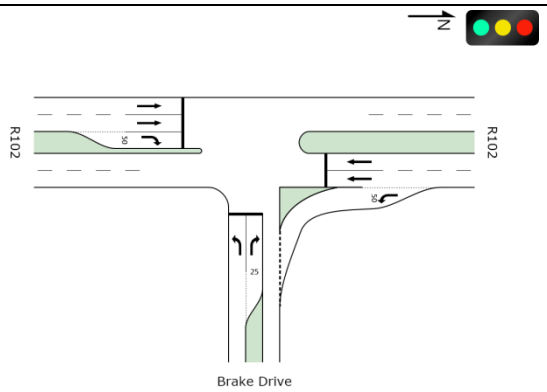
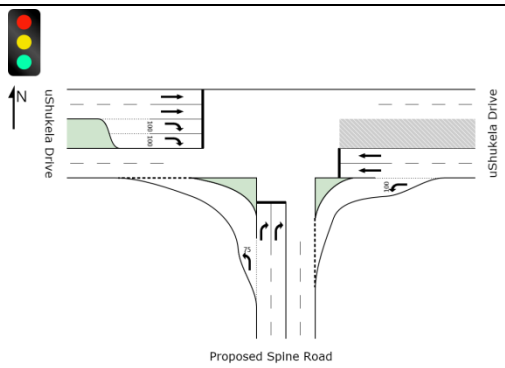
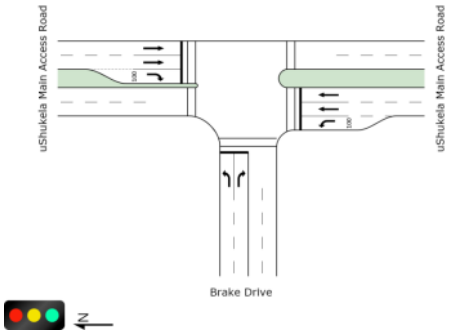
R102 / Brake Drive Intersection	 • Signal warrants must be checked and if the warrants are met then this intersection must be signalised. • This intersection must be upgraded to the layout shown above.	2017
uShukela Drive and Main Spine Road Intersection	 • The intersection configuration shown above must be used for the main access intersection with uShukela Drive.	2017
New Access Link off Brake Drive and Main Spine Road	 • The intersection configuration shown above will provide the necessary capacity required at this intersection.	2017

Table 44: Summary of Road Network Upgrades Required within the Five Year Horizon

10.3 Ten Year Horizon

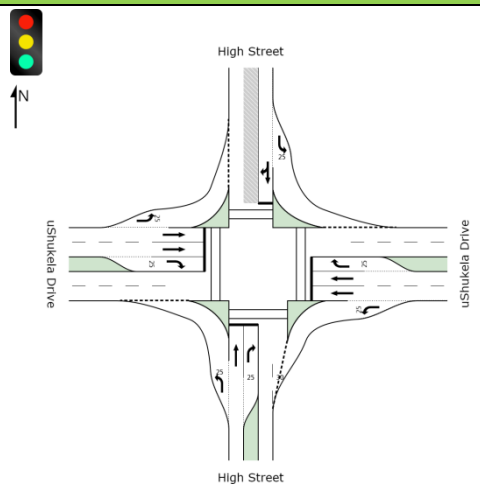
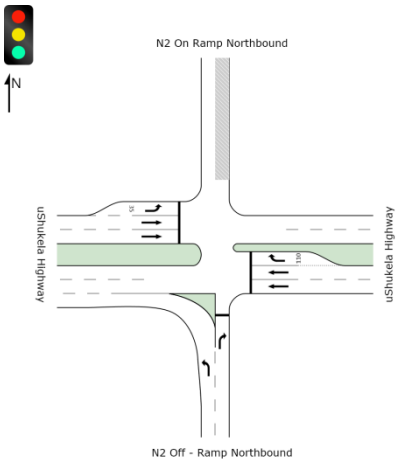
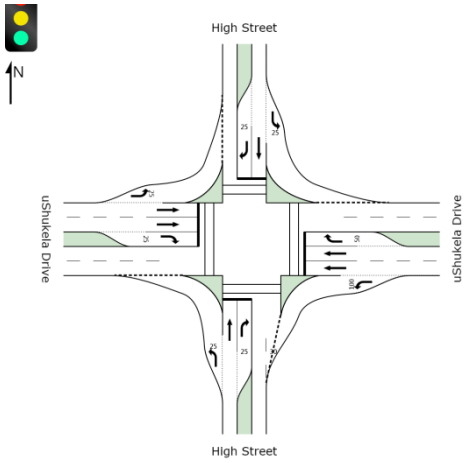
Network Element	Proposed Upgrade	Time Horizon
uShukela Drive / High Street intersection	 • The above intersection configuration will adequately cater for the envisaged traffic volumes in 2022.	2022

Table 45: Summary of Road Network Upgrades Required within the 10 Year Horizon

10.4 Fifteen Year Horizon

Network Element	Proposed Upgrade	Time Horizon
N2 Interchange – Western Intersection	 • This intersection must be upgraded to the geometric configuration shown above in 2027.	2027
Intersection of uShukela Drive and High Street	 • This intersection must be upgraded to the geometric configuration shown above in 2027.	2027

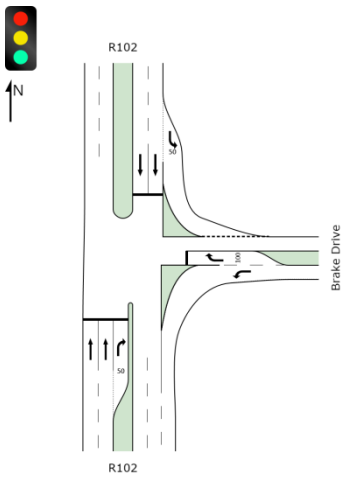
Intersection of Brake Drive and R102	 • This intersection must be upgraded to the geometric configuration shown above in 2027.	2027

Table 46: Summary of Road Network Upgrades Required within the 10 Year Horizon

11. Literature Review of Previous Studies for the Tongaat Area

Transportation Studies and Local Area Plans (LAP) for the Tongaat area were reviewed with the primary intent of understanding the future transport and developmental plans for the Tongaat area and to determine its impact on the uShukela Development. Of particular significance, is a technical report compiled by SSI in November 2010 for the King Shaka Airport and Tongaat Area, as part of a greater study for the Northern Urban Development Corridor (NUDC). The report highlights the fact that the R102 is a strategic route in this area that needs to be enhanced as a regional mobility corridor to augment the connectivity of the surrounding areas to the envisioned Aerotropolis. However, the capacity of the R102 in the immediate vicinity of Tongaat cannot be improved due to the extensive commercial, residential and industrial activities on either side of the R102. Furthermore, the promotion of the R102 as a regional mobility corridor through the Tongaat CBD will result in several negative externalities such as unprecedented congestion, road safety problems, unfriendly pedestrian environment and high levels of gas emissions within the Tongaat precinct. These externalities will have a negative socio-economic impact on the Tongaat CBD.

As a result, the SSI study focuses on developing a hierarchical system of roads that will promote regional mobility in this area by selecting alignments that will bypass the Tongaat CBD. According to SSI (2010), a bypass route for the Tongaat CBD has been contemplated since the late 1960's. A route alignment to the west of Tongaat, later commonly referred to as the Western Bypass, was initially proposed and proclaimed as Provincial Main Road 407. During the late 1980's, further transportation studies for this area motivated for a route on the eastern side of Tongaat, principally because the terrain was conducive to road construction. This alignment to the east of Tongaat is referred to as the Eastern Arterial. The SSI (2010) study tested various scenarios based on travel patterns and

traffic volumes in the area. The objective of this assessment was to identify a road network that provides regional mobility and access to developments while simultaneously decongesting the Tongaat CBD. The study concluded that a combination of the Western Bypass and the Eastern Arterial will improve the regional mobility and accessibility in the Tongaat area. The Western Bypass and the Eastern Arterial are shown in **Figure 12**, which was extracted from the SSI (2010) study.

The Western Bypass will specifically provide a high quality regional mobility link between the King Shaka Airport and the neighbouring towns to the north. Furthermore, the Western Bypass will separate the regional traffic that is currently passing through Tongaat from the CBD traffic. The proposed Western Bypass will have a minimum design speed of 100km/h with a fairly gentle geometric alignment along most of its alignment. Access to the Western Bypass will be at interchanges only, while crossing points with other roads will be achieved by means of overpasses and underpasses (SSI, 2010).

The Eastern Arterial on the other hand will function as an accessibility route providing unimpeded access to the airport and surrounding developments such as the Dube Tradeport and other developments, presumably like the proposed uShukela Development. The Eastern Arterial will unlock the land on the eastern side of Tongaat for the expansion of the town and create new development opportunities. The proposed alignment of the Eastern Arterial will most likely permit a design speed of 80km/h given the rolling terrain in the Tongaat area. Access onto the Eastern Arterial will either be at interchanges or limited to at-grade intersections. For certain sections of the Eastern Arterial there are alternative alignments proposed in the SSI study, as shown hereafter in **Figure 12**.

In essence, the SSI (2010) study shows that the Western Bypass and the Eastern Arterial will form critical links in ensuring the efficacy of the future road network for the NUDC, as the R102 will certainly not have the capacity to function as regional mobility corridor in the future. This traffic study for the uShukela Development directly correlates with the findings of the SSI study, as the results of analyses to date show that the R102 will not have the capacity to handle the future volumes of traffic.

In addition to the proposed bypass routes, the SSI (2010) study explicitly shows that uShukela Drive will encounter capacity problems in the future as a result of the natural growth in traffic volumes and will require an upgrade to a two lane dual carriageway highway, (SSI, 2010, p8). This finding also directly corroborates the results of the analyses conducted in this study for the uShukela Development.

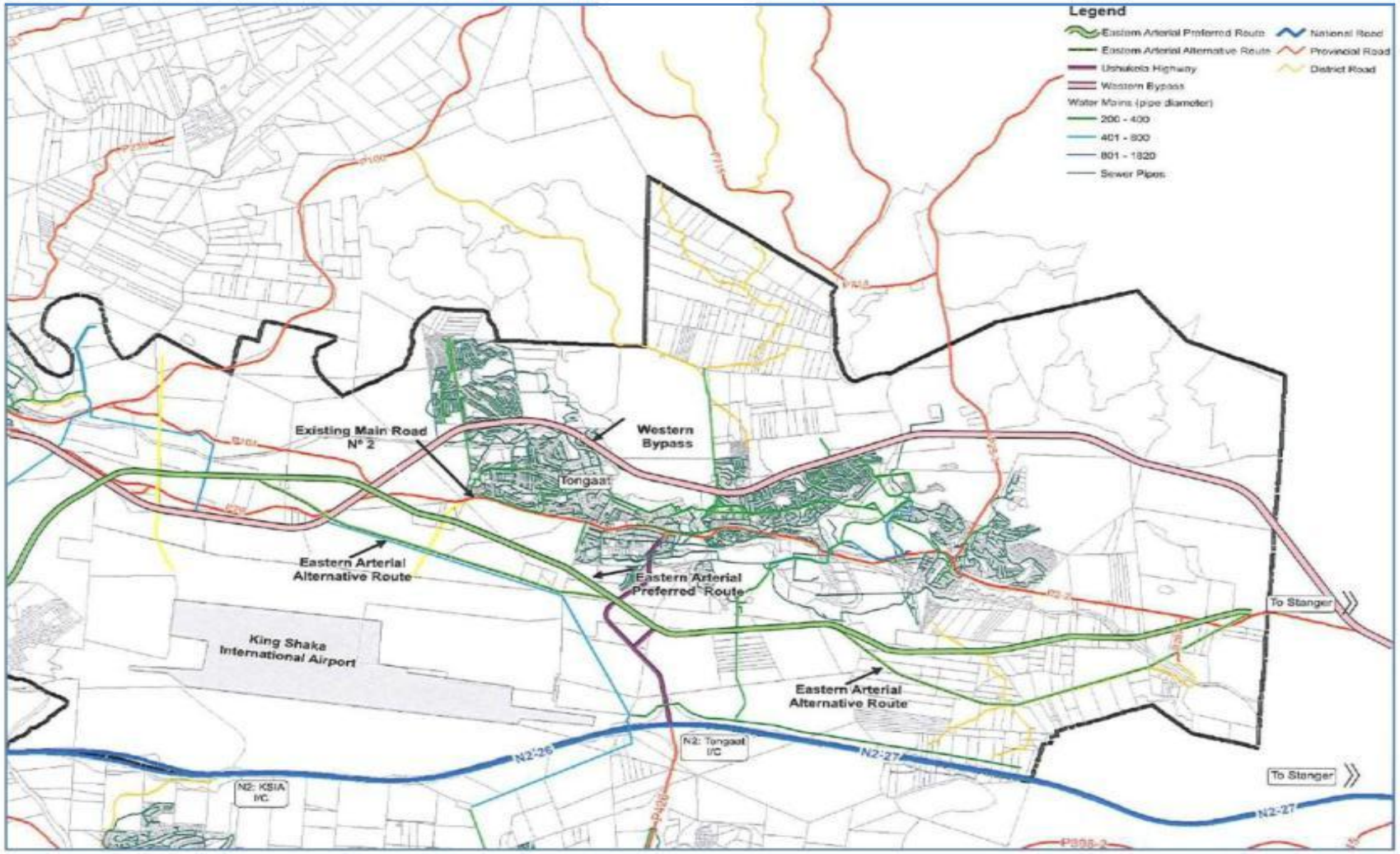


Figure 15: Western Bypass and Eastern Arterial (Source: SSI, 2010)

12. Conclusions

Tongaat-Hulett Developments and Dube Tradeport have formed a joint venture to develop a portion of land, approximately 431 000 m^2 of bulk area. The land is currently jointly owned by both companies. The proposed development is commonly referred to as the uShukela Drive Precinct Development. The uShukela Drive Precinct Development will be a multi-faceted development that will comprise of nine Trade Zones and a Conference Centre. Each Trade Zone will effectively comprise of Offices, Light Industry, Warehousing, Distribution and Manufacturing land use types.

Aurecon was commissioned by the joint venture to undertake a Traffic Study for the proposed uShukela Development which is located on a tract of land to the east of Tongaat and west of National Route 2 (N2). It is the primary intent of the developers of this project to symbiotically develop the land and the transportation system simultaneously such that the development can improve the economy, shape development patterns and influence the quality of life in the Tongaat Area.

It is envisaged that by 2017 the proposed uShukela Development will be 10% complete. By 2022 the development will attain 40% of its developmental potential. By 2027 the uShukela Development should be fully 100% complete.

The analysis of the existing traffic volumes in the base year showed that the R102 and the uShukela Drive links currently encounter mounting pressure during the peak hours and currently operate at a LOS E, under the prevailing traffic conditions in the base year, which is unacceptable. Most of the intersections within the study area currently operate at acceptable levels of service under the existing traffic conditions. However, there are turning movements at the N2 interchange eastern intersection and at the uShukela Drive / High Street intersection that operate at level of service E and will have to be addressed.

The analysis of the 5 year forecasted traffic volumes confirms that the uShukela Drive and R102 links will experience severe congestion, before any development-generated traffic is added onto the road network. These roads will operate at LOS E and LOS F during the peak hours purely as a result of the natural growth in the existing traffic volumes and therefore require upgrading to dual carriageway status.

The intersections within the study area display signs of distress in the 5 year horizon due to the natural growth in traffic volumes. Once the generated traffic from the uShukela Development and the Dube Tradeport are considered in the 5 year horizon, certain intersections will encounter high levels of congestion. The R102 and uShukela Drive intersection in particular will require major upgrading however this is not possible due to the space constraints adjacent to this intersection. Only minor upgrades to this intersection will be possible. Therefore, the introduction of the Brake Drive link will be highly beneficial in the 5 year horizon as this link will certainly alleviate the pressure on the road network within the

Tongaat CBD. Furthermore, the terminal intersections at the N2 interchange will also operate at poor levels of service and will require upgrading.

The analysis of the combined development-generated traffic volumes and the forecasted 10 year traffic volumes show that most of the surrounding road network (as upgraded in 2017) will have the capacity to handle the envisaged volumes of traffic. The intersection of uShukela Drive and High Street will be the only intersection within the study area that will require capacity upgrades in the 10 year horizon.

The analysis of the 15 year horizon revealed that 4 intersections within the study area will not have the capacity to cope with the demand required. As highlighted in Section 10.4, it is recommended that 3 of the 4 intersections be upgraded in the 15 year horizon. The link roads within the study area will have sufficient capacity and therefore will not require any upgrading.

Therefore, from a traffic perspective it is recommended that the uShukela Development be supported and approved.

Public transport usage in and through the uShukela Development must be given serious consideration into the future as this could drastically reduce the private vehicle flows discussed in the analyses tabled in this report. Measures such as the IRPTN (integrated rapid public transport network) will need to be applied to this northern area of eThekwini to ensure that unnecessary expenditure on private vehicle road network elements is contained.

Appendix 4: Ushukela – Watson Highway Development Site Stormwater Management Plan

BOSCH STEMELE

CONTRACT NO. 243/203 MARCH 2013

Tongaat Hulett DEVELOPMENTS

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uSHUKELA HIGHWAY

STORMWATER MANAGEMENT PLAN REVISION 2

Tongaat Hulett DEVELOPMENTS

dube tradePORT

uSHUKELA HIGHWAY

STORMWATER MANAGEMENT PLAN
REVISION 2

PROJECT No. : 243/203	**DATE**: March 2013
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DISCIPLINE: **STORMWATER MANAGEMENT PLAN**	

BOSCH STEMELE
• Consulting Engineers • Project Managers

QUALITY VERIFICATION

This report has been prepared under the control of the Bosch Stemele Quality Management System which meets the requirements of ISO 9001:2008 as independently certified by international auditors (Certificate No. 20705704/1)

Verification	Capacity	Name	Signature	Date
Checked by:	Lead Engineer	**A Knox**		12/4/13
Reviewed by:	Project Manager/Director	**C Kroeger**		17/4/13
Accepted by:	Client Authorised Representative	**R Wilkinson**		
Accepted by:	Client Authorised Representative			

uSHUKELA HIGHWAY

STORMWATER MANAGEMENT PLAN

REVISION 2

INDEX

I N D E X (contd.)

uSHUKELA HIGHWAY

STORMWATER MANAGEMENT PLAN

REVISION 2

1. INTRODUCTION

1.1. Description of the Development

The development is situated near Tongaat on the KwaZulu Natal north coast and falls within the jurisdiction of the eThekwini Municipality (see *Annexure A*). The proposed development consists of an industrial trade-zones, and minor mixed use precincts.

It is bounded by the N2 freeway and Toll Plaza to the east, the uShukela Drive (Watson Highway) to the north and the Hlawe River in the west.

Tongaat Hulett Developments and Dube Tradeport currently own the land making up the development area, and propose to jointly plan the development of the land.

The site is approximately 136 ha in size.

1.2. Purpose of the Stormwater Management Plan

The purpose of this document is to provide a guideline policy for the holistic management of stormwater for the overall development of the site.

This SWMP has the following purposes:

- To ensure compliance of the overall site with relevant legislation from a stormwater runoff perspective,
- To provide a practical and achievable plan and methodology of managing stormwater runoff from site,
- To protect the health, welfare and safety of the public from damage by stormwater and floods,
- To protect against property damage from stormwater and floods,
- To prevent erosion of soil by runoff,
- To conserve the fauna and flora of the natural environment including wetland and riparian zones,
- To protect and enhance the natural water resources in the sub catchments from pollution and siltation, and
- To develop a conceptual surface water runoff management policy.

1.3. Current Use & Topographical Features of the Site

The development will take place on existing cultivated farmland (sugarcane).

The area is relatively undulating with slopes ranging from between 5% up to 20% in certain places. It is also characterised by a number of small tributaries, with the bulk of them draining to the Hlawe River. The site is mostly divided into two primary sub-catchments which drain north and west to existing wetland features. A smaller sub-catchment drains to the east which eventually links up to the northern wetland.

Sub-surface conditions are dominated by the Berea Red formation of deep loose sands overlying firm clayey sands, with a smaller portion of the area consisting of the Vryheid Formation of siltstones and sandstones where firm to stiff sandy clays and clayey silts overlay soft siltstone and mudstone, inter-bedded with sandstone.

1.4. Proposed Use

The proposed developed will "flatten" out the current steep grades and make provision for a number of platforms with overland slopes in the region of 2% to 5%. The proposed platforms will be linked by internal access roadways between platforms. The proposed topography of the development will retain in general the north/west sub-catchment drainage areas.

1.5. Legal Requirements

The management of stormwater on site is governed by two main acts:

- National Water Act (36 of 1998) which deals with pollution control and the protection of existing watercourses, and
- National Environmental Management Act (107 of 1998) which deals with compliance and duty of care and remediation to the existing environment.

This SWMP includes recommendations for compliance to the applicable legislation.

1.6. Local Authority Requirements

The eThekwini Municipality design guidelines and policy for the design of Stormwater Drainage and Stormwater Management Systems (May 2008) has been incorporated in this Management Plan.

2. MANAGEMENT RESPONSIBILITIES

2.1. Stormwater Management

The development's bulk stormwater infrastructure will be developed by Tongaat Hulett Developments/Dube Tradeport, and will include all stormwater infrastructure within the open spaces and road reserves, and that connecting road reserves to open spaces via servitudes.

On completion, these facilities will be handed over to Ethekwini Municipality who will then become responsible for their operation and maintenance.

The purchasers/developers of the individual sites will be responsible for construction of the on-site stormwater facilities to the standards required by Tongaat Hulett Developments/Dube Tradeport, and approved by the Ethekwini Municipality. The Ethekwini Municipality will then assume responsibility for stormwater discharge from the sites.

A management association for the whole development will be constituted by Tongaat Hulett Developments/Dube Tradeport when the conditions of establishment of the first phase are met.

This management association may, in agreement with Ethekwini Municipality, perform operations and management functions including monitoring stormwater management on the individual properties, as well as the operation and management of stormwater facilities falling outside these individual properties.

3. EXCLUSIONS

The following are excluded from the SWMP:

- The SWMP provided a holistic overview of stormwater management on site. A more detailed layout and operation of the stormwater system would need to be defined in the detail design of the development,
- This SWMP excludes the delineation of wetland and river areas (undertaken by Wetland Consulting Services (Pty) Ltd.), and
- The determination of floodlines is excluded from this SWMP. The development proposal is situated significantly above any 1:100 year floodlines in the area and won't be affected by any floodlines. For reference Ethekwini determined floodlines are indicated on the appropriate drawings in the annexures.

4. MAJOR IDENTIFIED RISKS

The major risks applicable to this development are as follows:

4.1. Potential Flooding

The development of the area will result in increased "hardening" of the area (i.e. increased impermeable surface areas). This will result in increased overland runoff that will have to be catered for. Potential risks include flooding of on-site facilities (proposed industrial facilities, etc) as well as off-site (existing access roads, wetland areas and existing downstream properties).

4.2. Erosion

An increase in runoff will result in the increased likelihood of erosion. Based on the preliminary geotechnical investigation report, the site is overlain by loose sands which have a high erosion potential.

4.3. Pollution

The development of the area to primarily light industrial trade-zone uses will increase the risk of pollution, especially to the existing wetlands and river. Primary anticipated increased pollution includes hydrocarbons from vehicles, total suspended solids (TSS) from the light industrial portion of the development and domestic waste from the office and ablution components. In addition pollution from construction materials for the proposed development and associated facilities is also a potential risk.

4.4. Sedimentation

Accumulated material on hardened surfaced which is transported to the existing wetlands during storm events can lead to a build up of transported material in the wetlands. This material normally contains the bulk of the pollutants.

4.5. Environmental Impacts

The wetland receives water from the existing property via overland runoff and subsurface drainage through the perched water table of the more clayey sands (between the Berea Red and Vryheid Formation). Improper management of stormwater on site could negatively affect these areas by insufficient recharging of the wetlands.

5. DESIGN PHILOSOPHY

5.1. Stormwater System

The stormwater system for the proposed development must take cognisance of the impacts of both the minor and major stormwater system in terms of runoff, potential flooding, wetlands recharging, stormwater attenuation etc.

The minor stormwater system consists of all measures to address runoff from individual sites and road reserves, buildings and car lots to the major stormwater system. This includes kerbing, gutters, conduits, channels, infiltration systems etc. The minor system normally deals with low/medium rainfall events with high occurrence intervals (normally up to a once in 2 or 5-year interval) which are likely to cause a level of nuisance to users if not controlled. For this development it is proposed that the minor system on all individual sites be designed to handle a 1 in 5-year storm event.

The major stormwater system will consist of the natural waterways, wetlands and streams draining in a generally western and northern direction. It also includes attenuation dams and other structures to control stormwater runoff. The major system also controls runoff for high rainfall events with low occurrence intervals (usually 1 in 10 years or longer as in this case) with a high risk of flooding.

For this development it is proposed that the major system be designed to handle a 1 in 50-year storm event. Cognisance is to be taken though of risks by storms of a higher magnitude (i.e. 1 in 100-year).

As such the design philosophy for the minor and major stormwater system should allow for the following:

- Restrict stormwater flow to within a 10% increase of the pre-development flows using attenuating devices such as attenuation dams/structures or infiltration devices,
- Prevent the concentration of stormwater runoff at any point where erosion is a possibility. This will be prevalent near areas with high impermeably (roof structures, large surfaced areas) and embankments.
- Avoid ponding on site, especially near building structures,
- Avoid destabilisation of existing and proposed embankments,
- Ensure compliance to local authority standards,
- Construction of pollution reducing systems, and
- Ensure that the construction of stormwater control systems is executed in a safe and acceptable manner.

In addition the design philosophy should cater for other environmental factors that are potentially impacting on the surrounding habitat. The most important aspect is the recharging of the natural wetlands.

5.2. Conceptual Stormwater System Management for Individual Sites

The extent of proposed platforming on the site makes it more suitable to manage minor storm events on the individual site platforms instead of discharging directly to the wetlands and stream. Cognisance of recharging of the natural streams is to be taken into account as well.

As such it will be required that:

- Runoff from individual sites be limited to within an increase of less than 10% of the pre-development runoff for a 1:5-year storm event.
- Allowance be made to retain the first 25mm of precipitation for any storm event on the individual sites for infiltration and recharging of the wetlands and stream. Retaining this first 25mm can be done via various approved attenuation devices (storage tanks, permeable paving, swales, irrigation ponds etc).

The design and implementation of these measures will be the responsibility of the entity that develops each individual site, with the designs requiring approval by both the management association and the Ethekwini Municipality.

Runoff in excess of the above requirements is to be routed to defined points exiting the sites on roadways and streams, and attenuated to pre-development levels via attenuation devices (attenuation ponds, buffer dams etc).

5.3. Pollution Control

Section 4.3 deals with potential pollutant impact by the proposed development. Measures to be applied to reduce pollutants include bio-attenuation swales, artificial wetlands and infiltration measures. These measures will be applied at the point source (individual sites and road reserves) as far as possible.

5.4. Concept Stormwater Modelling Parameters

5.4.1. *Rainfall Data*

The following depth-duration-frequency rainfall data was used for the development:

Table 1: Local Depth Duration Frequency Rainfall

Station	Frasers (SAWB 241302)					
MAP	971mm					
Rainfall	1-Day Design Rainfall (mm)					
Duration (Days)	2	5	10	20	50	100
1	84	122	153	188	241	287

5.4.2. *Design Storm Frequencies*

The following design storm frequency is to be used:

i) Minor stormwater system: 1 in 5 year frequency (the proposed development is predominantly industrial & commercial in use and a smaller design return period is not advisable as it will lead to more periodic nuisance flooding).

ii) Minor stormwater system - pollution control: 25mm precipitation within a 24-hr period.

iii) Minor stormwater system wetlands recharging: 25mm precipitation within a 24-hr period.

iv) Major stormwater system/pollution control: 1 in 50 & 10 year frequency. Building floor levels to be above the 1:100 year flood level. Cognisance is to be taken of risks for a 1:100 year flood event.

5.4.3. *Runoff Generation*

Due to the size of the catchment the SCS instead of the Rational Formula was used to calculate runoff. Runoff was thus calculated using the Autodesk Storm and Sanitary Sewer Analysis Package that utilises the EPA SWMM analysis engine.

Parameters used are as follows:

Table 2: SWMM Modelling Parameters

Hydrology Method	SWMM
Distribution Curve	SA SCS Type 2
Link Routing	Kinematic Wave
Pre-development Weighted SCS Curve No.	Various
Post-development Weighted SCS Curve No.	Various
Conduit Manning's roughness factor	0.015
Stream Manning's roughness factor	0.032

The SCS curve numbers selected for use are discussed in detail in Bosch Stemele's report on catchment hydrology dated October 2012 which is included in its entirety as *Annexure E*.

For the development of the individual sites, 60% of the coverage will be hard surfaces (roofs) with 30% parking and 10% soft landscaping for the post-development runoff. Once the development proposals are finalised further adjustments can be made to fine tune expected runoff figures.

It is expected that due to the platforming earthworks operations and compaction efforts that infiltration be significantly reduced from the current scenario. The overall layout of the soils formation in the area (see the Catchment Hydrology Report – *Annexure E*) and the formation of platforms suggests that the bulk of the proposed development will be constructed on the silty clayey Vryheid formation soils. The SCS curve numbers thus adopted are as follows:

- Roof areas – 98,
- Impermeable traffic surfaces – 98
- Soft landscaping (incl. open areas in road reserves) – 80
- Undeveloped areas - 80

Subsequent changes to the layout must be taken into account and runoff recalculated before commencing with detail designs of the stormwater system.

5.4.4. *Subcatchment Runoff*

Annexure B contains a tabulated summary of expected runoff flows for the pre-development scenario. Also included in *Annexure B* are *Dwg. 243/203/022* showing the pre-development subcatchments, and *Dwg. 243/203/023* indicating the expected pre-development flows for the various sub-catchments.

Due to the extensive earthworks reshaping form the individual platforms, the drainage subcatchments are modified in extent. A direct comparison of subcatchments runoff for the pre- and post-development scenarios is therefore not possible.

Annexure C contains *Dwg. 243/203/024* which depicts the post-development subcatchments, as well as a tabulated summary of expected runoff flows for the post-development scenario. The anticipated runoff for the 1:2, 1:5, 1:10, 1:50 & 1:100 year storm events for the post-development sub-catchments is shown on *Dwg. 0243/203/025* (also in *Annexure C).*

5.5. Proposed Attenuating Measures

For the attenuating of stormwater runoff to predevelopment flow, a dual approach is to be considered.

5.5.1. *Attenuation Ponds*

The most common stormwater management method to intercept runoff and reduce flow to pre-development levels in hardened areas is through the use of attenuation ponds. Drawings illustrating the stormwater management are included in *Annexure D*.

They include *Dwgs. 0243/203/026 & 027* showing stormwater drainage proposals and the positioning of attenuation ponds required to handle major events including platform links to the ponds.

It is proposed that the attenuation pond walls be constructed using gabion type structures (*see Dwg. 0243/203/028)* or concrete masonry and lined with gunnite for additional protection. This will provide a more "natural looking" appearance to the landscape.

Dwg. 0243/203/029 shows the proposed method of roadways crossing stream lines.

A summary of the attenuation pond requirements is indicated on Table 3:

Table 3: Attenuation Pond Requirements

Catchment Reference	Size
RPF4B	1, 449m³
RPF16A	675m³
STR4	4, 015m³
STR2 (two ponds)	9, 037m³
STR9	2, 156 m³
Total attenuation requirement	17, 332m³

5.5.2. *Infiltration Measures (permeable surfacing, soakaways)*

To ensure maximisation of groundwater recharging, it is recommended that infiltration measures be constructed on the platformed sites. The eThekwini Municipality guidelines for soakaways for 1m³ of storage per 40m² of hardened land will be sufficient to allow the infiltrating of 25mm precipitation in the platformed areas. Based on a conceptual 60% hardening to roof structures, 30% paving and the remainder soft landscaping, this equates to 225m³ of storage for each hectare of hardened area.

It is recommended that interception of roof runoff be retained within the paving areas via permeable paving. Based on a 30% voids ratio in stone this would equate to a 250mm stone layer thickness. Note that the above won't reduce peak runoff volumes which would still have to be managed by the major storm system.

5.5.3. *Major Stormwater Runoff Control*

Where embankments are constructed, careful consideration will have to be applied to prevent erosion of the embankment face. No water may be permitted to run off from the platform down the embankment face, either in sheet flow or concentrated form. In this regard it is recommended that kerbing is constructed upstream of embankment slopes to divert flow away to an underground conduit or stabilised channel and on to the existing major stormwater system.

The outlet to the major stormwater system will only be allowed at developer specified outlet points. Energy dissipaters will be required where erosion is a possibility.

5.5.4. *Roadways*

Due to the large open nature of the development, the road reserves form a relatively small portion of the total area and thus do not contribute significantly to runoff.

Although roadways will be impermeable surfaces, runoff will be directed to roadside swales for infiltration. An overall layout showing the conceptual attenuation ponds, swales and internal stormwater pipework is shown on *Dwg. 0243/203/027.*

5.6. Wetlands Recharging

An assessment of the pre- and post-development scenario was undertaken to determine the impact that the development would have on groundwater and surface water recharging of the existing wetlands and streams. The assessment was based on a storm event with 25mm precipitation over a 24-hour period.

Table 4: Expected Groundwater Infiltration

Pre-development	41, 184m^3
Post-development combined	32, 770m^3

From the above nearly 80% of runoff for minor storm events will infiltrate into the soil to the wetlands within a 24-hour period. The remaining 20% will enter the wetlands area via overland flow.

Careful consideration must be given that the soakaways are not constructed on a perched water table. Should this be the case, outlets to the soakaways can be constructed to drain towards areas with higher infiltration potential.

5.7. Special Considerations

5.7.1. *Subcatchment RPF4B*

This subcatchment drains towards the uShukela Highway and the proposed hardening will lead to an increase in runoff leading to the roadway. The existing canal next to the roadway won't be able to cope with a major storm event. An attenuation pond with a capacity of approximately 1, 449m^3 will be required next to the highway to reduce flow to pre-development runoff.

5.7.2. *General Embankment protection*

The proposed platform embankments are in general at a slope of 1:2. Due to the sandy nature of soil on site, there is potential for erosion of the embankment face. Specific measures will therefore be required to minimise runoff from the platforms to the embankments, especially for large storm events.

Even with the bulk of overland runoff being redirected via kerbing or a berm, a certain level of erosion can be expected from precipitation on the embankments. It is recommended that these embankments be stabilised as soon as possible during the construction phase by placing of erosion protection measures and planting.

6. SITE ESTABLISHMENT AND PRELIMINARY ACTIVITIES

The following general conditions must be adhered to and maintained during the site establishment and preliminary activities of the project.

6.1. Existing Stormwater Systems

All existing drainage systems (streams, channels) are to be maintained by the main developer in accordance with normal agricultural soil conservation practices and local authority guidelines as far as possible (except where the town planning layout makes provision for the development of land over existing drainage systems).

6.2. Access Routes

Access routes to the construction site must follow the existing access roads as far as possible. Should new access roads be required these must be constructed in a way to minimise concentrated flow runoff and pollution to the existing wetlands.

6.3. Contractors Site Camp

The clearing of vegetation for the contractor's site camp is to be limited to the site camp area only.

The creation of hardened surfaces within the site camp area is to be kept to a minimum and is to be agreed to by the Engineer prior to construction.

Any soil or topsoil stockpiles created during site establishment are to be maintained as flat as possible, with no side slope greater than 1 in 4. The stockpiles are to be covered with cut brush found on site to provide wind screening and prevent soil loss.

7. CONSTRUCTION STAGE ACTIVITIES

7.1. Programming

Stripping of vegetation to allow commencement of construction of the earthworks platform shall only be undertaken immediately prior to that element of construction commencing.

Construction of the embankment shall be done in segments up to full height, before moving on to the next area, clearing vegetation, and constructing embankment, etc.

The construction of internal stormwater piped systems are to be programmed for construction immediately on completion of the bulk earthworks for the road works.

7.2. Stockpiles

Any soil or topsoil stockpiles created during the construction phase are to be maintained as flat as possible, and shall not exceed 6m in height. Materials from stockpiles are to be used as soon as is practically possible or spread and spoiled in designated areas.

7.3. Haulage and Temporary Access Roads on Site

Construction vehicles must be restricted to demarcated access routes and turning areas.

7.4. Exposed Surfaces

To minimize the time that an area is exposed, the stripping of vegetation is to be carried out progressively and immediately prior to commencement of construction activities in a particular area.

Topsoiling and re-vegetation of exposed surfaces is to commence immediately after the completion of all construction activity.

All embankments or cut slopes, unless otherwise directed by the Engineer, shall be protected by a cut off drain to prevent water from cascading down the face of the slope.

7.5. Stormwater Systems

No dumping of construction rubble or spoil is to occur in completed stormwater drains, pipes, channels or natural drainage lines (existing wetland, stream, & riparian zone).

Weekly checks are to be carried out on the site's drainage system to ensure that the water flow is unobstructed. These are to be repaired or cleared of silt if required.

7.6. Contract Completion

All undeveloped surfaces hardened due to construction activities are to be ripped, topsoiled and vegetated as soon as possible.

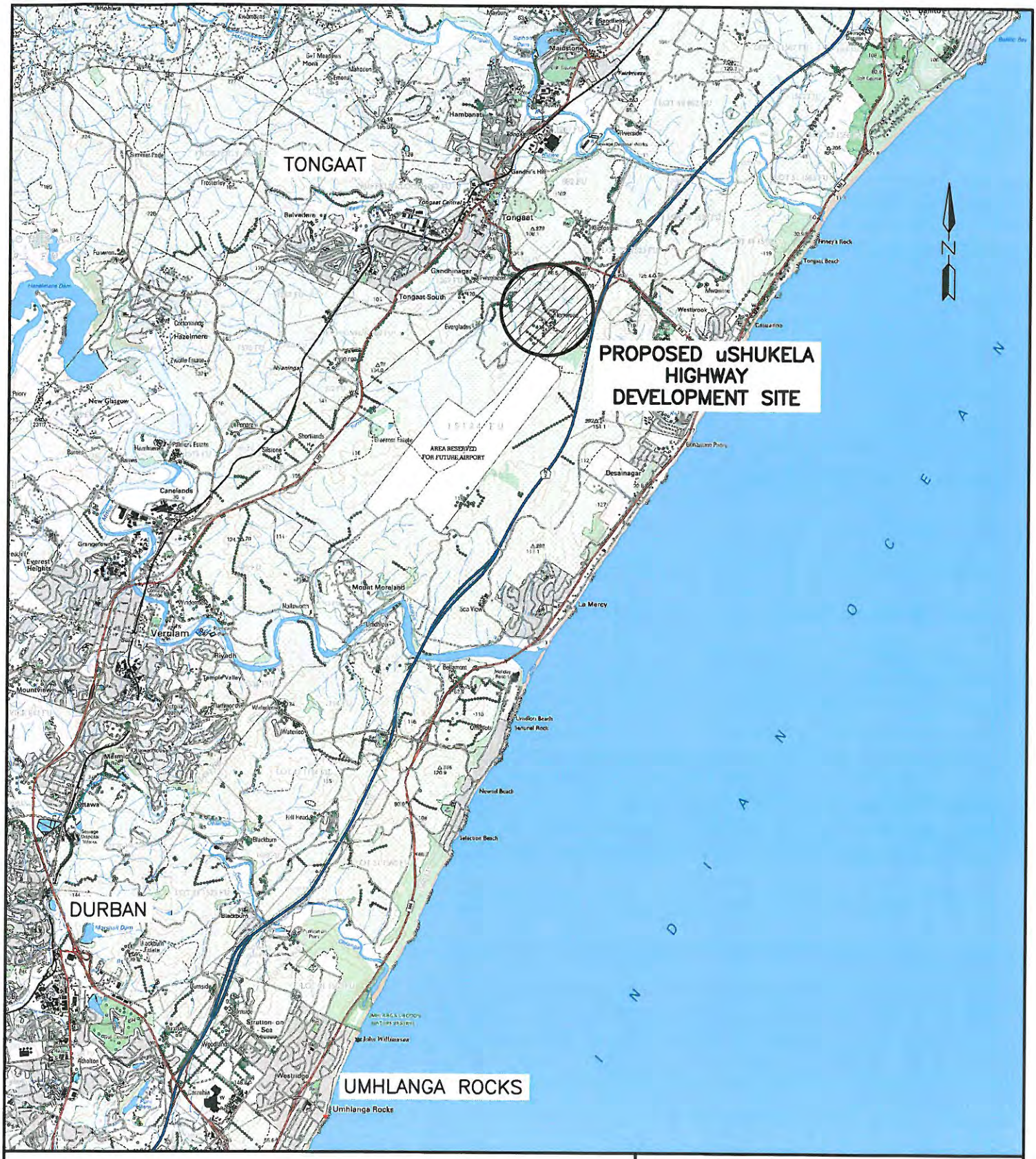
8. MAINTENANCE

See *Annexure F* relating to Operation & Maintenance.

Prepared by L. Streicher
Bosch Stemele (Pty) Ltd

ANNEXURE A:

LOCALITY PLAN
DWG NO. 243/203/21



TONGAAT HULETT DEVELOPMENTS/ DUBE TRADE PORT uSHUKELA HIGHWAY

LOCALITY PLAN

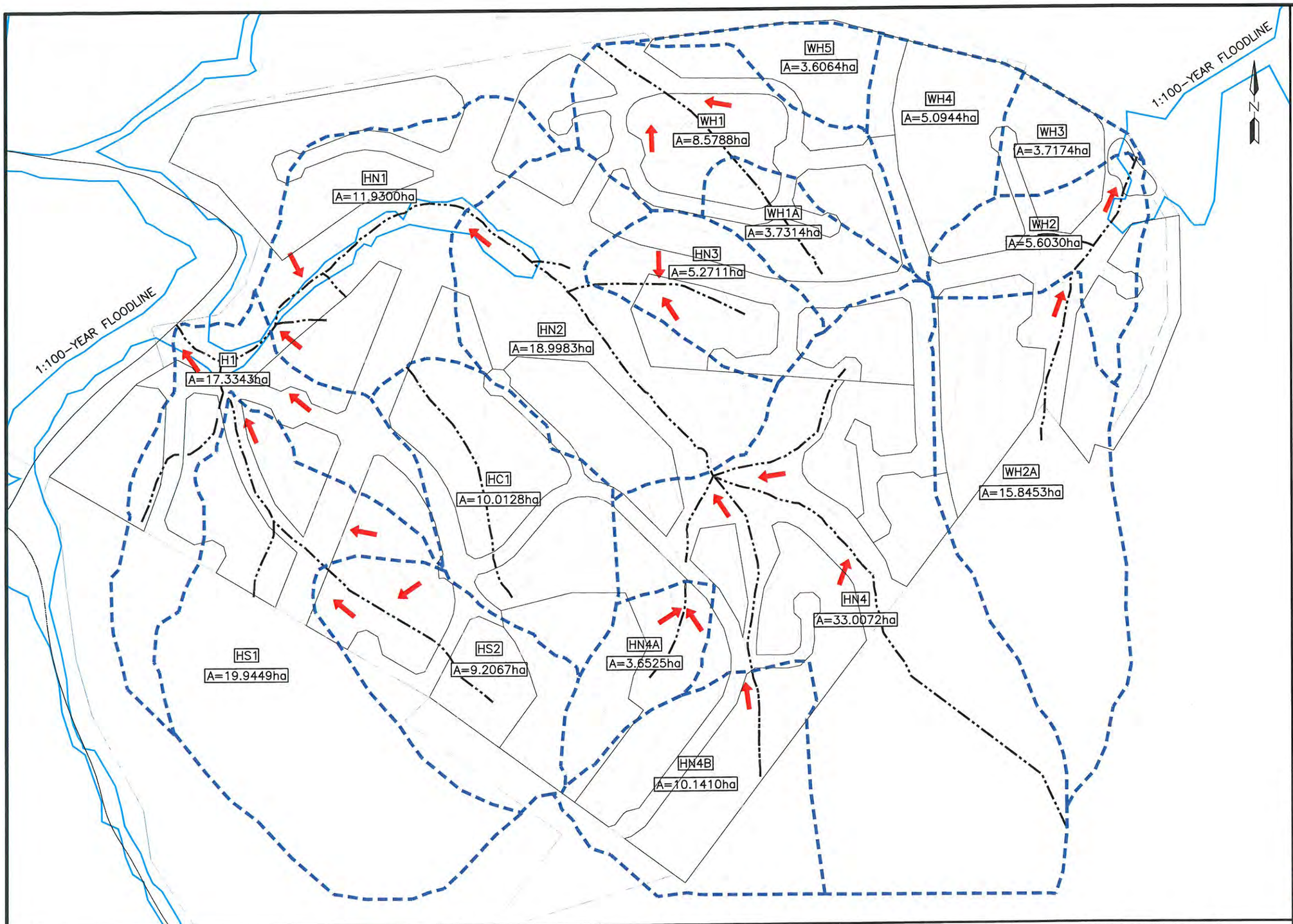
BOSCH STEMELE
Consulting Engineers • Project Managers
ISO 9001:2008 CERTIFIED

DESIGNED	L.S	APPROVED	
DRAWN	S.M		
CHECKED	G.C	DRAWING No.	REV
SCALE	NTS	243/203/021	01
DATE	05/12/2011		

ANNEXURE B:

PRE-DEVELOPMENT RUNOFF DATA

DWG NO'S:
243/203/22
243/203/23



LEGEND

- OVER FLOW PATH
- WH2 SUB-CATCHMENT No.
- MAIN CATCHMENT BOUNDARIES
- 1:100-YEAR FLOODLINE

REV.	DESCRIPTION	DATE	APPR'D
01	FOR REPORT	07/02/13	
0	FOR REPORT.	15/05/12	

DESIGNED L.S
DRAWN S.M
CHECKED G.C

APPROVED

PROJECT MANAGER

DIRECTOR

SCALE NTS

DATE 15/05/12

TONGAAT HULETT DEVELOPMENTS/ DUBE TRADEPORT USHUKELA HIGHWAY

PRE-DEVELOPMENT SUBCATCHMENT AREAS - LAYOUT PLAN

DRAWING NUMBER 243/203/022

A3

REVISION 01

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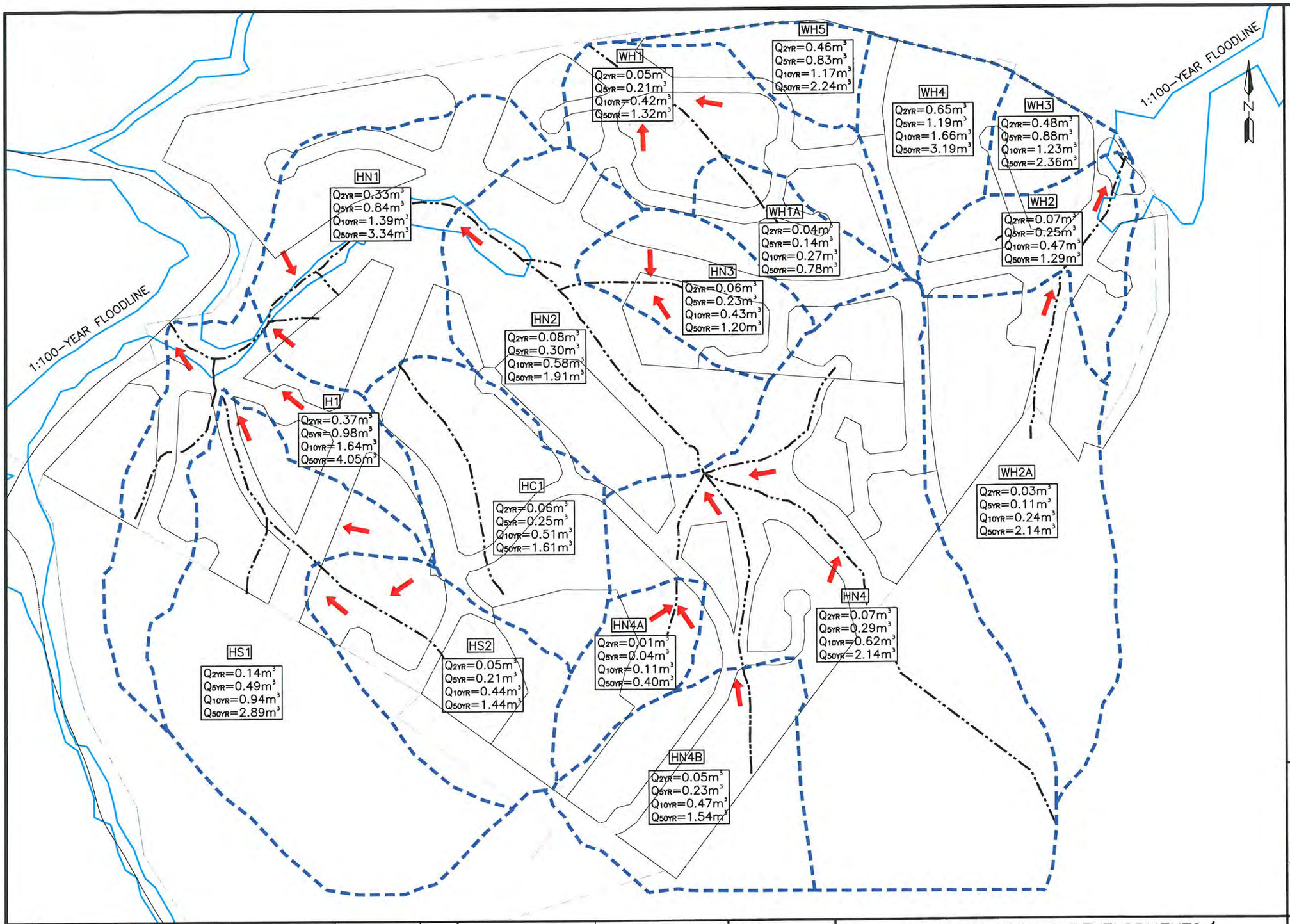

LEGEND

- OVER FLOW PATH
- WH2 SUB–CATCHMENT No.
- MAIN CATCHMENT BOUNDARIES
- 1:100–YEAR FLOODLINE

REV.	DESCRIPTION	DATE	APPR'D
01	FOR REPORT	07/02/13	
0	FOR REPORT.	15/05/12	

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DRAWN S.M
CHECKED G.C

APPROVED

PROJECT MANAGER

DIRECTOR

SCALE NTS

DATE 15/05/12

TONGAAT HULETT DEVELOPMENTS/ DUBE TRADEPORT uSHUKELA HIGHWAY

EXPECTED:

PRE–DEVELOPMENT SUBCATCHMENT FLOWS – LAYOUT PLAN

DRAWING NUMBER 243/203/023

A3

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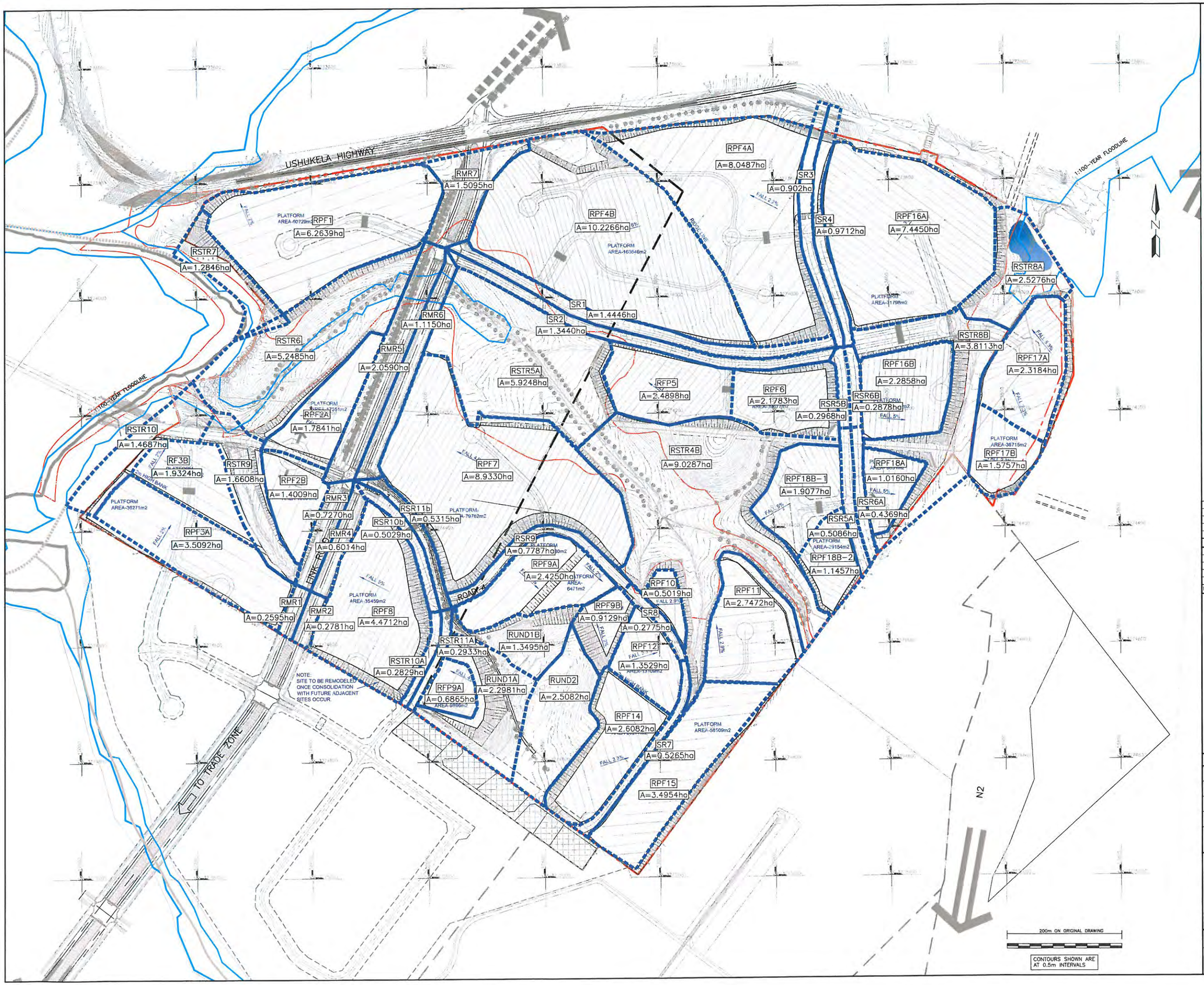
ANNEXURE C:

POST-DEVELOPMENT RUNOFF DATA

DWG NO'S:
243/203/24
243/203/25



LEGEND

- SUB-CATCHMENT BOUNDARY
- 1:100-YEAR FLOODLINE
- A=2.2858ha SUB-CATCHMENT AREA

REV.	DESCRIPTION	DATE	APPR'D
01	FOR REPORT	07/02/13	
0	FOR REPORT.	15/05/12	

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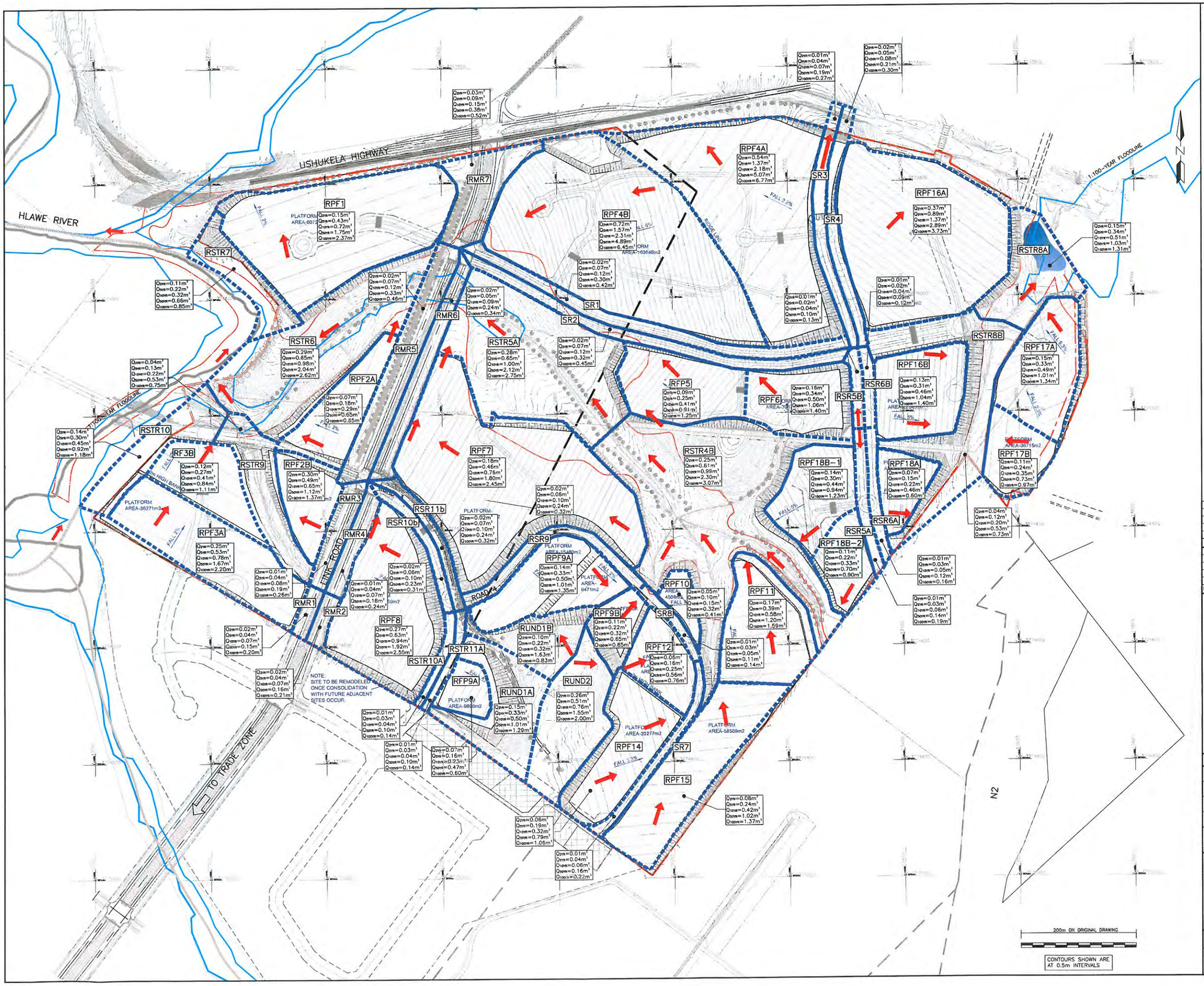
DESIGNED	L.S	DRAWN	S.M
CHECKED	G.C	CIVIL ENGINEER	L.S
STRUCTURAL ENGINEER	N/A	MECHANICAL ENGINEER	N/A
ELECTRICAL ENGINEER	N/A	CO-ORDINATION ENGINEER	N/A

APPROVED _____ PROJECT MANAGER _____ DIRECTOR

TONGAAT HULETT DEVELOPMENTS/ DUBE TRADEPORT uSHUKELA HIGHWAY

POST DEVELOPMENT SUBCATCHMENT LAYOUT PLAN

SCALE	1 : 3000	DATE	05/12/11
DRAWING NUMBER	243/203/024	A1	REVISION 01



LEGEND

- OVER FLOW PATHS
- NATURAL DRAINAGE ROUTES
- SUB-CATCHMENT BOUNDARIES
- 1:100-YEAR FLOODLINE

REV.	DESCRIPTION	DATE	APPR'D
01	FOR REPORT	07/02/13	
0	FOR REPORT.	11/05/12	

DRG. No. REFERENCE DRAWING

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DESIGNED	L.S	DRAWN	S.M
CHECKED	G.C	CIVIL ENGINEER	L.S
STRUCTURAL ENGINEER	N/A	MECHANICAL ENGINEER	N/A
ELECTRICAL ENGINEER	N/A	CO-ORDINATION ENGINEER	N/A

APPROVED _____ PROJECT MANAGER _____ DIRECTOR

TONGAAT HULETT DEVELOPMENTS/ DUBE TRADEPORT uSHUKELA HIGHWAY

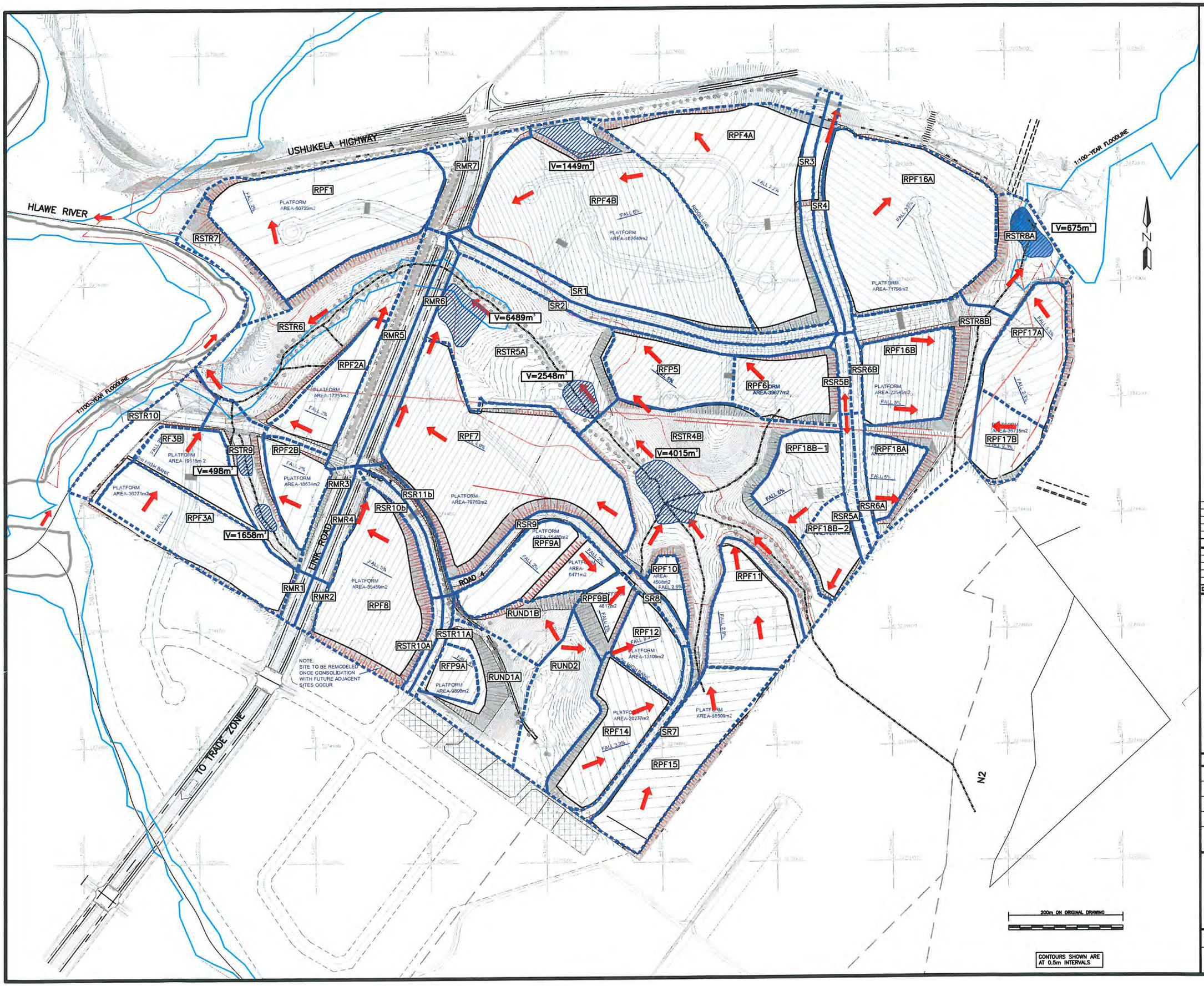
EXPECTED: POST DEVELOPMENT SUBCATCHMENT RUNOFF

SCALE	1 : 3000	DATE	05/12/11
DRAWING NUMBER	243/203/025	A1	REVISION 01

ANNEXURE D:

DWG NO'S:

243/203/26
243/203/27
243/203/28
243/203/29



LEGEND

- V=9579m³ — RETENTION PONDS REQUIREMENTS
- OVER FLOW PATHS
- NATURAL DRAINAGE ROUTES
- SUB-CATCHMENT BOUNDARIES
- 1:100-YEAR FLOODLINE

REV.	DESCRIPTION	DATE	APPR'D
01	FOR REPORT	07/02/13	
0	FOR REPORT.	11/06/12	

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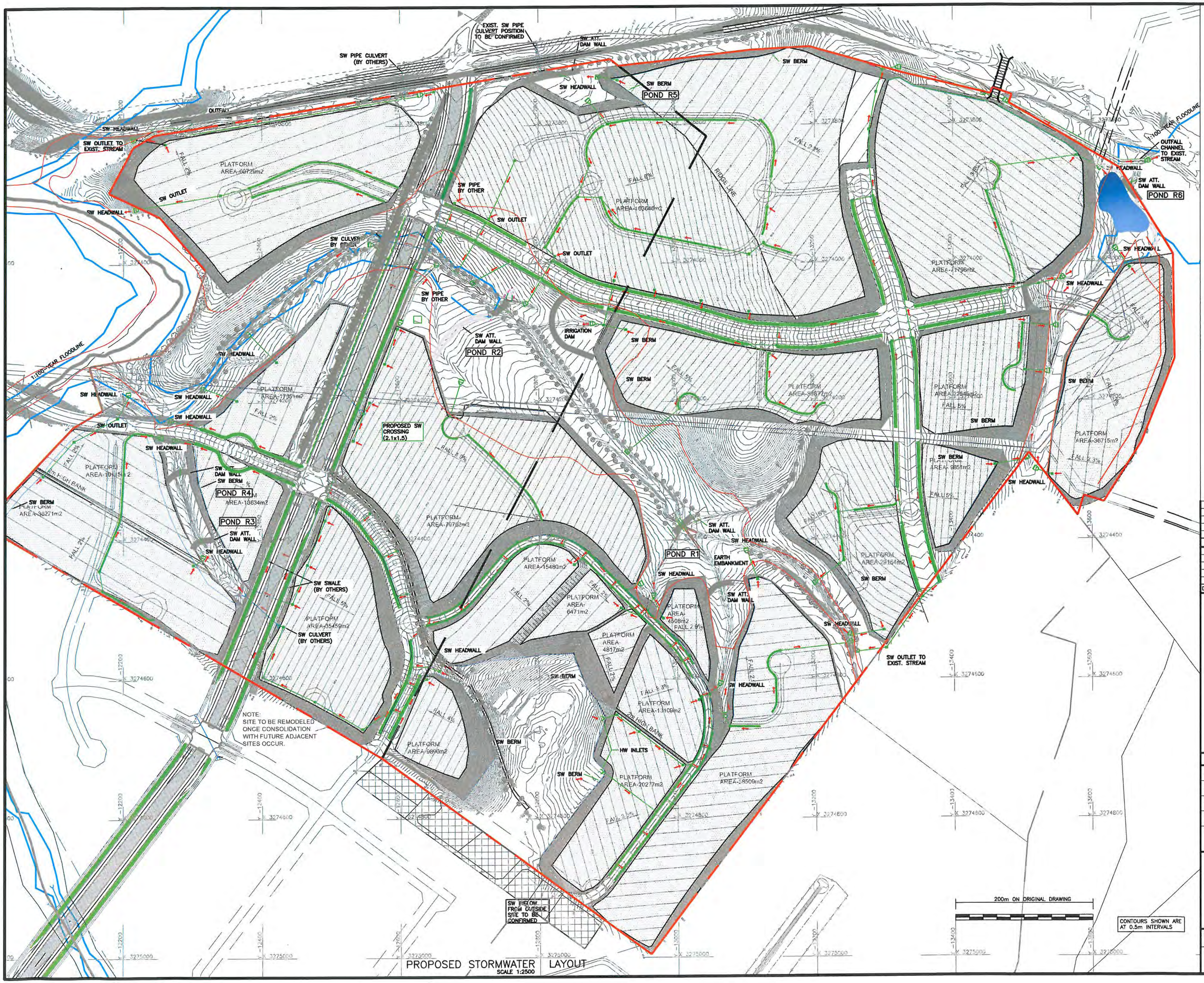
DESIGNED	L.S	DRAWN	S.M
CHECKED	G.C	CIVIL ENGINEER	L.S
STRUCTURAL ENGINEER	N/A	MECHANICAL ENGINEER	N/A
ELECTRICAL ENGINEER	N/A	CO-ORDINATION ENGINEER	N/A

APPROVED _____ PROJECT MANAGER _____ DIRECTOR

TONGAAT HULETT DEVELOPMENTS/ DUBE TRADEPORT uSHUKELA HIGHWAY

PROPOSED RETENTION POND REQUIREMENTS

SCALE	1 : 3000	DATE	05/12/11
DRAWING NUMBER	243/203/026	A1	REVISION 01



REV.	DESCRIPTION	DATE	APPR'D
01	FOR REPORT	07/02/13	
0	FOR REPORT.	15/5/12	

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STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		CO-ORDINATION ENGINEER	
APPROVED	PROJECT MANAGER		DIRECTOR

TONGAAT HULETT DEVELOPMENTS/
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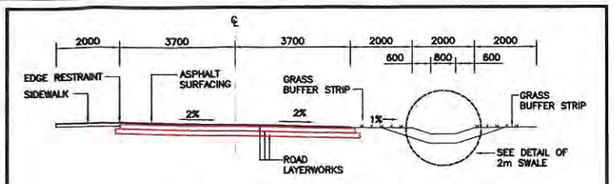
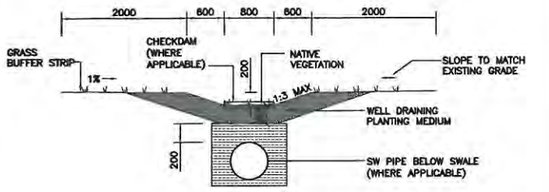
uSHUKELA HIGHWAY

PROPOSED BULK & INTERNAL STORMWATER LAYOUT

SCALE	1:2500	DATE	15/05/2012
DRAWING NUMBER	243/203/027	A1	REVISION 01

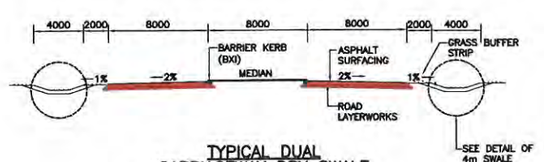


TYPICAL SINGLE CARRIAGEWAY SWALE CROSS-SECTION
SCALE 1 : 100

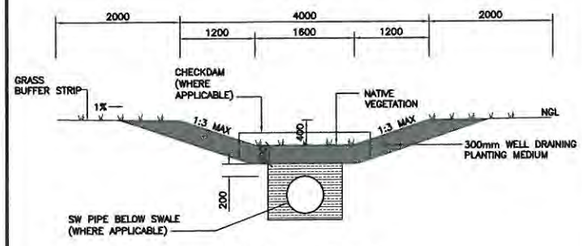


2m SWALE DETAIL
SCALE 1 : 50

TYPICAL SINGLE CARRIAGEWAY SWALE CROSS-SECTION & DETAIL

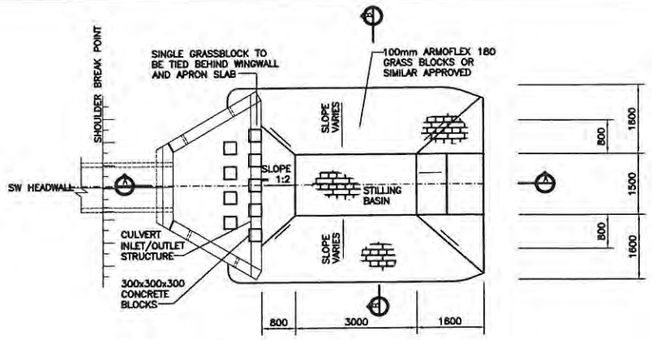


TYPICAL DUAL CARRIAGEWAY DRY SWALE CROSS-SECTION
SCALE 1 : 250



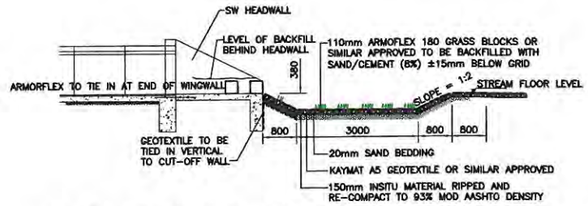
4m SWALE DETAIL
SCALE 1 : 50

TYPICAL DUAL CARRIAGEWAY DRY SWALE CROSS-SECTION & DETAIL

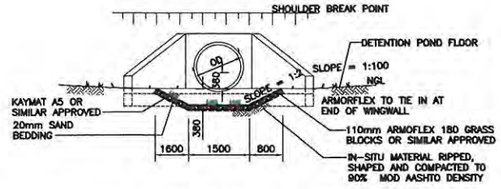


NOTE:
STILLING BASIN DIMENSIONS FOR PIPES UP TO 750mmø

HEADWALL & STILLING BASIN DETAIL
SCALE 1: 75

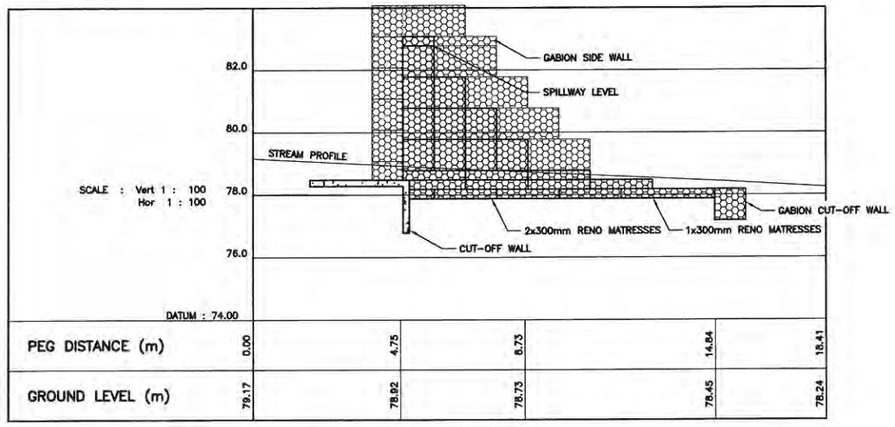


TYPICAL STILLING BASIN DETAIL UPSTREAM OF LOW FLOW CHANNEL SECTION (B)
SCALE 1: 75



TYPICAL LOW-FLOW CANAL SECTION
SECTION (B)
SCALE 1: 75

TYPICAL HEADWALL STILLING BASIN DETAIL (PIPES UP TO 750mmø)



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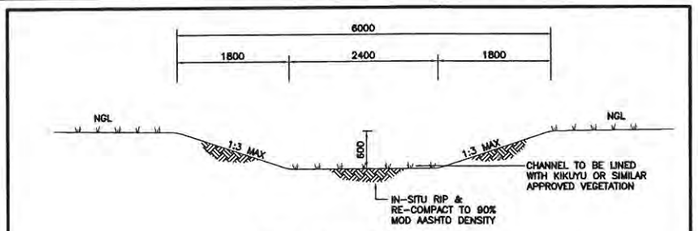
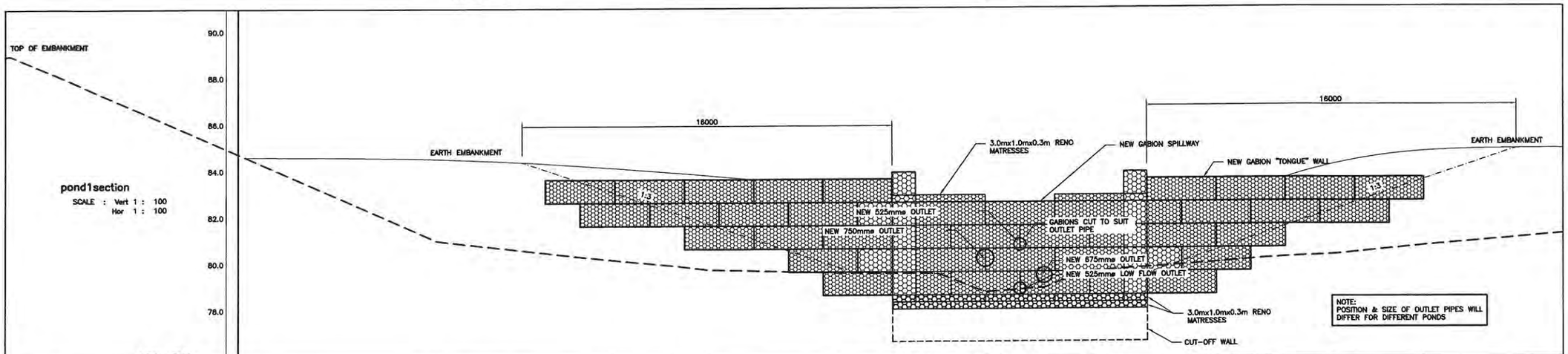
GROUND LEVEL (m)	79.17	78.92	78.73	78.45	78.24

TYPICAL SECTION THROUGH ATTENUATION POND CENTRE SECTION (POND R1)
SCALE: SEE ABOVE



OPEN CHANNEL DETAIL:
ADJACENT TO WATSON HIGHWAY
SCALE 1 : 50



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GROUND LEVEL (m)	89.03	81.15	80.42	80.07	79.89	79.74	79.70	79.18	78.90	78.85	79.09	79.76	80.12	80.31	80.45	80.83

TYPICAL FRONT ELEVATION OF ATTENUATION POND (POND R1)
SCALE: SEE ABOVE

REV.	DESCRIPTION	DATE	APPR'D
01	FOR REPORT	07/02/13	
0	FOR REPORT.	15/05/12	

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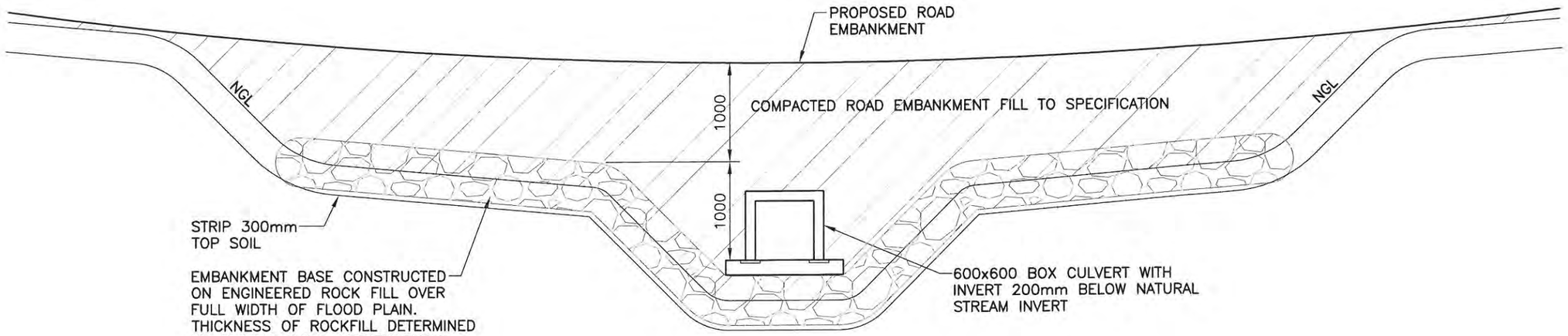
DESIGNED LS	DRAWN RC
CHECKED	CIVIL ENGINEER
STRUCTURAL ENGINEER	MECHANICAL ENGINEER
ELECTRICAL ENGINEER	CO-ORDINATION ENGINEER

APPROVED
PROJECT MANAGER DIRECTOR

TONGAAT HULETT DEVELOPMENTS/ DUBE TRADEPORT uSHUKELA HIGHWAY

TYPICAL STORMWATER INFRASTRUCTURE DETAILS

SCALE 1:2500	DATE 28/03/2012
DRAWING NUMBER 243/203/028	A1
REVISION 01	



TYPICAL LONG SECTION OF ROAD EMBANKMENT OVER WETLAND CROSSING

REV.	DESCRIPTION	DATE	APPR'D
01	FOR REPORT	07/02/13	
0	FOR INFORMATION.	21/05/12	

DESIGNED A.M.K.
DRAWN H.W.
CHECKED

APPROVED
PROJECT MANAGER
DIRECTOR

SCALE 1 : 50
DATE MAY 2012

TONGAT HULETT DEVELOPMENTS/
DUBE TRADEPORT
uSHUKELA HIGHWAY

TYPICAL ROAD CROSSING OVER STREAM LINES
RSTR8B AND RSTR9

DRAWING NUMBER 243/203/029 | A3 | REVISION 01

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ANNEXURE E:

ANALYSIS OF SITE CATCHMENT HYDROLOGY AND INFLUENCES OF DEVELOPMENT ON CATCHMENT STORAGE AND SURFACE RUN-OFF REV. 3

CONTRACT NO. 243/203 MARCH 2013

Tongaat Hulett DEVELOPMENTS

dube tradePORT

uSHUKELA HIGHWAY

ANALYSIS OF SITE CATCHMENT HYDROLOGY & INFLUENCES OF DEVELOPMENT OF CATCHMENT STORAGE & SURFACE RUN-OFF REVISION 3

Tongaat Hulett DEVELOPMENTS

dube tradePORT

uSHUKELA HIGHWAY

ANALYSIS OF SITE CATCHMENT HYDROLOGY AND INFLUENCES OF DEVELOPMENT ON CATCHMENT STORAGE AND SURFACE RUN-OFF

REVISION 3

PROJECT No. : 243/203	**DATE**: March 2013
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DISCIPLINE: **ANALYSIS OF SITE CATCHMENT HYDROLOGY – REVISION 3**	

BOSCH STEMELE

• Consulting Engineers • Project Managers

QUALITY VERIFICATION

This report has been prepared under the control of the Bosch Stemele Quality Management System which meets the requirements of ISO 9001:2008 as independently certified by international auditors (Certificate No. 20705704/1)

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uSHUKELA HIGHWAY

ANALYSIS OF SITE CATCHMENT HYDROLOGY AND INFLUENCES OF DEVELOPMENT ON CATCHMENT STORAGE AND SURFACE RUN-OFF – REVISION 3

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uSHUKELA HIGHWAY

ANALYSIS OF SITE CATCHMENT HYDROLOGY AND INFLUENCES OF DEVELOPMENT ON CATCHMENT STORAGE AND SURFACE RUN-OFF

REVISION 3

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1. INTRODUCTION

1.1. Background

Dube Tradeport, in conjunction with Tongaat Hulett Developments, is proposing the development of a light industrial, office park and retail complex near Tongaat on the KwaZulu Natal north coast.

The development is situated at the northern end of the King Shaka International Airport and is bounded by the N2 freeway and Toll Plaza to the east, uShukela Drive (Watson Highway) to the north, and the Hlawe River in the west.

The development site measures approximately 136ha in extent and is currently under cultivated sugarcane. The overall catchment including areas outside the development and draining to the Hlawe River and the Watson Highway (Tongaat River) is 186ha.

The terrain is relatively gentle for the area, with sub-surface conditions dominated by the Berea Red formation of deep loose sands overlying firm clayey sands, with a smaller portion of the area consisting of the Vryheid Formation of siltstones and sandstones where firm to stiff sandy clays and clayey silts overlay soft siltstone and mudstone, interbedded with sandstone.

Various town planning options have been proposed for the development by town planning consultants, Urban Design, with the preferred option as set out on Dwg No. SK01 Rev 19 (See Annexure E1) dated Jan 2013.

The existing site has been entirely altered, with the primary land use being commercial sugar cane production and offers little biodiversity value. However wetlands specialists view its environmental value in its hydrological processes and the influence this has on the receiving environment. It is considered that the Berea Red formations underlying a high percentage of the site provides substantial storage value for rainfall, which will move through the soil horizons until it reaches the underlying clayey sands, at which point the water moves laterally with the natural slopes, daylighting as seasonal baseflow in the valley lines, driving the surface streams which occur on the site.

The concern of the wetland specialists with the development planned for the site is that the land use changes will intercept rainfall that was previously intercepted by the vegetation or stored in the soil profile, and convert this to surface run-off.

The perceived consequences of this surface run-off is:

- Increased volume and rate of runoff.
- Extensive erosion of the sandy soils.
- The development of erosion gullies and unsightly donga systems.
- Widespread alien plant infestation.
- Exacerbated sediment deposition downstream; and
- Potential flooding of properties downstream.

Approximately 43ha of the site includes wetland and riparian habitat, which will present a challenge to the cost effectiveness of the proposed development if these areas plus buffer areas are not encroached on.

In an effort to satisfy environmental objectives, Tongaat Hulett Developments employed the services of Wetland Consulting Services to investigate a number of alternative scenarios aimed at achieving a potentially viable development.

Their investigations and findings are set out in a report headed "Wetland/Riparian Development Layout Recommendation – uShukela – Watson Highway Development Site", dated May 2011.

Following a meeting on 13 June 2011 it was agreed that a more detailed hydrological assessment and report of how run-off will be dealt with on the site will be carried out by Bosch Stemele that would show:

- Pre-development and post-development run-off for the 1 in 2 year rainfall event for various sub-catchments within the site.
- Indicate the volume of infiltration that will occur within these sub-catchments within the site.
- Provide sketch layouts of infiltration measures to be provided on the site.
- Typical details of stormwater dissipation structures.

1.2. Objective

The objective of the analysis will be to show how the mitigating measures can be used to:

- Manage the post-development hydrology to within 10% variance of the pre-development scenario.
- Retain upland catchment infiltration, such that seepage to central stream channels and wetlands are maintained.
- Prevent any further soil erosion from the site.

1.3. Proposed Stormwater Controls on the Site

1.3.1. *Individual Sites*

In terms of the conditions of establishment, these will be governed to a maximum coverage of 60% of the site area. The remainder of the site area will be taken up by parking and soft landscaping. These wil be split on approximately 30% coverage for parking and 10% for soft landscaping.
All roof run-off will be directed to soakaways, sized in accordance with eThekwini Municipality's requirements of one cubic metre of clear volume to drain every 40 square metres of roofed area on the site.

All paved areas on the sites will be required to make use of "permeable paving" which provides a built-in infiltration function as well as an attenuation function.

All potential stormwater is therefore "attenuated" and encouraged to infiltrate the sub-soils in either permeable paving or soakaways.

Any overflows from large storm events will be piped down embankment slopes and discharged at natural water course levels or piped to the formalised stormwater reticulation within the road reserves.

A series of stormwater attenuation structures are proposed throughout the development, within the public open spaces, to deal with excesses from large storms.

Energy dissipaters will be utilised to discharge stormwater at the natural water course level, reducing the possibility of scour. Typical examples of energy dissipaters are enclosed as Annexure E2. The type and dimension of these will depend on storm flows and grade of discharged flow.

1.3.2. *Road Reserves*

Road reserves will consist of a trafficable impermeable surface making up approximately 50% of the road reserves, with the balance of the reserve consisting of soft landscaping (50%).

Stormwater run-off from the impermeable road surfaces will be contained in a formalised stormwater "swale" system from where it will drain to attenuation/infiltration structures located at strategic points within the "open spaces" within the development.

Energy dissipaters as detailed in Annexure E2, will be utilised on the discharge outlets from the stormwater system and attenuation/infiltration structures.

2. APPROACH AND METHODOLOGY

Catchment hydrology is not an exact science and the results are subject to the assumptions made and the analytical technique used.

For consensus of the results, agreement between the parties on the main factors that effect surface run-off and infiltration must be reached. These main factors are:

- Analytical methods (computer simulation model).
- Sub-catchment boundaries.
- Hydrological soil group for the sub-catchments.
- Land cover classification within the sub-catchment.
- Overall (SCS) Curve Number for estimating run-off.
- Design rainfall and intensity distribution type.

This report sets out the analytical methods used and assumptions made for each of the main factors.

2.1. Analytical Method

To determine rainfall run-off hydrographs and the initial abstraction or the amount of water before run-off, such as infiltration or rainfall interception by vegetation, use is made of the Autodesk Storm and Sanitary Analysis software utilising the US Environmental Protection Agency's (EPA) SWMM modelling engine. For modelling purposes the SCS runoff curve number method was utilised.

A separate model utilising the Visual SCS computer software was developed and is used for comparative purposes in this report. This software is an adaption of the widely used SCS method by the School of Bio-Resources Engineering and Environmental Hydrology of the University of KwaZulu Natal, which makes use of local rainfall records and intensity distribution types as well as local catchment parameters.

The SCS method is an empirical relationship of estimating initial abstraction and run-off as a function of soil type and land use.

The rainfall-run-off relationship incorporates an initial abstraction, direct run-off and actual retention in the soils. These are calculated making use of a run-off curve number (CN), which is an empirical parameter developed from analysis of run-off from small catchments (generally less than 1 mile^2) and hill slope plots monitored by the USDA Natural Resources and Conservation Services.

The curve number CN combines hydrologic soil group factors and land use factors.

In view of the concern related to the amount of surface run-off related to the change in land use and the amount of infiltration taken into account during both the pre-development and post-development scenarios, we believe the SCS method of analysis ideally suits this application.

2.2. Sub-Catchment Boundaries

The accompanying Figure 1, Annexure E3, shows the sub-catchment boundaries used in the analysis for the pre-development scenario.

The surface drainage of the development can be split into three distinct areas.

The majority of the development area drains to the west to the Hlawe River which flows in a northerly direction along the western boundary of the development. This catchment area comprises moderately steep topography, with narrow, well-defined drainage lines, with permanent sub-surface seepage zones and seasonal surface flow.

The catchment is further divided into a number of sub-catchments which have been designated the suffix HN (Hlawe North), HC (Hlawe Central) and HS (Hlawe South), all of which discharge to the Hlawe River through catchment H1.

The balance of the development drains northwards towards the Watson Highway and the Tongaat River.

There are two distinctive catchments in this drainage zone, designated WH1 and WH2.

These comprise gently rolling hills with flatter/plainer topography, with broad, poorly defined drainage and seepage areas.

A breakdown of each catchment and sub-catchment area is given in Table 1a - Hlawe River and 1b – Tongaat River.

Table 1a: Hlawe River Pre-development Sub-Catchment Areas

SUB-CATCHMENT	AREA Ha
Hlawe River	
H1	17.33
HC1	10.01
HN1	11.93
HN2	19.00
HN3	5.27
HN4A	3.65
HN4B	10.14
HS1	19.94
HS2	9.21
Sub-15 (Part of HN4)	6.52
HN4	20.53
Sub-18 (Part of HN4)	2.66
Sub-19 (Part of HN4)	3.28
Total towards Hlawe River	**139.47**

Table 1b: Tongaat River Pre-development Sub-Catchment Areas

SUB-CATCHMENT	AREA Ha
Tongaat River	
WH1	8.58
WH1A	3.73
WH2	5.60
WH2A	15.85
WH3	3.72
WH4	5.09
WH5	3.61
Total towards Watson Highway	**46.18**
Combined catchment area	**185.65**

2.3. Hydrological Soils Groups

Use is made of TGC Engineers, Preliminary Geotechnical Investigation Report dated September 2009 to identify hydrological soils groups falling within the sub-catchment boundaries.

The overlay of sub-catchments on the geology and associated soils is shown in Figure 2, Annexure E3.

There are two distinct formations that cover the area under investigation, these are:

- Berea Red Formation, which are characterised by:
  - Generally 2.0m – 4.0m of loose sands overlying firm clayey soils.
  - The upper sands will be moderately to highly permeable.
  - The sands and clayey sands are highly erodible.
  - Perched water tables are common in the sands overlying the less permeable clayey sands.
- Vryheid Formation Siltstone/Sandstone, which are characterised by:
  - Generally 0 – 3.0m of soft/firm/stiff sandy clays and silty clays overlying soft through to hard dolerite bed rock.
  - Water movement through the soil is restricted to very restricted.
  - The cohesive soils of this formation are expected to have a low to moderate erosion potential.

Using the NRCS Hydrologic Soil Group Definitions, the above two sub-soil formations fall within the following Hydrologic Soil Group:

Sub-Soil Formation	Group
Berea Red Formation:	A
Vryheid Formation:	D

A breakdown of hydrologic soil group area for each sub-catchment and cumulative catchment area is given in Table 2:

Table 2: Hydrologic Soil Group Areas by Pre-Development Sub-Catchment

SUB-CATCHMENT	SUB-CATCHMENT AREA (Ha)	AREA BY HYDROLOGICAL SOILS GROUP (Ha)	
		A	D
H1	17.33	4.47	12.86
HN1	11.93	9.02	2.91
HN2	19.00	16.01	2.99
HN3	5.27	3.53	1.74
HN4	20.53	18.73	1.80
HN4A	3.65	100.00	0.00
HN4B	10.14	8.88	1.26
HC1	10.01	7.80	2.21
HS1	19.94	13.00	6.94
HS2	9.21	7.58	1.63
Sub15 (part of subcatchment HN4)	6.52	5.95	0.57
Sub18 (part of subcatchment HN4)	2.66	2.43	0.23
Sub19 (part of subcatchment HN4)	3.28	2.99	0.29
Total towards Hlawe River	**139.47**	**200.39**	**35.43**
WH1	8.58	6.36	2.22
WH1A	3.73	2.65	1.08
WH2	5.6	5.05	0.55
WH2A	15.85	15.41	0.45
WH3	3.72	3.72	0.00
WH4	5.09	5.09	0.00
WH5	3.61	3.61	0.00
Total towards Watson Highway	**46.18**	**41.89**	**4.30**
TOTAL SUB-CATCHMENTS	185.65	242.28	39.73

2.4. Land Cover Classification

Use is made of Urban Design's town planning layout option shown on Dwg. No. Sk 01 Rev 19.

The town planning layout has been overlaid with the sub-catchment boundaries and the Hydrological Soils Groups and is shown in Figure 3, Annexure E3.

A breakdown of land use in accordance to sub-catchment boundaries and hydrological soils groups is attached as a number of spreadsheets enclosed as Annexure E4.

2.5. SCS Curve Number

Use is made of the SCS Urban Hydrology for Small Watersheds, 2nd Ed., June 1986, SCS Curve Number Table for various land uses, see Table 3.

Table 3: SCS Curve Numbers

Land Use	Treatment / Practice / Description	Hydrological Condition	Hydrological Soil Group						
			A	A/B	B	B/C	C	C/D	D
Fallow	Straight Row		77	82	86	89	91	93	94
Row Crops	Straight Row	Poor	72	77	81	85	86	90	91
	Straight Row	Good	67	73	78	82	85	87	89
	Planted on Contour	Poor	70	75	79	82	84	86	88
	Planted on Contour	Good	65	70	75	79	82	84	86
	Conservation Structures	Poor	66	70	74	77	80	81	82
	Conservation Structures	Good	62	67	71	75	78	80	81
Garden and Truck Crops			45	56	66	72	77	80	83
	Straight Row	Good	68	71	75	79	81	83	84
Small Grain	Straight Row	Poor	65	71	76	80	84	86	88
	Straight Row	Good	65	69	75	79	83	85	87
	Planted on Contour	Poor	63	69	74	79	82	84	85
	Planted on Contour	Good	61	67	73	78	81	83	84
	Planted on Contour – winter rainfall region	Good	63	66	70	75	78	80	81
	Conservation Structures	Poor	61	67	72	76	79	81	82
	Conservation Structures	Good	59	65	70	75	78	80	81
Close seeded legumes or rotational meadow	Straight Row	Poor	66	72	77	81	85	87	89
	Straight Row	Good	58	65	72	75	81	84	85
	Planted on Contour	Poor	64	70	75	80	83	84	85
	Planted on Contour	Good	55	63	69	74	78	81	83
	Conservation Structures	Poor	63	68	73	77	80	82	83
	Conservation Structures	Good	51	60	67	72	76	78	80
Sugarcane	Straight row, trash burnt	-	43	55	65	72	77	80	82
	Straight row, trash mulch	-	43	56	66	72	77	80	83
	Straight row, limited cover	-	67	73	78	82	85	87	89
	Straight row, partial cover	-	49	60	69	73	79	82	84
	Straight row, complete cover	-	39	50	61	68	74	78	80
	Planted on contour, limited cover	-	65	70	75	79	82	84	86
	Planted on contour, partial cover	-	25	46	59	67	75	80	83
	Planted on contour, complete cover	-	6	14	35	59	70	75	79
Pasture or veld (range)	-	Poor	68	74	79	83	86	88	89
	-	Fair	49	61	69	75	79	82	84
	-	Good	39	51	61	68	74	78	80
	Planted on Contour	Poor	47	57	67	75	81	85	88
	Planted on Contour	Fair	25	46	59	67	75	80	83
	Planted on Contour	Good	6	14	35	59	70	75	79
Irrigated pasture		Good	35	41	48	57	65	68	70
Meadow		Good	30	45	58	65	71	75	81
Woods		Poor	45	56	66	72	77	80	83
		Fair	36	49	60	68	73	77	79
		Good	25	47	55	64	70	74	77
Scrub	Brush – winter rainfall region	-	28	34	44	53	60	64	66
Orchards	Winter region, understory of crop cover	Good	39	44	53	61	66	69	71

Table 3: SCS Curve Numbers (contd.)

Forests / plantations	Humus depth 25mm compactness:	compact		52	62	72	77	82	85	87
		Moderate		46	58	68	73	78	82	85
		Loose/friable		37	49	60	66	71	74	77
	Humus depth 50mm compactness:	compact		48	58	68	73	78	82	85
		Moderate		42	54	65	70	75	78	81
		Loose/friable		32	45	57	62	67	71	74
	Humus depth 100mm compactness:	compact		41	53	64	69	74	77	80
		Moderate		34	47	59	64	69	72	75
		Loose/friable		23	37	50	56	61	64	67
	Humus depth 150mm compactness:	compact		37	49	60	66	71	74	77
		Moderate		30	43	56	61	66	69	72
		Loose/friable		18	33	47	52	57	61	65
Urban/suburban land uses	Open spaces, parks, cemeteries		Good (75% + grass cover)	39	51	61	68	74	78	80
			Fair (50 – 75% grass cover)	49	61	69	75	79	82	84
	Commercial/business areas		85% impervious	89	91	92	93	94	95	95
	Industrial districts		72% impervious	81	85	88	90	91	92	93
	Residential lot size:	$500m^2$	65% impervious	77	81	85	88	90	91	92
		$1000m^2$	38% impervious	61	69	75	80	83	85	87
		$1350m^2$	30% impervious	57	65	72	77	81	84	86
		$2000m^2$	25% impervious	54	63	70	76	80	83	85
		$4000m^2$	20% impervious	51	61	68	75	78	82	84
	Paved parking lots, roofs, etc.			98	98	98	98	98	98	98
	Streets/roads:	Tarred, with storm sewers, kerbs		98	98	98	98	98	98	98
		Gravel		76	81	85	88	89	90	91
		Dirt		72	77	82	85	87	88	89
		Dirt – hard surface		74	79	84	88	90	91	92

From Table 3, the following CN numbers have been adopted for the analysis:

Table 4: Adopted Curve Numbers

LAND USE DESCRIPTION	HYDROLOGICAL SOILS GROUP	
	A	D
Buildings (roof run-off to soakaways)	71	84
Trafficable Surfaces (Impermeable)	98	98
Soft Landscaping	39	80
Open Space	39	80
Permeable Paving	25	32
Sugarcane	25	83

Current documentation does not provide for CN values for permeable paving. However, studies of long term stormwater quantity and quality performance of permeable pavement systems have been carried out by the Centre for Water and Watershed Studies at the University of Washington and by the Biological and Agricultural Engineering Department of North Carolina State University.

Both studies have found that with the use of permeable paving, surface run-off comprises between 0% and 2% of the total outflow volume for storms with rainfall depths less than 50mm.

Based on curves developed for Typical Run-off depth for various CN numbers, see Annexure E, we propose using a CN value of 25 for the Berea Red soils (0% run-off) and 32 for the Vryheid formation soils for permeable paving (2mm or about 2% of a 1 in 2 year storm depth).

For the soakaways for roof run-off the $1m^3$ storage per $40m^2$ of roof area equates to a 25mm rainfall depth. There is then a certain amount of soil infiltration within the soakaways during a one-day design rainfall event. This is estimated to be 27mm for the Berea Red soils and 9mm for the Vryheid Formation soils. Total infiltration in the soakaways is therefore estimated to be 52mm in the Berea Red soils and 34mm in the Vryheid Formation soils.

Using the Typical Run-off depth for various CN numbers, (Annexure E5), the CN for roof run-off to soakaways is 71 for the Berea Red soils and 84 for the Vryheid Formation soils.

2.6. Design Rainfall and Intensity Distribution Type

2.6.1. *Rainfall Depth*

It had been agreed with Wetland Consulting Services that the analysis of run-off and rainfall interception/infiltration be based on the 1 in 2 year design storm. This has been adopted because it is felt that a 1 in 2 year rainfall event is more likely to represent the more frequent rainfall events which impact on the normal functioning of the wetlands.

Design Storm Frequencies for the design of the stormwater system within the development will however be based on the 1 in 5 year rainfall event, with critical points, such as road culverts, natural drainage lines or attenuation structures being designed for the 1 in 20 year rainfall event, and checked for impacts of the 1 in 100 year rainfall event.

Use is made of data from the SAWB Rainfall Station No. 241 302 (Frasers), which is located approximately 7.6km from the site and at a similar altitude and distance from the coast.

The 1 in 2 year, 24 hour Design Rainfall Depth adopted for the analysis is 84mm.

A breakdown of available rainfall stations in the area and the adopted station No. 241 302 24 hour Design Rainfall Depths is attached as Annexure E6.

2.6.2. *Time Distribution of Design Rainfall Intensity*

The design rainfall intensity distribution over a day varies regionally in Southern Africa. Four distribution "types" have been identified over the region, with Type 4 producing the highest intensities and Type 1 the lowest intensities.

A map showing the delineation of the distribution types is attached in Annexure E6.

A Type 2 distribution has been used in the analysis of the uShukela site.

3. ANALYSIS

Two scenarios, pre-development and post-development, have been analysed, making use of assumptions set out in Section 2.

A summary of input data in the analysis & output results using the SWMM model is given in Annexure E7.

A summary of the results utilising the Visual SCS software for the catchments draining to the Hlawe River is shown in Annexure E8.

4. DISCUSSION OF RESULTS

4.1. Areas Draining to Hlawe River

From the Visual SCS software results, for those catchments draining to the Hlawe River (H1) the total run-off volume has increased from the pre-development scenario of 11 600m^3 to 24 200m^3, with the balance, 12 600m^3 needing to be taken up in the attenuation structures. The SWMM model shows and increased runoff figure from 19 331 to 36498m^3 for the 1:2 year storm. Considering that the total precipitation volume is 156 000m^3 in the catchment area and considering that stormwater runoff calculation is not an exact science, the results are considered reasonable.

The additional volume required for attenuation can be accommodated at the outlets of each of the sub-catchments draining this area and retention facilities sized in accordance with the various sub-catchment run-off excesses.

One solution is to design the permeable paving car parks within this catchment to accept ponding of up to a 60mm depth for the larger storm events, or a combination of this measure, which accepts some ponding, say 30mm and some attenuation, say 6 300m^3. This will assist in increasing catchment interception/infiltration.

4.2. Areas Draining to the Tongaat River

Using the Visual SCS software for catchments WH1 and WH2, the total run-off volume has increased from the pre-development scenario of 800m^3 for both catchments to 2300m^3 and 2 200m^3 respectively. Based on this attenuation structures will be required at the sub-catchment outlets of both catchments to attenuate discharge peaks to within to within 10% of pre-development levels.

For catchment WH1 interception/infiltration volumes have decreased from 9 600m^3 at pre-development stage to 8 000m^3 at post-development stage, a 1 600m^3 or 17% decrease.

Again, by designing the permeable paving in the sub-catchment to accept some ponding, allowing for further storage from road reserves in roadside swales and attenuation of roof runoff in soakaways, the target of 10% is achievable.

For catchment WH2, interception/infiltration volumes have decreased from 16 900m^3 at pre-development stage to 15 600m^3 at post-development stage, a 1 400m^3 or 8% decrease, which is within the target of 10%.

4.3. SWMM model results

From the results of the rainfall interception/infiltration in the SWMM model (Annexure E7), it can be seen that interception/infiltration has decreased from a pre-development volume of 43 312m^3 to 32 770m^3 for a 25mm precipitation storm event via normal infiltration. This is a decrease of 10 542m^3, or 25% of pre-development volumes. This is outside of the target of 10%. For the 1:2 post-development scenario, the infiltration ratio decreases (124 430m^3 vs 68 808m^3). However, taking into consideration further infiltration via the proposed swales in the road reserves and runoff storage from roofs into soakaways, infiltration can be increased to 102589m^3 which is within 82% of the pre-development infiltration. Using the attenuation facilities the target of 10% will be achievable.

A summary of the required attenuation facilities from the SWMM model that will be required is as follows (see table 5 below):

Table 5: Attenuation Facility Storage Requirements

Catchment Reference	Volume
RPF4B	1, 449m^3
RPF16A	675m^3
STR4	4, 015m^3
STR2 (two ponds)	9, 037m^3
STR9	2, 156 m^3
Total attenuation requirement	**17, 332m^3**

5. CONCLUSIONS

Based on the analysis carried out, the following conclusions can be made:

5.1 Making use of the various proposed interception/infiltration measures over the development site will not attenuate the post-development run-off peaks to within 10% of the pre-development peaks and attenuation facilities will be required on each of the catchments.

5.2 The position of these attenuation facilities would be ideally located in the open space wetland areas.

6. RECOMMENDATIONS

Based on the review of the analysis, the following is recommended:

6.1 Attenuation structures be considered at the discharge point of each sub-catchment or where ideally located and be designed to attenuate the post-development discharge peak to within 10% of the pre-development discharge peak.

6.2 Permeable paving throughout the development be designed to allow for ponding of up to 30mm for all design rainfall depths greater than 50mm,

6.3 Soakaways to intercept and retain roof runoff be installed as per the eThekwini Municipality's requirements, and

6.4 Swales be installed in road reserves to intercept and retain runoff from impermeable road surfaces.

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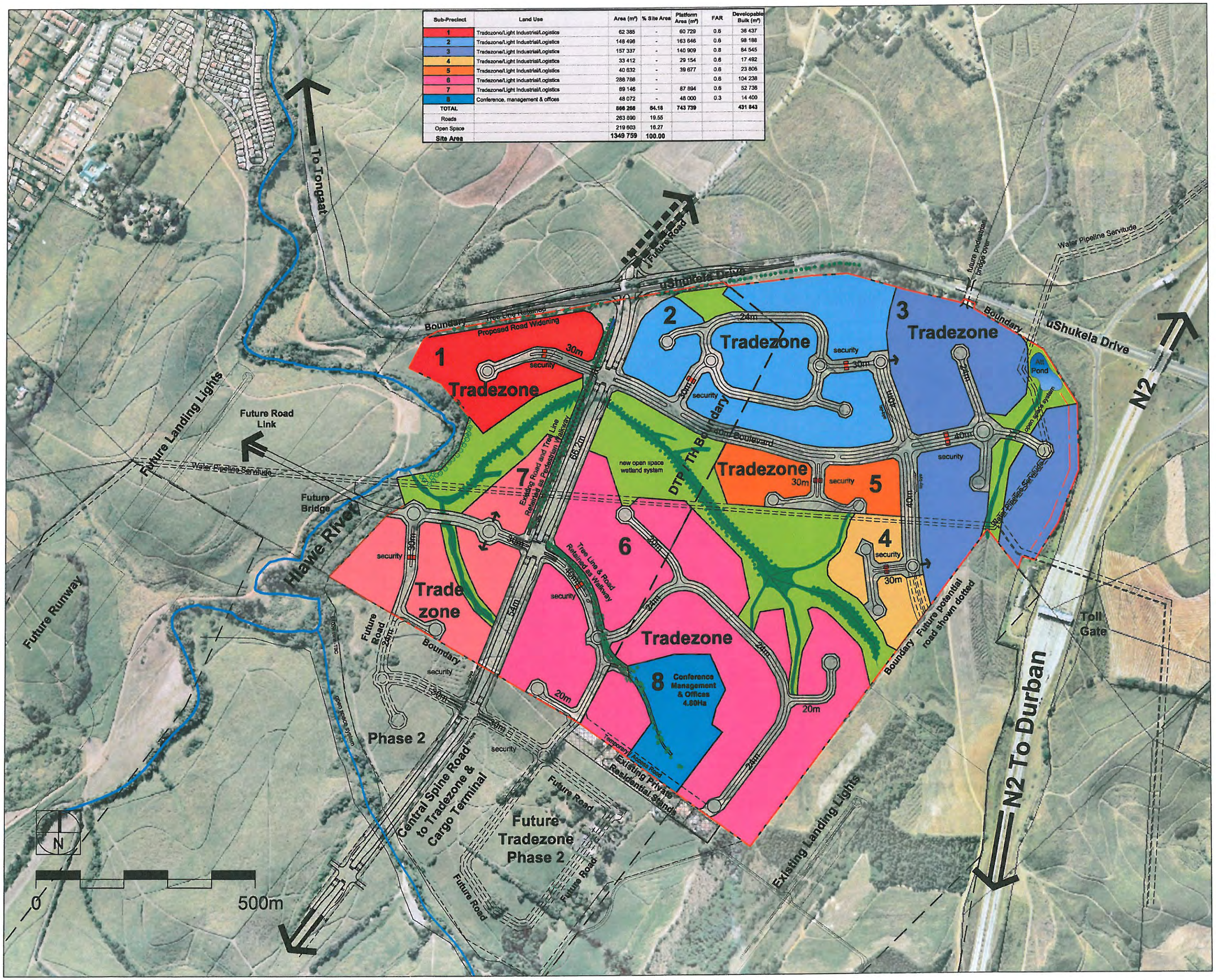
ANNEXURE E1:

TOWN PLANNING LAYOUT
DWG NO. SK01 REV. 19

Sub-Precinct	Land Use	Area (m²)	% Site Area	Platform Area (m²)	FAR	Developable Bulk (m²)
1	Tradezone/Light Industrial/Logistics	62 385	-	60 729	0.6	36 437
2	Tradezone/Light Industrial/Logistics	148 498	-	163 646	0.6	98 188
3	Tradezone/Light Industrial/Logistics	157 337	-	140 909	0.8	84 545
4	Tradezone/Light Industrial/Logistics	33 412	-	29 154	0.6	17 492
5	Tradezone/Light Industrial/Logistics	40 632	-	39 677	0.6	23 806
6	Tradezone/Light Industrial/Logistics	288 786	-		0.6	104 238
7	Tradezone/Light Industrial/Logistics	89 146	-	87 894	0.6	52 736
8	Conference, management & offices	48 072	-	48 000	0.3	14 400
TOTAL		866 266	64.18	743 739		431 843
Roads		263 890	19.55			
Open Space		219 603	16.27			
Site Area		1349 759	100.00			



Do not scale dimensions from this drawing

Any errors, omissions and discrepancies to be reported immediately

Revision	Description	Date

INTERNAL ROADS (INCLUDING ALIGNMENT) MAY BE SUBJECT TO CHANGE PROVIDED IS WITHIN THE DEVELOPMENT FOOTPRINT

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Johannesburg
Durban
Port Elizabeth
Pretoria
Sedgefield

ADA Urban Design

Client

dube tradePORT

Tongaat Hulett DEVELOPMENTS

Project

Dube TradePort

uShukela Highway

Description

Proposed Layout Plan

Status

For Information

Scale	Drawn	Date
1:4000	BE	Jan 2013
Job number	Drawing number	Revision
	Sk 01	19

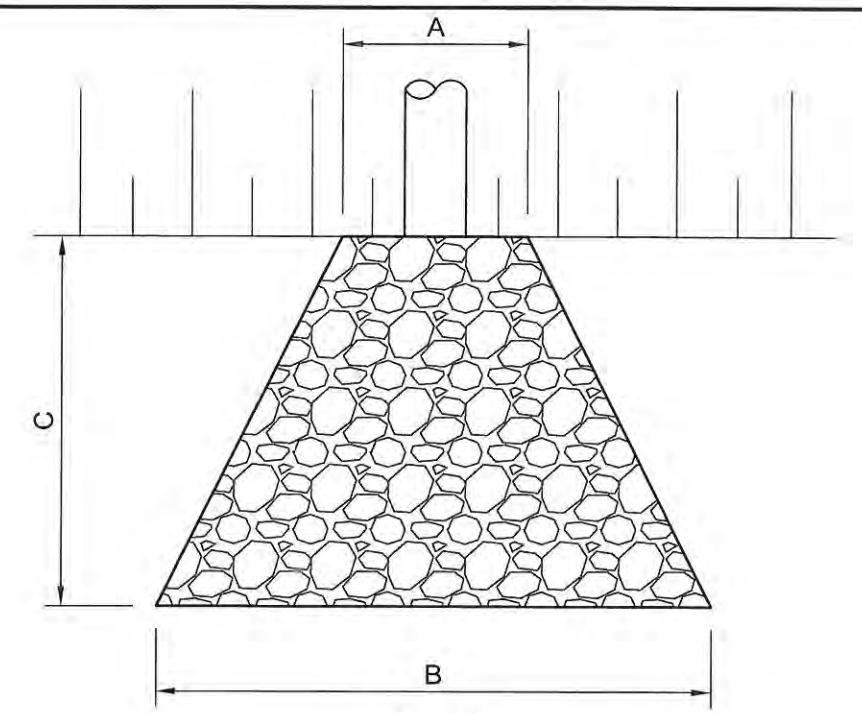
Original size 100mm

ANNEXURE E2:

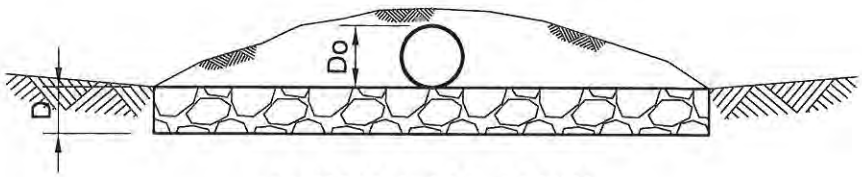
TYPICAL STORMWATER ENERGY DISSIPATERS PLACED AT OUTFALLS TO STORMWATER SYSTEMS

DWG NOS.:
S226
S227
S228
S229

TYPICAL DETAILS OF PERMEABLE PAVING
DWG. NOS.:
ANNEXURE E2-1 AND
243/203/10



PLAN



UPSTREAM VIEW

TYPE 1 STONE

$D_{50} = 0.0883\ Q^{1.333}/D_0^{2.333}$ (m)

$C = 3.0792\ Q/D_0^{1.8} + 2.4384$ (m)

MINIMUM DOWNSTREAM DEPTH

$D = 0.5\ D_0\ F_0$

$A = 3D_0$

$B = A + C$

MAXIMUM DOWNSTREAM DEPTH

$D = 0.5\ D_0\ F_0 - 0.3\ D_0$ (m)

$A = 3D_0$ (m)

$B = A + 0.4\ C$ (m)

LIST OF SYMBOLS

D	–	BED THICKNESS
D_{50}	–	50% FINER PER MASS
D_0	–	VERTICAL CULVERT DIMENSION
F_0	–	FROUDE NUMBER
A, B, C	–	SEE TYPES 1 TO 3
Y_3	–	DOWNSTREAM DEPTH

WATERWAYS STONE STILLING BASINS
TYPE 1

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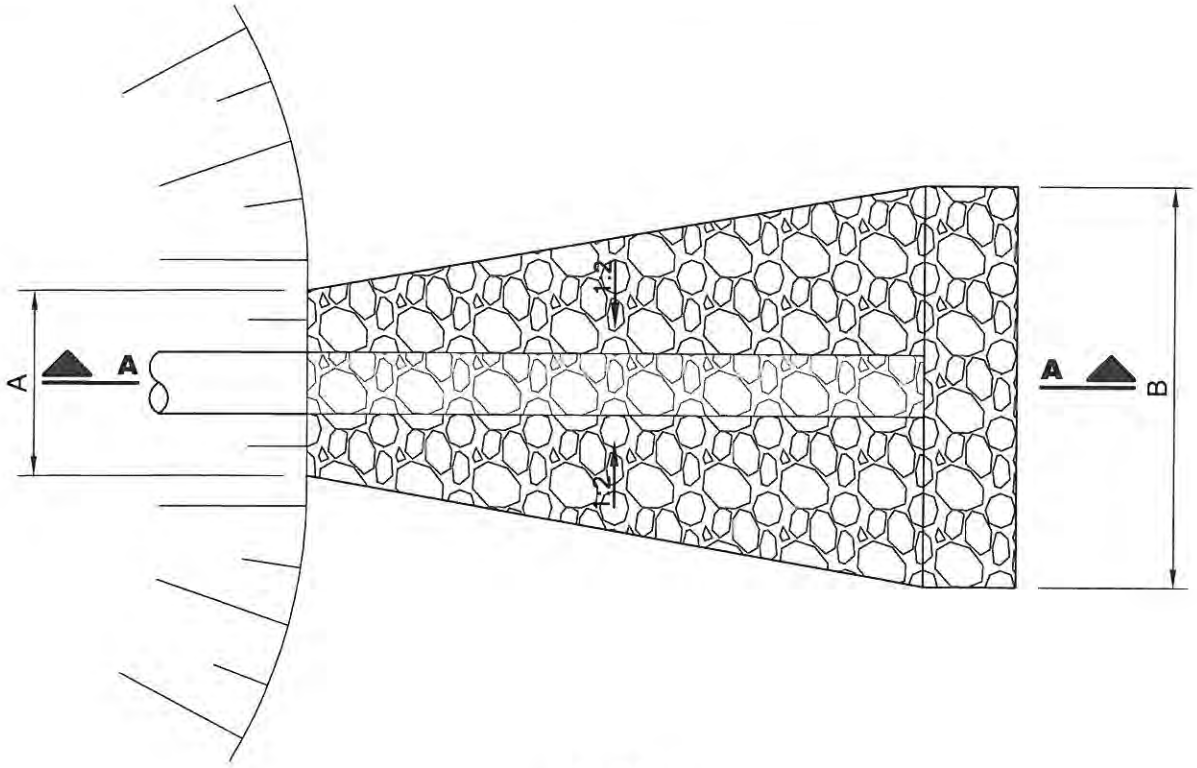
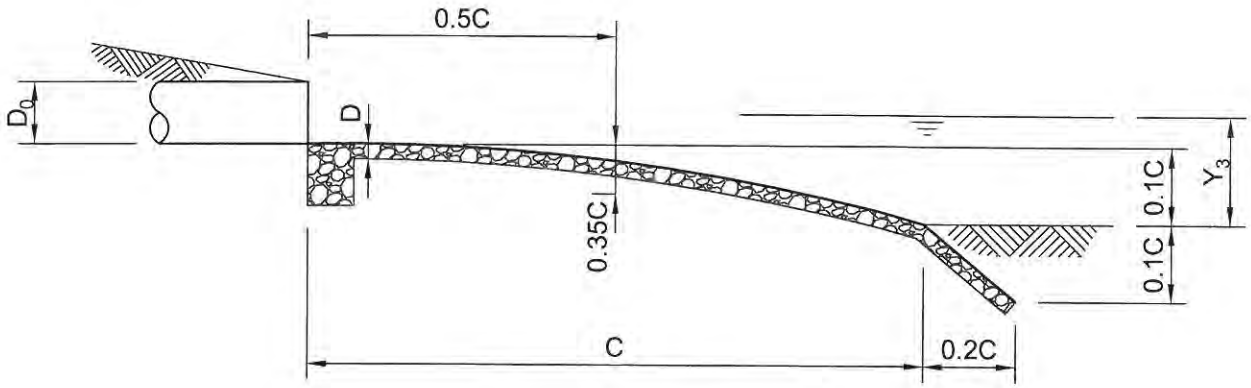
DESIGNED	A.M.K.	APPROVED	
DRAWN	H.W.		
CHECKED		DRAWING No.	REV
SCALE	NTS	S 226	A
DATE	SEPT. 2011		



PLAN



SECTION A–A

TYPE 2 STONE

$D_{50} = 0.0707\ Q^{1.333}/D_0^{2.33}$ (m)
$C = 5\ D_0$ (m)
$A = 3\ D_0$ (m)
$B = 5\ D_0$ (m)
$D = 2\ D_{50}$ (m)

WATERWAYS STONE STILLING BASINS
TYPE 2

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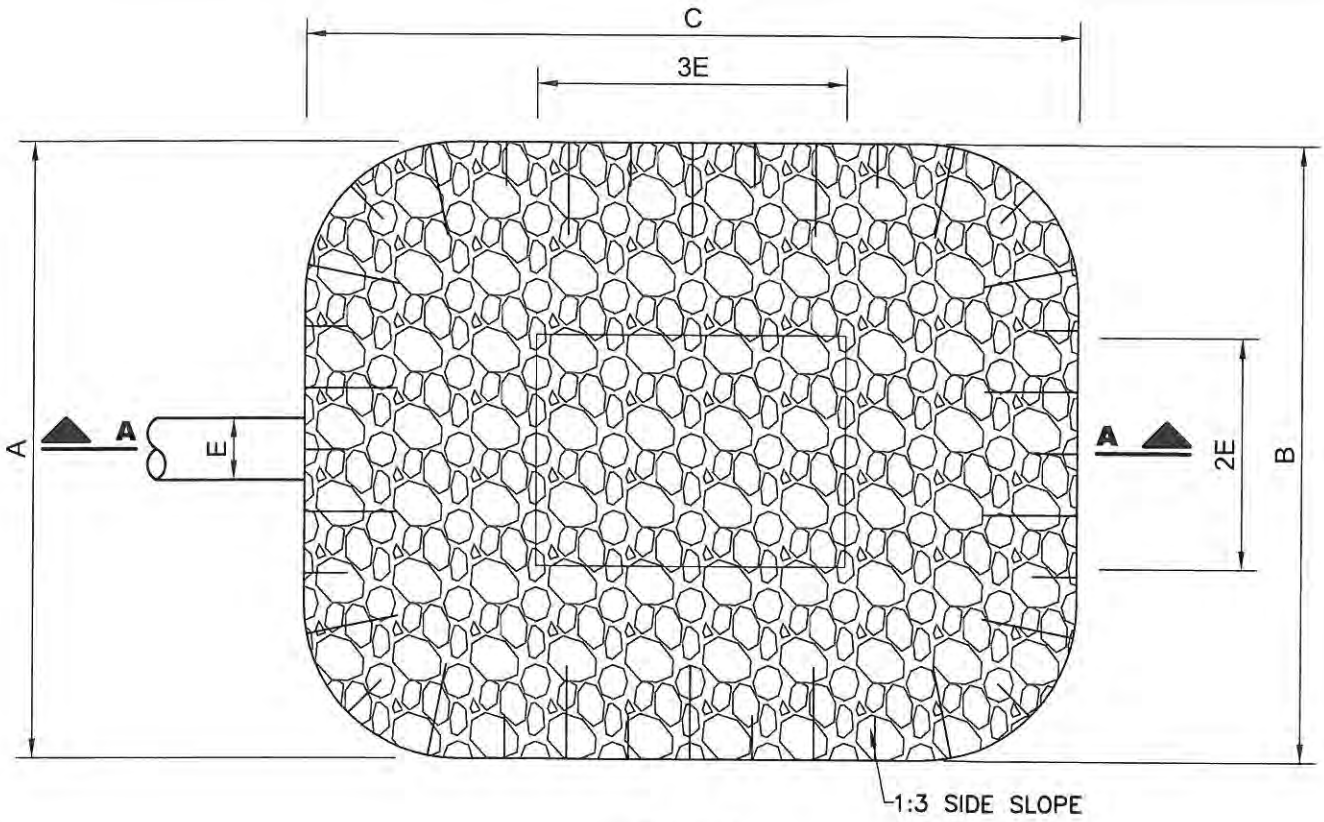
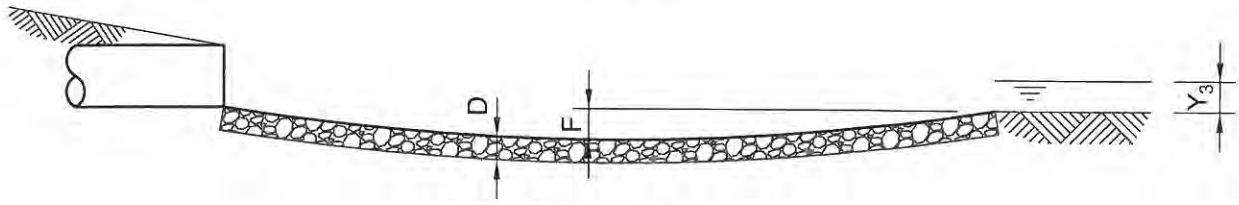


PLAN



SECTION A–A

TYPE 3(a) STONE
SHALLOW STILLING BASIN

$D_{50} = 0.0552\ Q^{1.333}/D_0^{2.333}$ (m)
$C = 3D_0 + 6F$ (m)
$A = 2D_0 + 6F$ (m)
$B = 2D_0 + 6F$ (m)
$D = 2D_{50}$ (m)
$E = D_0$ (m)
$F = 0.5D_0$ (m)

TYPE 3(b) STONE
DEEP STILLING BASIN

$D_{50} = 0.0362\ Q^{1.333}/D_0^{2.333}$ (m)

$F = D_0$ (m)

WATERWAYS STONE STILLING BASINS
TYPE 3

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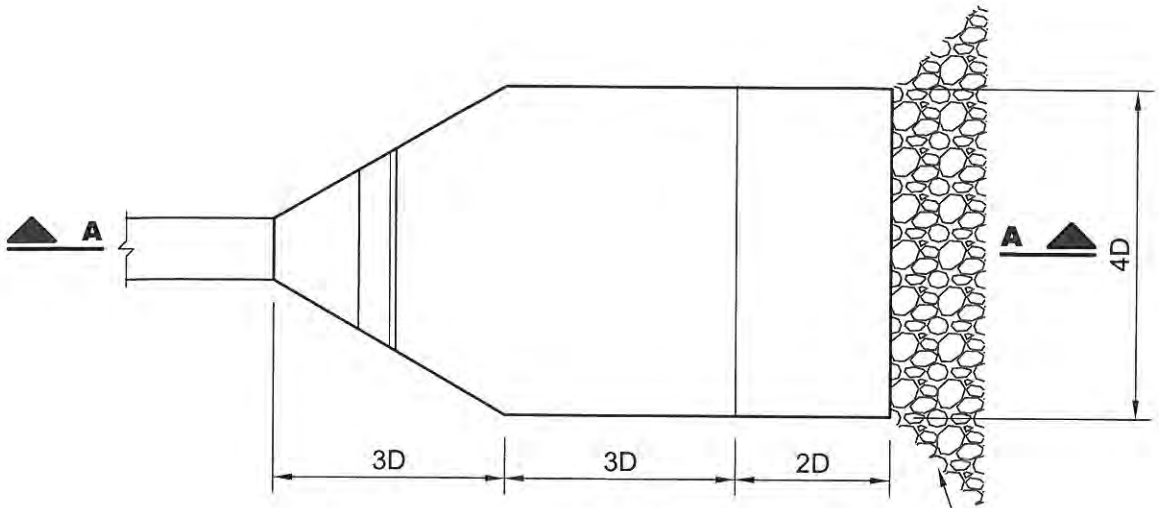
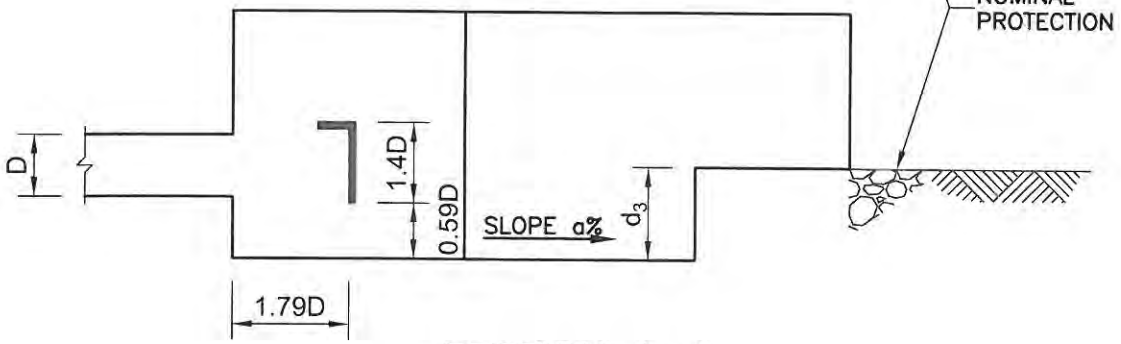
CHECKED		DRAWING No.	REV
SCALE	NTS	S 228	A
DATE	SEPT. 2011		



PLAN



SECTION A–A

a%	d_3/D
1	0.59
2	0.59
4	0.71
8	0.92
16	1.25
32	1.92
64	NOT RECOMMENDED

TYPE V STILLING BASIN

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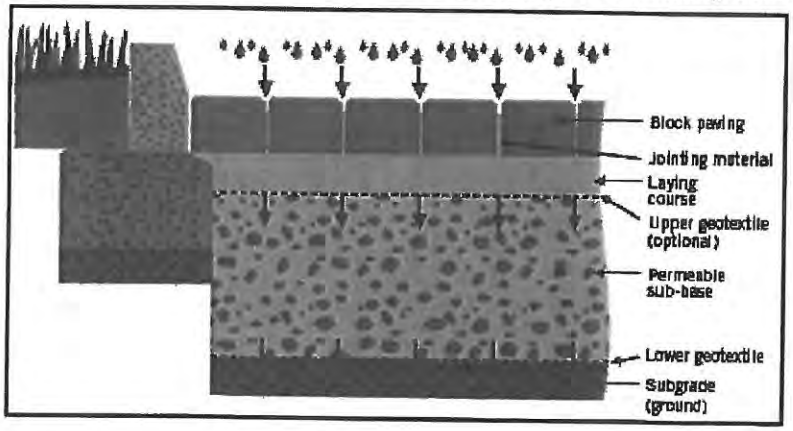
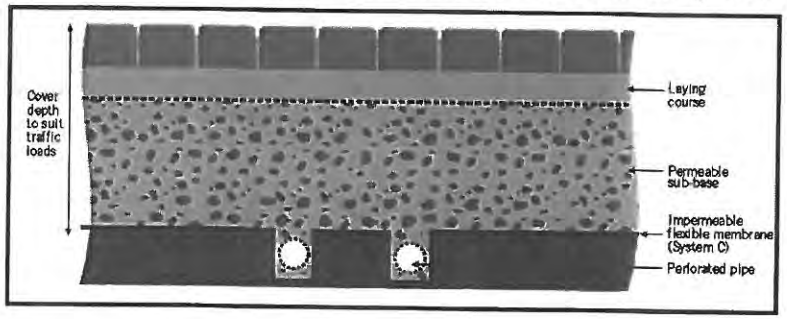
CHECKED		DRAWING No.	REV
SCALE	NTS	S 229	A
DATE	SEPT. 2011		

Annexure E2-1

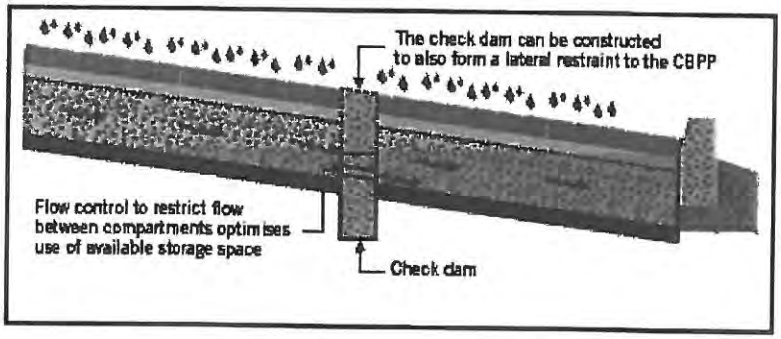
Typical Section Through Permeable Paving on High Permeability Soils

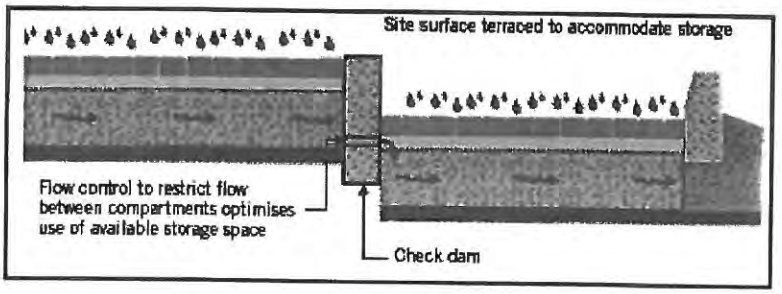


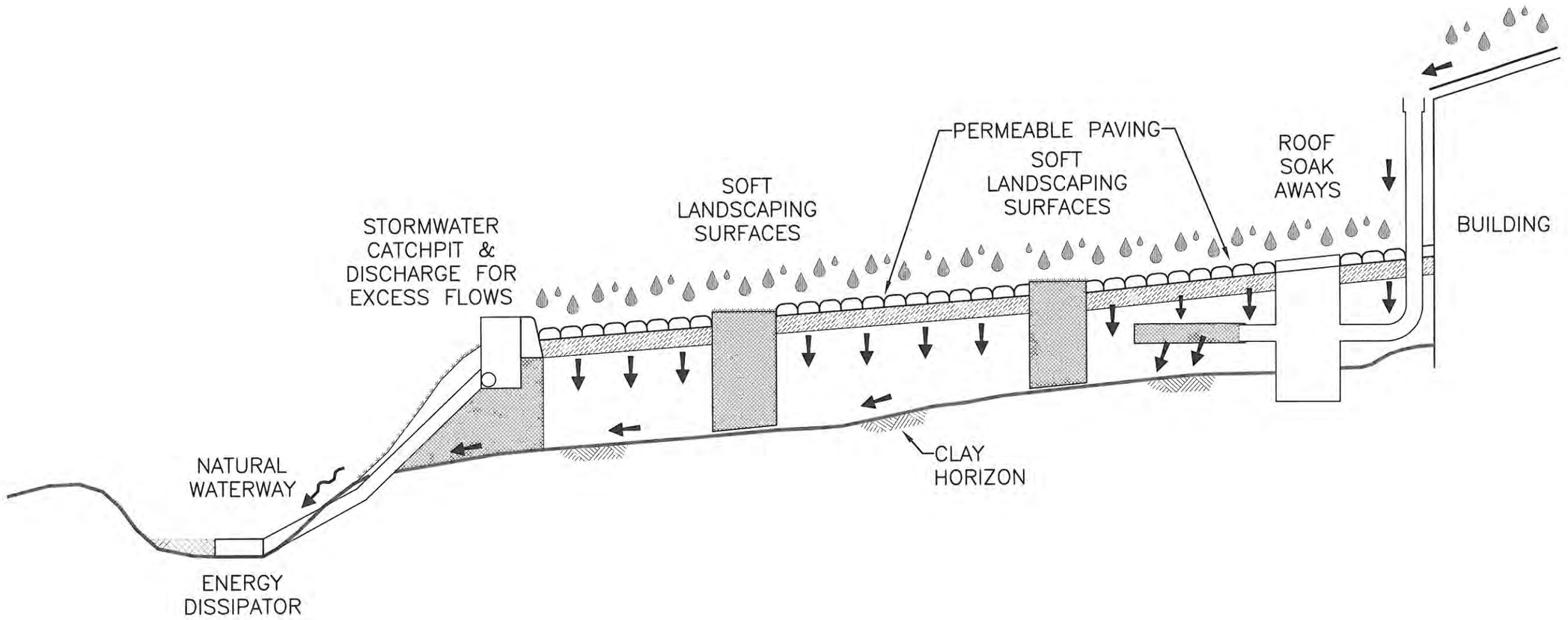
Typical Section Through Permeable Paving on Low Permeability Soils



Typical Details on Sloping Sites







REV.	DESCRIPTION	DATE	APPR'D
0	FOR INFORMATION.	20/09/11	

DESIGNED A.M.K
DRAWN H.W.
CHECKED

APPROVED
PROJECT MANAGER
DIRECTOR

SCALE NTS
DATE SEPT. 2011

TONGAAT HULETT DEVELOPMENTS/ DUBE TRADEPORT uSHUKELA HIGHWAY

TYPICAL SECTION THRO' DEVELOPMENT PLATFORM

DRAWING NUMBER 243/203/010 | A3 | REVISION 0

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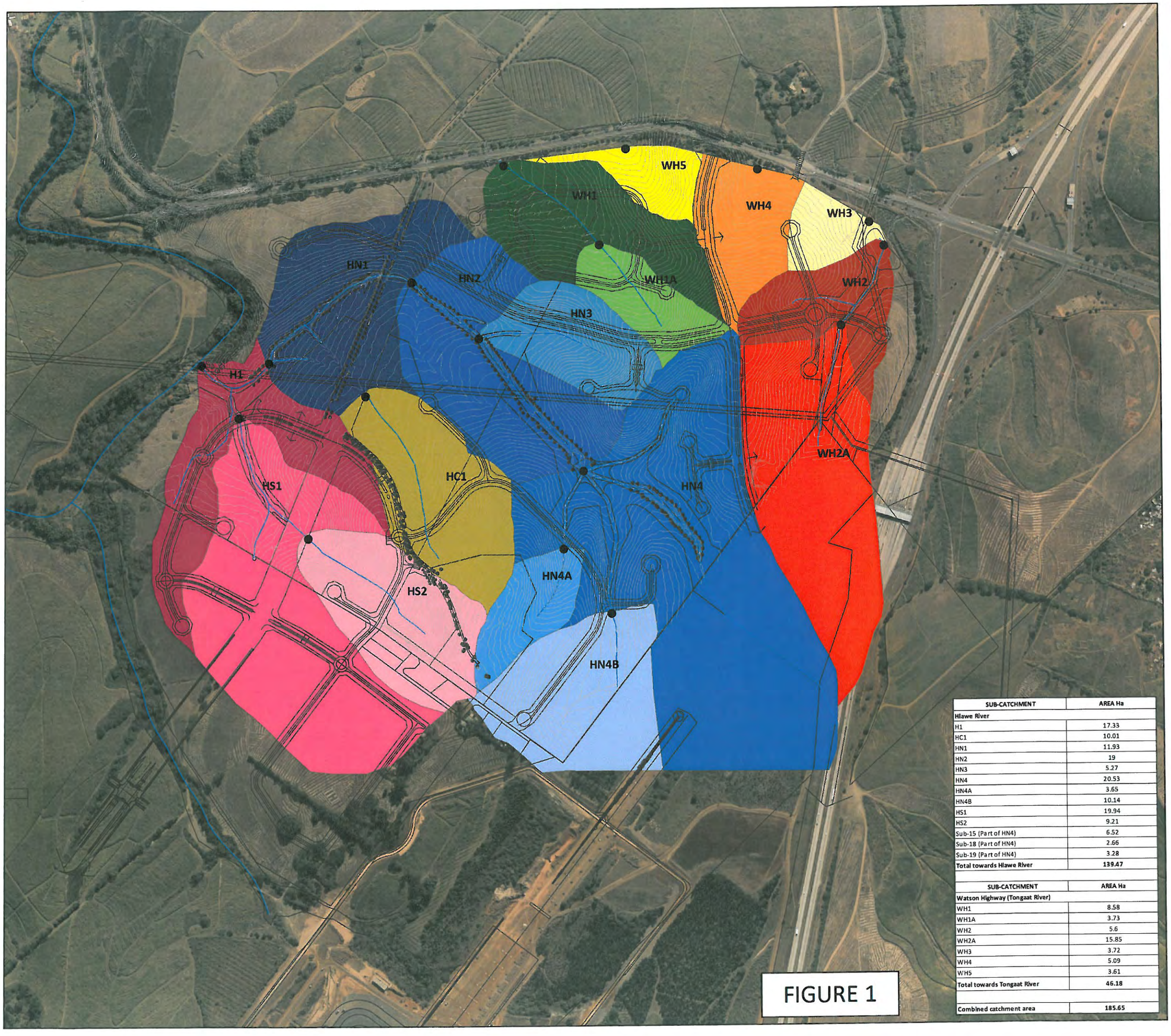
ISO 9001:2008 CERTIFIED

ANNEXURE E3:

FIGURE 1 – SUB CATCHMENT BOUNDARIES

FIGURE 2 – OVERLAY OF SUB-CATCHMENT BOUNDARIES ON GEOLOGY AND ASSOCIATED SOILS

FIGURE 3 – TOWN PLANNING LAYOUT, SUB-CATCHMENT BOUNDARIES AND SOILS FORMATIONS



SUB-CATCHMENT	AREA Ha
Hlawe River	
H1	17.33
HC1	10.01
HN1	11.93
HN2	19
HN3	5.27
HN4	20.53
HN4A	3.65
HN4B	10.14
HS1	19.94
HS2	9.21
Sub-15 (Part of HN4)	6.52
Sub-18 (Part of HN4)	2.66
Sub-19 (Part of HN4)	3.28
Total towards Hlawe River	**139.47**

SUB-CATCHMENT	AREA Ha
Watson Highway (Tongaat River)	
WH1	8.58
WH1A	3.73
WH2	5.6
WH2A	15.85
WH3	3.72
WH4	5.09
WH5	3.61
Total towards Tongaat River	**46.18**
Combined catchment area	**185.65**

FIGURE 1

BOSCH STEMELE

PROJECT No. 0243-203

TONGAAT HULETT DEVELOPMENTS

DUBE TRADE PORT

uSHUKELA HIGHWAY

VISUAL SCS ANALYSIS

SUB-CATCHMENT BOUNDARIES

MAP REFERENCE No. : 0243-203-007

REVISION No. : 3

REVISION DATE: 09/10/2012

A3 SHEET

SCALE 1:7 500

MAP KEY PLAN

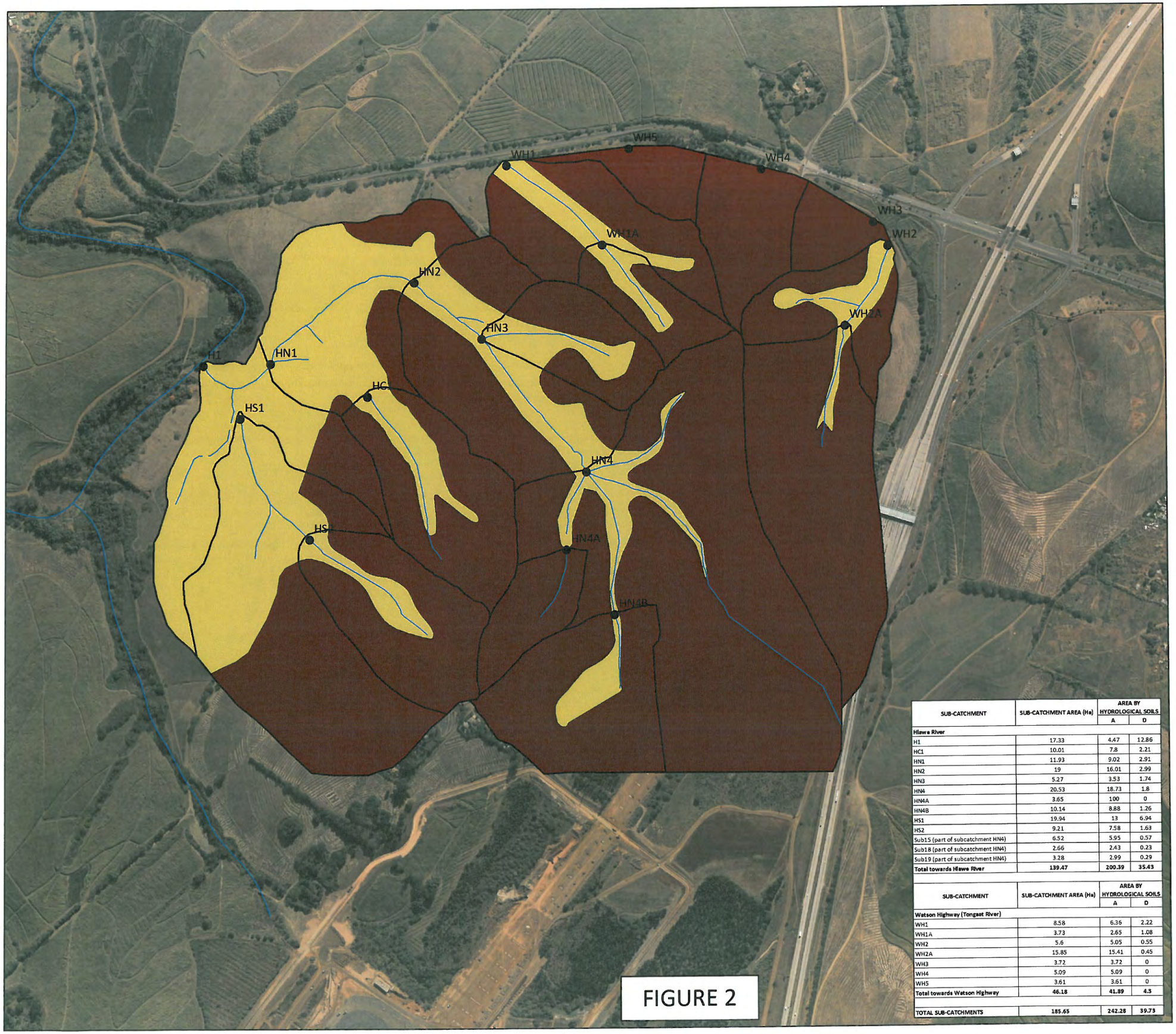
LEGEND

- Sub-catchment Nodes Rev 3
- Contours
- Streamlines

CO-ORDINATE SYSTEM: LO31_WGS84

N W E S

0 50 100 200 300 400 Meters



SUB-CATCHMENT	SUB-CATCHMENT AREA (Ha)	AREA BY HYDROLOGICAL SOILS	
		A	D
Hlawe River			
H1	17.33	4.47	12.86
HC1	10.01	7.8	2.21
HN1	11.93	9.02	2.91
HN2	19	16.01	2.99
HN3	5.27	3.53	1.74
HN4	20.53	18.73	1.8
HN4A	3.65	100	0
HN4B	10.14	8.88	1.26
HS1	19.94	13	6.94
HS2	9.21	7.58	1.63
Sub15 (part of subcatchment HN4)	6.52	5.95	0.57
Sub18 (part of subcatchment HN4)	2.66	2.43	0.23
Sub19 (part of subcatchment HN4)	3.28	2.99	0.29
Total towards Hlawe River	**139.47**	**200.39**	**35.43**

SUB-CATCHMENT	SUB-CATCHMENT AREA (Ha)	AREA BY HYDROLOGICAL SOILS	
		A	D
Watson Highway (Tongaat River)			
WH1	8.58	6.36	2.22
WH1A	3.73	2.65	1.08
WH2	5.6	5.05	0.55
WH2A	15.85	15.41	0.45
WH3	3.72	3.72	0
WH4	5.09	5.09	0
WH5	3.61	3.61	0
Total towards Watson Highway	**46.18**	**41.89**	**4.3**
TOTAL SUB-CATCHMENTS	**185.65**	**242.28**	**39.73**

FIGURE 2

BOSCH STEMELE

PROJECT No. 0243-203

TONGAAT HULETT DEVELOPMENTS

DUBE TRADE PORT

uSHUKELA HIGHWAY

VISUAL SCS ANALYSIS
OVERLAY OF SUB-CATCHMENTS ON
GEOLOGY AND ASSOCIATED SOILS

MAP REFERENCE No. : 0243-203-008
REVISION No. : 2
REVISION DATE: 09/10/2012
A3 SHEET
SCALE 1:7 500

MAP KEY PLAN

LEGEND

- Sub-catchment Nodes Rev 3
- Streamlines
- Berea Red within Catchment
- Vryheid Soils within Catchment

CO-ORDINATE SYSTEM: LO31_WGS84

N W E S

0 50 100 200 300 400 Meters

BOSCH STEMELE

PROJECT No. 0243-203

TONGAAT HULETT DEVELOPMENTS

DUBE TRADE PORT

uSHUKELA HIGHWAY

TOWN PLANNING LAYOUT
SUB-CATCHMENT BOUNDARIES
SOILS FORMATIONS

MAP REFERENCE No. : 0243-203-009
REVISION No. : 2
REVISION DATE: 09/10/2012
A3 SHEET
SCALE 1:7 500

MAP KEY PLAN

LEGEND
- Berea Red within Catchment
- Vryheid Soils within Catchment
- Contours

Sub-Precinct
- 1_Business Park
- 2_Retail Park
- 3_Mixed Use
- 4_Business Park
- 5_Business Park
- 6_Tradezone
- 7_Tradezone
- 8_Conference_Mngt_Offices
- Attenuation Pond
- Open Space
- Phase 2

CO-ORDINATE SYSTEM: LO31_WGS84

N W E S

0 50 100 200 300 400 Meters

FIGURE 3

ANNEXURE E4:

BREAKDOWN OF LAND USE AND CN NUMBER IN ACCORDANCE WITH SUB-CATCHMENT BOUNDARIES AND HYDROLOGICAL SOILS GROUPS

E4-1: POST DEVELOPMENT

E4.2: PRE DEVELOPMENT

ANNEXURE E4-1

POST DEVELOPMENT

H1 - POST-DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.22	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1	0.00	0.00	0.00	0.00		0.61	0.61			
2	0.00	0.00	0.00	0.00		0.00	0.00			
3	0.00	0.00	0.00	0.00		0.00	0.00			
4	0.00	0.00	0.00	0.00		0.00	0.00			
5	0.00	0.00	0.00	0.00		0.00	0.00			
6	1.22	0.73	0.12	0.37		0.00	0.00			
7	0.00	0.00	0.00	0.00		0.00	0.00			
8	0.00	0.00	0.00	0.00		0.00	0.00			
Area Totals	1.22	0.73	0.12	0.37	1.22	0.61	0.61	0.00	0.00	
Total Soil Type 1 Catchment Area	2.44									
% Split to Total		30.00%	5.00%	15.00%		25.00%	25.00%	0.00%	0.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		21.30	1.95	3.75		24.50	9.75	0.00	0.00	61.25

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.69	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.47	(ha) 2.64	
1	0.0	0.0	0.0	0.0		0.8	0.8			
2	0.0	0.0	0.0	0.0		0.0	0.0			
3	0.0	0.0	0.0	0.0		0.0	0.0			
4	0.0	0.0	0.0	0.0		0.0	0.0			
5	0.0	0.0	0.0	0.0		0.0	0.0			
6	0.0	0.0	0.0	0.0		0.0	0.0			
7	2.2	1.3	0.2	0.6		0.0	0.0			
8	0.0	0.0	0.0	0.0		0.0	0.0			
Area Totals	2.2	1.3	0.2	0.7	1.7	0.8	0.8	0.5	2.6	
Total Soil Type 2 Catchment Area	7.01									
% Split to Total		18.90%	3.15%	9.45%		12.06%	12.06%	6.71%	37.67%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		15.88	2.52	3.02		11.82	9.65	5.37	31.27	79.52

Total Catchment Area	9.45		74.80
	0.09	km2	

HN1 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.00	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1	0.00	0.24	0.04	0.12	0.00	0.00	0.00	0.00	0.00	
2	1.01	0.61	0.10	0.30		0.00	0.00			
3	0.00	0.00	0.00	0.00		0.00	0.00			
4	0.00	0.00	0.00	0.00		0.00	0.00			
5	0.00	0.00	0.00	0.00		0.00	0.00			
6	1.60	0.96	0.16	0.48		0.00	0.00			
7	0.00	0.00	0.00	0.00		0.00	0.00			
8	0.00	0.00	0.00	0.00		0.00	0.00			
Area Totals	3.00	1.80	0.30	0.90	0.00	0.00	0.00	0.00	0.00	
Total Soil Type 1 Catchment Area	3.00									
% Split to Total		60.00%	10.00%	30.00%		0.00%	0.00%	0.00%	0.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		42.60	3.90	7.50		0.00	0.00	0.00	0.00	54.00

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.00	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 2.80	(ha) 0.00	
1	2.1	1.4	0.2	0.7	1.0	0.5	0.5	2.8	0.0	
2	0.0	0.0	0.0	0.0		0.0	0.0			
3	0.0	0.0	0.0	0.0		0.0	0.0			
4	0.0	0.0	0.0	0.0		0.0	0.0			
5	0.0	0.0	0.0	0.0		0.0	0.0			
6	0.0	0.0	0.0	0.0		0.0	0.0			
7	2.8	1.7	0.3	0.8		0.0	0.0			
8	0.0	0.0	0.0	0.0		0.0	0.0			
Area Totals	5.1	3.1	0.5	1.5	1.0	0.5	0.5	2.8	0.0	
Total Soil Type 2 Catchment Area	8.89									
% Split to Total		34.36%	5.73%	17.18%		5.62%	5.62%	31.49%	0.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		28.86	4.58	5.50		5.51	4.50	25.19	0.00	74.14

Total Catchment Area	11.89		69.06
	0.12	km2	

HN2 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.91	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 1.95	(ha) 0.00	
1	0.00	0.00	0.00	0.00		0.46	0.46			
2	1.04	0.62	0.10	0.31		0.00	0.00			
3	0.00	0.00	0.00	0.00		0.00	0.00			
4	0.00	0.00	0.00	0.00		0.00	0.00			
5	1.30	0.78	0.13	0.39		0.00	0.00			
6	3.91	2.35	0.39	1.17		0.00	0.00			
7	0.00	0.00	0.00	0.00		0.00	0.00			
8	0.00	0.00	0.00	0.00		0.00	0.00			
Area Totals	6.25	3.75	0.63	1.88	0.91	0.46	0.46	1.95	0.00	
Total Soil Type 1 Catchment Area	9.11									
% Split to Total		41.16%	6.86%	20.58%		4.99%	4.99%	21.41%	0.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		29.23	2.68	5.15		4.89	1.95	8.35	0.00	52.24

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 50%	Soft Landscaping (ha) 15%	Permeable Paving (ha) 35%	Gross Area (ha) -	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 3.91	(ha) 0.00	
1	0.0	0.0	0.0	0.0		0.0	0.0			
2	0.0	0.0	0.0	0.0		0.0	0.0			
3	0.0	0.0	0.0	0.0		0.0	0.0			
4	0.0	0.0	0.0	0.0		0.0	0.0			
5	0.0	0.0	0.0	0.0		0.0	0.0			
6	0.0	0.0	0.0	0.0		0.0	0.0			
7	0.0	0.0	0.0	0.0		0.0	0.0			
8	0.0	0.00	0.00	0.0		0.0	0.0			
Area Totals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	
Total Soil Type 2 Catchment Area	3.91									
% Split to Total		0.00%	0.00%	0.00%		0.00%	0.00%	100.00%	0.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		0.00	0.00	80.00	0.00	80.00

Total Catchment Area	13.02		60.57
	0.13	km2	

HN3 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.19	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.02	(ha) 0.00	
1		0.00	0.00	0.00		0.59	0.59			
2		0.69	0.12	0.35		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.97	0.16	0.48		0.00	0.00			
6		0.00	0.00	0.00		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.00	0.00	0.00		0.00	0.00			
Area Totals	2.76	1.66	0.28	0.83	1.19	0.59	0.59	0.02	0.00	
Total Soil Type 1 Catchment Area	3.97									
% Split to Total		41.76%	6.96%	20.88%		14.92%	14.92%	0.57%	0.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		29.65	2.71	5.22		14.62	5.82	0.22	0.00	58.24

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.05	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.86	(ha) 0.00	
1		0.0	0.0	0.0		0.0	0.0			
2		0.0	0.0	0.0		0.0	0.0			
3		0.0	0.0	0.0		0.0	0.0			
4		0.0	0.0	0.0		0.0	0.0			
5		0.6	0.1	0.3		0.0	0.0			
6		0.0	0.0	0.0		0.0	0.0			
7		0.0	0.0	0.0		0.0	0.0			
8		0.00	0.00	0.0		0.0	0.0			
Area Totals	1.1	0.6	0.1	0.3	0.0	0.0	0.0	0.9	0.0	
Total Soil Type 2 Catchment Area	1.96									
% Split to Total		32.27%	5.38%	16.14%		1.17%	1.17%	43.87%	0.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		27.11	4.30	5.16		1.15	0.94	35.10	0.00	73.76

Total Catchment Area	5.93		63.37
	0.06	km2	

HN4 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%		Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 3.24	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 1.77	(ha) 0.54	
1		0.00		0.00	0.00		1.62	1.62			
2		0.00		0.00	0.00		0.00	0.00			
3		0.00		0.00	0.00		0.00	0.00			
4		3.08		0.51	1.54		0.00	0.00			
5		0.51		0.08	0.25		0.00	0.00			
6		6.60		1.10	3.30		0.00	0.00			
7		0.00		0.00	0.00		0.00	0.00			
8		1.22		0.20	0.61		0.00	0.00			
Area Totals	19.01	11.40		1.90	5.70	3.24	1.62	1.62	1.77	0.54	
Total Soil Type 1 Catchment Area	24.55										
% Split to Total		46.46%		7.74%	23.23%		6.60%	6.60%	7.19%	2.19%	100.00%
CN for use Class		71		39	25		98	39	39	25	
Composite CN :		32.98		3.02	5.81		6.47	2.57	2.80	0.55	54.20

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%		Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.13	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 2.68	(ha) 0.00	
1		0.0		0.0	0.0		0.1	0.1			
2		0.0		0.0	0.0		0.0	0.0			
3		0.0		0.0	0.0		0.0	0.0			
4		0.0		0.0	0.0		0.0	0.0			
5		0.0		0.0	0.0		0.0	0.0			
6		0.8		0.1	0.4		0.0	0.0			
7		0.0		0.0	0.0		0.0	0.0			
8		0.0		0.0	0.0		0.0	0.0			
Area Totals	1.3	0.8		0.1	0.4	0.1	0.1	0.1	2.7	0.0	
Total Soil Type 2 Catchment Area	4.12										
% Split to Total		19.02%		3.17%	9.51%		1.59%	1.59%	65.12%	0.00%	100.00%
CN for use Class		84		80	32		98	80	80	83	
Composite CN :		15.97		2.54	3.04		1.56	1.28	52.10	0.00	76.48

Total Catchment Area	28.67		57.41
	0.29	km2	

HN4A - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.06	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.05	(ha) 0.00	
1		0.00	0.00	0.00		0.03	0.03			
2		0.00	0.00	0.00		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		1.04	0.17	0.52		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		1.10	0.18	0.55		0.00	0.00			
Area Totals	3.57	2.14	0.36	1.07	0.06	0.03	0.03	0.05	0.00	
Total Soil Type 1 Catchment Area	3.68									
% Split to Total		58.21%	9.70%	29.10%		0.76%	0.76%	1.46%	0.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		41.33	3.78	7.28		0.75	0.30	0.57	0.00	54.00

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) -	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1		0.0	0.0	0.0		0.0	0.0			
2		0.0	0.0	0.0		0.0	0.0			
3		0.0	0.0	0.0		0.0	0.0			
4		0.0	0.0	0.0		0.0	0.0			
5		0.0	0.0	0.0		0.0	0.0			
6		0.0	0.0	0.0		0.0	0.0			
7		0.0	0.0	0.0		0.0	0.0			
8		0.0	0.0	0.0		0.0	0.0			
Area Totals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Soil Type 2 Catchment Area	0.00									
% Split to Total		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Total Catchment Area	3.68		#DIV/0!
	0.04	km2	

HN4B - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.87	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.54	
1		0.00	0.00	0.00		0.44	0.44			
2		0.00	0.00	0.00		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		2.60	0.43	1.30		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.11	0.02	0.05		0.00	0.00			
Area Totals	4.52	2.71	0.45	1.35	0.87	0.44	0.44	0.00	0.54	
Total Soil Type 1 Catchment Area	5.92									
% Split to Total		45.74%	7.62%	22.87%		7.36%	7.36%	0.00%	9.06%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		32.47	2.97	5.72		7.21	2.87	0.00	2.26	53.51

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.00	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1		0.0	0.0	0.0		0.0	0.0			
2		0.0	0.0	0.0		0.0	0.0			
3		0.0	0.0	0.0		0.0	0.0			
4		0.0	0.0	0.0		0.0	0.0			
5		0.0	0.0	0.0		0.0	0.0			
6		0.8	0.1	0.4		0.0	0.0			
7		0.0	0.0	0.0		0.0	0.0			
8		0.0	0.0	0.0		0.0	0.0			
Area Totals	1.3	0.8	0.1	0.4	0.0	0.0	0.0	0.0	0.0	
Total Soil Type 2 Catchment Area	1.27									
% Split to Total		59.99%	10.00%	30.00%		0.01%	0.01%	0.00%	0.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		50.39	8.00	9.60		0.01	0.00	0.00	0.00	68.00

Total Catchment Area	7.20		56.07
	0.07	km2	

HC1 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area					Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%		Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.67	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1	[illegible]	0.00		0.00	0.00	[illegible]	0.83	0.83	[illegible]	[illegible]	
2	[illegible]	0.00		0.00	0.00		0.00	0.00			
3	[illegible]	0.00		0.00	0.00		0.00	0.00			
4	[illegible]	0.00		0.00	0.00		0.00	0.00			
5	[illegible]	0.00		0.00	0.00		0.00	0.00			
6	[illegible]	2.87		0.48	1.44		0.00	0.00			
7	[illegible]	0.00		0.00	0.00		0.00	0.00			
8	[illegible]	0.36		0.48	0.36		0.00	0.00			
Area Totals	5.99	3.24		0.96	1.80	1.67	0.83	0.83	0.00	0.00	
Total Soil Type 1 Catchment Area	7.66										
% Split to Total		42.22%		12.54%	23.47%		10.89%	10.89%	0.00%	0.00%	100.00%
CN for use Class		71		39	25		98	39	39	25	
Composite CN :		29.98		4.89	5.87		10.67	4.25	0.00	0.00	55.65

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area					Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%		Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.14	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1	[illegible]	0.0		0.0	0.0	[illegible]	0.1	0.1	[illegible]	[illegible]	
2	[illegible]	0.0		0.0	0.0		0.0	0.0			
3	[illegible]	0.0		0.0	0.0		0.0	0.0			
4	[illegible]	0.0		0.0	0.0		0.0	0.0			
5	[illegible]	0.0		0.0	0.0		0.0	0.0			
6	[illegible]	1.2		0.2	0.6		0.0	0.0			
7	[illegible]	0.0		0.0	0.0		0.0	0.0			
8	[illegible]	0.00		0.00	0.0		0.0	0.0			
Area Totals	2.0	1.2		0.2	0.6	0.1	0.1	0.1	0.0	0.0	
Total Soil Type 2 Catchment Area	2.17										
% Split to Total		56.21%		9.37%	28.11%		3.15%	3.15%	0.00%	0.00%	100.00%
CN for use Class		84		80	32		98	80	80	83	
Composite CN :		47.22		7.50	8.99		3.09	2.52	0.00	0.00	69.33

Total Catchment Area	9.83		58.67
	0.10	km2	

HS1 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 4.25	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.28	(ha) 9.67	
1	[illegible]	0.00	0.00	0.00	[illegible]	2.13	2.13	[illegible]	[illegible]	
2	[illegible]	0.00	0.00	0.00		0.00	0.00			
3	[illegible]	0.00	0.00	0.00		0.00	0.00			
4	[illegible]	0.00	0.00	0.00		0.00	0.00			
5	[illegible]	0.00	0.00	0.00		0.00	0.00			
6	[illegible]	2.05	0.34	1.03		0.00	0.00			
7	[illegible]	0.01	0.00	0.01		0.00	0.00			
8	[illegible]	0.85	0.14	0.43		0.00	0.00			
Area Totals	4.86	2.92	0.49	1.46	4.25	2.13	2.13	0.28	9.67	
Total Soil Type 1 Catchment Area	19.06									
% Split to Total		15.30%	2.55%	7.65%		11.16%	11.16%	1.45%	50.73%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		10.87	0.99	1.91		10.94	4.35	0.56	12.68	42.31

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 2.23	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 1.24	(ha) 2.53	
1	[illegible]	0.0	0.0	0.0	[illegible]	1.1	1.1	[illegible]	[illegible]	
2	[illegible]	0.0	0.0	0.0		0.0	0.0			
3	[illegible]	0.0	0.0	0.0		0.0	0.0			
4	[illegible]	0.0	0.0	0.0		0.0	0.0			
5	[illegible]	0.0	0.0	0.0		0.0	0.0			
6	[illegible]	0.8	0.1	0.4		0.0	0.0			
7	[illegible]	1.7	0.3	0.9		0.0	0.0			
8	[illegible]	0.0	0.0	0.0		0.0	0.0			
Area Totals	4.2	2.5	0.4	1.3	2.2	1.1	1.1	1.2	2.5	
Total Soil Type 2 Catchment Area	10.16									
% Split to Total		24.60%	4.10%	12.30%		10.97%	10.97%	12.17%	24.90%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		20.66	3.28	3.94		10.75	8.77	9.74	20.67	77.80

Total Catchment Area	29.22		54.65
	0.29	km2	

HS2 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.27	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.28	(ha) 2.12	
1		0.00	0.00	0.00		0.64	0.64			
2		0.00	0.00	0.00		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		1.52	0.25	0.76		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.85	0.14	0.43		0.00	0.00			
Area Totals	3.95	2.37	0.40	1.19	1.27	0.64	0.64	0.28	2.12	
Total Soil Type 1 Catchment Area	7.61									
% Split to Total		31.13%	5.19%	15.57%		8.35%	8.35%	3.62%	27.79%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		22.10	2.02	3.89		8.18	3.26	1.41	6.95	47.82

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.10	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.37	(ha) 0.00	
1		0.0	0.0	0.0		0.0	0.0			
2		0.0	0.0	0.0		0.0	0.0			
3		0.0	0.0	0.0		0.0	0.0			
4		0.0	0.0	0.0		0.0	0.0			
5		0.0	0.0	0.0		0.0	0.0			
6		0.7	0.1	0.4		0.0	0.0			
7		0.0	0.0	0.0		0.0	0.0			
8		0.0	0.0	0.0		0.0	0.0			
Area Totals	1.2	0.7	0.1	0.4	0.1	0.0	0.0	0.4	0.0	
Total Soil Type 2 Catchment Area	1.64									
% Split to Total		42.90%	7.15%	21.45%		2.95%	2.95%	22.59%	0.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		36.04	5.72	6.86		2.89	2.36	18.08	0.00	71.95

Total Catchment Area	9.25		
	0.09	km2	52.10

WH1 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.94	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1		0.00	0.00	0.00		0.47	0.47			
2	5.52	3.31	0.55	1.66		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		0.00	0.00	0.00		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.00	0.00	0.00		0.00	0.00			
Area Totals	5.52	3.31	0.55	1.66	0.94	0.47	0.47	0.00	0.00	
Total Soil Type 1 Catchment Area	6.46									
% Split to Total		51.27%	8.54%	25.63%		7.28%	7.28%	0.00%	0.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		36.40	3.33	6.41		7.13	2.84	0.00	0.00	56.11

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.30	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1		0.0	0.0	0.0		0.2	0.2			
2	1.8	1.1	0.2	0.5		0.0	0.0			
3		0.0	0.0	0.0		0.0	0.0			
4		0.0	0.0	0.0		0.0	0.0			
5		0.0	0.0	0.0		0.0	0.0			
6		0.0	0.0	0.0		0.0	0.0			
7		0.0	0.0	0.0		0.0	0.0			
8		0.0	0.0	0.0		0.0	0.0			
Area Totals	1.8	1.1	0.2	0.5	0.3	0.2	0.2	0.0	0.0	
Total Soil Type 2 Catchment Area	2.10									
% Split to Total		51.43%	8.57%	25.71%		7.14%	7.14%	0.00%	0.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		43.20	6.86	8.23		7.00	5.71	0.00	0.00	71.00

Total Catchment Area	8.56		59.76
	0.09	km2	

WH1A - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.75	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1	[redacted]	0.00	0.00	0.00	[redacted]	0.37	0.37	[redacted]	[redacted]	
2	[redacted]	1.16	0.19	0.58	[redacted]	0.00	0.00	[redacted]	[redacted]	
3	[redacted]	0.00	0.00	0.00	[redacted]	0.00	0.00	[redacted]	[redacted]	
4	[redacted]	0.00	0.00	0.00	[redacted]	0.00	0.00	[redacted]	[redacted]	
5	[redacted]	0.00	0.00	0.00	[redacted]	0.00	0.00	[redacted]	[redacted]	
6	[redacted]	0.00	0.00	0.00	[redacted]	0.00	0.00	[redacted]	[redacted]	
7	[redacted]	0.00	0.00	0.00	[redacted]	0.00	0.00	[redacted]	[redacted]	
8	[redacted]	0.00	0.00	0.00	[redacted]	0.00	0.00	[redacted]	[redacted]	
Area Totals	1.93	1.16	0.19	0.58	0.75	0.37	0.37	0.00	0.00	
Total Soil Type 1 Catchment Area	2.68									
% Split to Total		43.27%	7.21%	21.64%		13.94%	13.94%	0.00%	0.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		30.72	2.81	5.41		13.66	5.44	0.00	0.00	58.04

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.01	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00	
1	[redacted]	0.0	0.0	0.0	[redacted]	0.0	0.0	[redacted]	[redacted]	
2	[redacted]	0.7	0.1	0.3	[redacted]	0.0	0.0	[redacted]	[redacted]	
3	[redacted]	0.0	0.0	0.0	[redacted]	0.0	0.0	[redacted]	[redacted]	
4	[redacted]	0.0	0.0	0.0	[redacted]	0.0	0.0	[redacted]	[redacted]	
5	[redacted]	0.0	0.0	0.0	[redacted]	0.0	0.0	[redacted]	[redacted]	
6	[redacted]	0.0	0.0	0.0	[redacted]	0.0	0.0	[redacted]	[redacted]	
7	[redacted]	0.0	0.0	0.0	[redacted]	0.0	0.0	[redacted]	[redacted]	
8	[redacted]	0.00	0.00	0.0	[redacted]	0.0	0.0	[redacted]	[redacted]	
Area Totals	1.1	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	
Total Soil Type 2 Catchment Area	1.09									
% Split to Total		59.72%	9.95%	29.86%		0.23%	0.23%	0.00%	0.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		50.16	7.96	9.56		0.23	0.19	0.00	0.00	68.10

Total Catchment Area	3.77		60.95
	0.04	km2	

WH2 - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.38	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.05	(ha) 0.00	
1		0.00	0.00	0.00		0.69	0.69			
2		0.00	0.00	0.00		0.00	0.00			
3	1.92	1.15	0.19	0.58		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		0.00	0.00	0.00		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.00	0.00	0.00		0.00	0.00			
Area Totals	1.92	1.15	0.19	0.58	1.38	0.69	0.69	0.05	0.00	
Total Soil Type 1 Catchment Area	3.35									
% Split to Total		34.39%	5.73%	17.19%		20.60%	20.60%	1.49%	0.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		24.42	2.24	4.30		20.19	8.03	0.58	0.00	59.75

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.27	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 1.60	(ha) 0.00	
1		0.0	0.0	0.0		0.1	0.1			
2		0.0	0.0	0.0		0.0	0.0			
3	0.3	0.2	0.0	0.1		0.0	0.0			
4		0.0	0.0	0.0		0.0	0.0			
5		0.0	0.0	0.0		0.0	0.0			
6		0.0	0.0	0.0		0.0	0.0			
7		0.0	0.0	0.0		0.0	0.0			
8		0.0	0.0	0.0		0.0	0.0			
Area Totals	0.3	0.2	0.0	0.1	0.3	0.1	0.1	1.6	0.0	
Total Soil Type 2 Catchment Area	2.17									
% Split to Total		8.45%	1.41%	4.23%		6.16%	6.16%	73.60%	0.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		7.10	1.13	1.35		6.03	4.93	58.88	0.00	79.42

Total Catchment Area	5.52		67.49
	0.06	km2	

WH2A - POST DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area					Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%		Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.41	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.46	(ha) 8.57	
1	[redacted]	0.00		0.00	0.00	[redacted]	0.21	0.21	[redacted]	[redacted]	
2	[redacted]	0.00		0.00	0.00		0.00	0.00			
3	[redacted]	3.14		0.52	1.57		0.00	0.00			
4	[redacted]	0.00		0.00	0.00		0.00	0.00			
5	[redacted]	0.00		0.00	0.00		0.00	0.00			
6	[redacted]	0.00		0.00	0.00		0.00	0.00			
7	[redacted]	0.00		0.00	0.00		0.00	0.00			
8	[redacted]	0.00		0.00	0.00		0.00	0.00			
Area Totals	5.24	3.14		0.52	1.57	0.41	0.21	0.21	0.46	8.57	
Total Soil Type 1 Catchment Area	14.68										
% Split to Total		21.41%		3.57%	10.70%		1.41%	1.41%	3.12%	58.38%	100.00%
CN for use Class		71		39	25		98	39	39	25	
Composite CN :		15.20		1.39	2.68		1.38	0.55	1.22	14.60	37.01

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area					Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%		Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) -	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.98	(ha) 0.00	
1	[redacted]	0.0		0.0	0.0	[redacted]	0.0	0.0	[redacted]	[redacted]	
2	[redacted]	0.0		0.0	0.0		0.0	0.0			
3	[redacted]	0.0		0.0	0.0		0.0	0.0			
4	[redacted]	0.0		0.0	0.0		0.0	0.0			
5	[redacted]	0.0		0.0	0.0		0.0	0.0			
6	[redacted]	0.0		0.0	0.0		0.0	0.0			
7	[redacted]	0.0		0.0	0.0		0.0	0.0			
8	[redacted]	0.0		0.0	0.0		0.0	0.0			
Area Totals	0.0	0.0		0.0	0.0	0.0	0.0	0.0	1.0	0.0	
Total Soil Type 2 Catchment Area	0.98										
% Split to Total		0.00%		0.00%	0.00%		0.00%	0.00%	100.00%	0.00%	100.00%
CN for use Class		84		80	32		98	80	80	83	
Composite CN :		0.00		0.00	0.00		0.00	0.00	80.00	0.00	80.00

Total Catchment Area	15.66		39.70
	0.16	km2	

ANNEXURE E4-2

PRE DEVELOPMENT

H1 - PRE-DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.17	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 2.27	
1	[illegible]	0.00	0.00	0.00	[illegible]	0.09	0.09	[illegible]	[illegible]	
2	[illegible]	0.00	0.00	0.00		0.00	0.00			
3	[illegible]	0.00	0.00	0.00		0.00	0.00			
4	[illegible]	0.00	0.00	0.00		0.00	0.00			
5	[illegible]	0.00	0.00	0.00		0.00	0.00			
6	[illegible]	0.00	0.00	0.00		0.00	0.00			
7	[illegible]	0.00	0.00	0.00		0.00	0.00			
8	[illegible]	0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.17	0.09	0.09	0.00	2.27	
Total Soil Type 1 Catchment Area	2.44									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.49	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 6.52	
1	[illegible]	0.0	0.0	0.0	[illegible]	0.25	0.25	[illegible]	[illegible]	
2	[illegible]	0.0	0.0	0.0		0.00	0.00			
3	[illegible]	0.0	0.0	0.0		0.00	0.00			
4	[illegible]	0.0	0.0	0.0		0.00	0.00			
5	[illegible]	0.0	0.0	0.0		0.00	0.00			
6	[illegible]	0.0	0.0	0.0		0.00	0.00			
7	[illegible]	0.0	0.0	0.0		0.00	0.00			
8	[illegible]	0.0	0.0	0.0		0.00	0.00			
Area Totals	0.0	0.0	0.0	0.0	0.5	0.2	0.2	0.0	6.5	
Total Soil Type 2 Catchment Area	7.01									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	9.45		69.12
	0.09	km2	

HN1 - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation **Hyrological soil group:** A

	Developed Area				Road Servitudes			Open Space	Cane Areas
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 50%	Soft Landscaping (ha) 15%	Permeable Paving (ha) 35%	Gross Area (ha) 0.21	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 2.79
1		0.00	0.00	0.00		0.11	0.11		
2		0.00	0.00	0.00		0.00	0.00		
3		0.00	0.00	0.00		0.00	0.00		
4		0.00	0.00	0.00		0.00	0.00		
5		0.00	0.00	0.00		0.00	0.00		
6		0.00	0.00	0.00		0.00	0.00		
7		0.00	0.00	0.00		0.00	0.00		
8		0.00	0.00	0.00		0.00	0.00		
Area Totals	0.00	0.00	0.00	0.00	0.21	0.11	0.11	0.00	2.79
Total Soil Type 1 Catchment Area	3.00								
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation **Hyrological soil group:** D

	Developed Area				Road Servitudes			Open Space	Cane Areas
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 50%	Soft Landscaping (ha) 15%	Permeable Paving (ha) 35%	Gross Area (ha) 0.62	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 8.27
1		0.0	0.0	0.0		0.31	0.31		
2		0.0	0.0	0.0		0.00	0.00		
3		0.0	0.0	0.0		0.00	0.00		
4		0.0	0.0	0.0		0.00	0.00		
5		0.0	0.0	0.0		0.00	0.00		
6		0.0	0.0	0.0		0.00	0.00		
7		0.0	0.0	0.0		0.00	0.00		
8		0.0	0.0	0.0		0.00	0.00		
Area Totals	0.0	0.0	0.0	0.0	0.6	0.3	0.3	0.0	8.3
Total Soil Type 2 Catchment Area	8.89								
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	11.89		69.44
	0.12	km2	

HN2 - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.64	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 8.47	
1	[illegible]	0.00	0.00	0.00	[illegible]	0.32	0.32	[illegible]	[illegible]	
2	[illegible]	0.00	0.00	0.00		0.00	0.00			
3	[illegible]	0.00	0.00	0.00		0.00	0.00			
4	[illegible]	0.00	0.00	0.00		0.00	0.00			
5	[illegible]	0.00	0.00	0.00		0.00	0.00			
6	[illegible]	0.00	0.00	0.00		0.00	0.00			
7	[illegible]	0.00	0.00	0.00		0.00	0.00			
8	[illegible]	0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.64	0.32	0.32	0.00	8.47	
Total Soil Type 1 Catchment Area	9.11									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.27	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 3.64	
1	[illegible]	0.0	0.0	0.0	[illegible]	0.14	0.14	[illegible]	[illegible]	
2	[illegible]	0.0	0.0	0.0		0.0	0.0			
3	[illegible]	0.0	0.0	0.0		0.0	0.0			
4	[illegible]	0.0	0.0	0.0		0.0	0.0			
5	[illegible]	0.0	0.0	0.0		0.0	0.0			
6	[illegible]	0.0	0.0	0.0		0.0	0.0			
7	[illegible]	0.0	0.0	0.0		0.0	0.0			
8	[illegible]	0.0	0.0	0.0		0.0	0.0			
Area Totals	0.0	0.0	0.0	0.0	0.3	0.1	0.1	0.0	3.6	
Total Soil Type 2 Catchment Area	3.91									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	13.02		44.67
	0.13	km2	

HN3 - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.28	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 3.69	
1		0.00	0.00	0.00		0.14	0.14			
2		0.00	0.00	0.00		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		0.00	0.00	0.00		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.28	0.14	0.14	0.00	3.69	
Total Soil Type 1 Catchment Area	3.97									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.14	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 1.83	
1		0.0	0.0	0.0		0.07	0.07			
2		0.0	0.0	0.0		0.00	0.00			
3		0.0	0.0	0.0		0.00	0.00			
4		0.0	0.0	0.0		0.00	0.00			
5		0.0	0.0	0.0		0.00	0.00			
6		0.0	0.0	0.0		0.00	0.00			
7		0.0	0.0	0.0		0.00	0.00			
8		0.0	0.0	0.0		0.00	0.00			
Area Totals	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	1.8	
Total Soil Type 2 Catchment Area	1.96									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	5.93		46.36
	0.06	km2	

HN4 - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation **Hyrological soil group:** A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.72	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 22.83	
1	[illegible]	0.00	0.00	0.00	[illegible]	0.86	0.86	[illegible]	[illegible]	
2	[illegible]	0.00	0.00	0.00		0.00	0.00			
3	[illegible]	0.00	0.00	0.00		0.00	0.00			
4	[illegible]	0.00	0.00	0.00		0.00	0.00			
5	[illegible]	0.00	0.00	0.00		0.00	0.00			
6	[illegible]	0.00	0.00	0.00		0.00	0.00			
7	[illegible]	0.00	0.00	0.00		0.00	0.00			
8	[illegible]	0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	1.72	0.86	0.86	0.00	22.83	
Total Soil Type 1 Catchment Area	24.55									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation **Hyrological soil group:** D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.29	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 3.83	
1	[illegible]	0.0	0.0	0.0	[illegible]	0.14	0.14	[illegible]	[illegible]	
2	[illegible]	0.0	0.0	0.0		0.00	0.00			
3	[illegible]	0.0	0.0	0.0		0.00	0.00			
4	[illegible]	0.0	0.0	0.0		0.00	0.00			
5	[illegible]	0.0	0.0	0.0		0.00	0.00			
6	[illegible]	0.0	0.0	0.0		0.00	0.00			
7	[illegible]	0.0	0.0	0.0		0.00	0.00			
8	[illegible]	0.0	0.0	0.0		0.00	0.00			
Area Totals	0.0	0.0	0.0	0.0	0.3	0.1	0.1	0.0	3.8	
Total Soil Type 2 Catchment Area	4.12									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	28.67		36.01
	0.29	km2	

HN4A - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation **Hyrological soil group:** A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.26	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 3.42	
1	[illegible]	0.00	0.00	0.00	[illegible]	0.13	0.13	[illegible]	[illegible]	
2	[illegible]	0.00	0.00	0.00		0.00	0.00			
3	[illegible]	0.00	0.00	0.00		0.00	0.00			
4	[illegible]	0.00	0.00	0.00		0.00	0.00			
5	[illegible]	0.00	0.00	0.00		0.00	0.00			
6	[illegible]	0.00	0.00	0.00		0.00	0.00			
7	[illegible]	0.00	0.00	0.00		0.00	0.00			
8	[illegible]	0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.26	0.13	0.13	0.00	3.42	
Total Soil Type 1 Catchment Area	3.68									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation **Hyrological soil group:** D

	Developed Area				Road Servitudes			Open Space	Cane Areas
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) -	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 0.00
1	[illegible]	0.0	0.0	0.0	[illegible]	0.00	0.00	[illegible]	[illegible]
2	[illegible]	0.0	0.0	0.0		0.00	0.00		
3	[illegible]	0.0	0.0	0.0		0.00	0.00		
4	[illegible]	0.0	0.0	0.0		0.00	0.00		
5	[illegible]	0.0	0.0	0.0		0.00	0.00		
6	[illegible]	0.0	0.0	0.0		0.00	0.00		
7	[illegible]	0.0	0.0	0.0		0.00	0.00		
8	[illegible]	0.0	0.0	0.0		0.00	0.00		
Area Totals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Soil Type 2 Catchment Area	0.00								
% Split to Total		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Total Catchment Area	3.68		#DIV/0!
	0.04	km2	

HN4B - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 50%	Soft Landscaping (ha) 15%	Permeable Paving (ha) 35%	Gross Area (ha) 0.41	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 5.51	
1	[illegible]	0.00	0.00	0.00	[illegible]	0.21	0.21	[illegible]	[illegible]	
2	[illegible]	0.00	0.00	0.00		0.00	0.00			
3	[illegible]	0.00	0.00	0.00		0.00	0.00			
4	[illegible]	0.00	0.00	0.00		0.00	0.00			
5	[illegible]	0.00	0.00	0.00		0.00	0.00			
6	[illegible]	0.00	0.00	0.00		0.00	0.00			
7	[illegible]	0.00	0.00	0.00		0.00	0.00			
8	[illegible]	0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.41	0.21	0.21	0.00	5.51	
Total Soil Type 1 Catchment Area	5.92									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 50%	Soft Landscaping (ha) 15%	Permeable Paving (ha) 35%	Gross Area (ha) 0.09	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 1.18	
1	[illegible]	0.0	0.0	0.0	[illegible]	0.04	0.04	[illegible]	[illegible]	
2	[illegible]	0.0	0.0	0.0		0.00	0.00			
3	[illegible]	0.0	0.0	0.0		0.00	0.00			
4	[illegible]	0.0	0.0	0.0		0.00	0.00			
5	[illegible]	0.0	0.0	0.0		0.00	0.00			
6	[illegible]	0.0	0.0	0.0		0.00	0.00			
7	[illegible]	0.0	0.0	0.0		0.00	0.00			
8	[illegible]	0.0	0.0	0.0		0.00	0.00			
Area Totals	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.2	
Total Soil Type 2 Catchment Area	1.27									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	7.20		37.83
	0.07	km2	

HC1 - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.54	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 7.13	
1	[illegible]	0.00	0.00	0.00	[illegible]	0.27	0.27	[illegible]	[illegible]	
2	[illegible]	0.00	0.00	0.00		0.00	0.00			
3	[illegible]	0.00	0.00	0.00		0.00	0.00			
4	[illegible]	0.00	0.00	0.00		0.00	0.00			
5	[illegible]	0.00	0.00	0.00		0.00	0.00			
6	[illegible]	0.00	0.00	0.00		0.00	0.00			
7	[illegible]	0.00	0.00	0.00		0.00	0.00			
8	[illegible]	0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.54	0.27	0.27	0.00	7.13	
Total Soil Type 1 Catchment Area	7.66									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.15	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 2.02	
1	[illegible]	0.0	0.0	0.0	[illegible]	0.08	0.08	[illegible]	[illegible]	
2	[illegible]	0.0	0.0	0.0		0.0	0.0			
3	[illegible]	0.0	0.0	0.0		0.0	0.0			
4	[illegible]	0.0	0.0	0.0		0.0	0.0			
5	[illegible]	0.0	0.0	0.0		0.0	0.0			
6	[illegible]	0.0	0.0	0.0		0.0	0.0			
7	[illegible]	0.0	0.0	0.0		0.0	0.0			
8	[illegible]	0.0	0.0	0.0		0.0	0.0			
Area Totals	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	2.0	
Total Soil Type 2 Catchment Area	2.17									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	9.83		40.27
	0.10	km2	

HS1 - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.33	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 17.72
1	0.00	0.00	0.00	0.00	1.33	0.67	0.67	0.00	17.72
2	0.00	0.00	0.00	0.00		0.00	0.00		
3	0.00	0.00	0.00	0.00		0.00	0.00		
4	0.00	0.00	0.00	0.00		0.00	0.00		
5	0.00	0.00	0.00	0.00		0.00	0.00		
6	0.00	0.00	0.00	0.00		0.00	0.00		
7	0.00	0.00	0.00	0.00		0.00	0.00		
8	0.00	0.00	0.00	0.00		0.00	0.00		
Area Totals	0.00	0.00	0.00	0.00	1.33	0.67	0.67	0.00	17.72
Total Soil Type 1 Catchment Area	19.06								
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.71	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 9.45
1	0.0	0.0	0.0	0.0	0.7	0.36	0.36	0.0	9.5
2	0.0	0.0	0.0	0.0		0.0	0.0		
3	0.0	0.0	0.0	0.0		0.0	0.0		
4	0.0	0.0	0.0	0.0		0.0	0.0		
5	0.0	0.0	0.0	0.0		0.0	0.0		
6	0.0	0.0	0.0	0.0		0.0	0.0		
7	0.0	0.0	0.0	0.0		0.0	0.0		
8	0.0	0.0	0.0	0.0		0.0	0.0		
Area Totals	0.0	0.0	0.0	0.0	0.7	0.4	0.4	0.0	9.5
Total Soil Type 2 Catchment Area	10.16								
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	29.22		47.31
	0.29	km2	

HS2 - PRE- DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation Hyrological soil group: A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.53	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 7.08	
1	[illegible]	0.00	0.00	0.00	[illegible]	0.27	0.27	[illegible]	[illegible]	
2	[illegible]	0.00	0.00	0.00		0.00	0.00			
3	[illegible]	0.00	0.00	0.00		0.00	0.00			
4	[illegible]	0.00	0.00	0.00		0.00	0.00			
5	[illegible]	0.00	0.00	0.00		0.00	0.00			
6	[illegible]	0.00	0.00	0.00		0.00	0.00			
7	[illegible]	0.00	0.00	0.00		0.00	0.00			
8	[illegible]	0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.53	0.27	0.27	0.00	7.08	
Total Soil Type 1 Catchment Area	7.61									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation Hyrological soil group: D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.11	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 1.52	
1	[illegible]	0.0	0.0	0.0	[illegible]	0.06	0.06	[illegible]	[illegible]	
2	[illegible]	0.0	0.0	0.0		0.0	0.0			
3	[illegible]	0.0	0.0	0.0		0.0	0.0			
4	[illegible]	0.0	0.0	0.0		0.0	0.0			
5	[illegible]	0.0	0.0	0.0		0.0	0.0			
6	[illegible]	0.0	0.0	0.0		0.0	0.0			
7	[illegible]	0.0	0.0	0.0		0.0	0.0			
8	[illegible]	0.0	0.0	0.0		0.0	0.0			
Area Totals	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	1.5	
Total Soil Type 2 Catchment Area	1.64									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	9.25		37.86
	0.09	km2	

WH1 - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation **Hyrological soil group:** A

	Developed Area				Road Servitudes			Open Space	Cane Areas
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.45	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 6.01
1	[illegible]	0.00	0.00	0.00	[illegible]	0.23	0.23	[illegible]	[illegible]
2	[illegible]	0.00	0.00	0.00		0.00	0.00		
3	[illegible]	0.00	0.00	0.00		0.00	0.00		
4	[illegible]	0.00	0.00	0.00		0.00	0.00		
5	[illegible]	0.00	0.00	0.00		0.00	0.00		
6	[illegible]	0.00	0.00	0.00		0.00	0.00		
7	[illegible]	0.00	0.00	0.00		0.00	0.00		
8	[illegible]	0.00	0.00	0.00		0.00	0.00		
Area Totals	0.00	0.00	0.00	0.00	0.45	0.23	0.23	0.00	6.01
Total Soil Type 1 Catchment Area	6.46								
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation **Hyrological soil group:** D

	Developed Area				Road Servitudes			Open Space	Cane Areas
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.15	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 1.95
1	[illegible]	0.0	0.0	0.0	[illegible]	0.07	0.07	[illegible]	[illegible]
2	[illegible]	0.0	0.0	0.0		0.0	0.0		
3	[illegible]	0.0	0.0	0.0		0.0	0.0		
4	[illegible]	0.0	0.0	0.0		0.0	0.0		
5	[illegible]	0.0	0.0	0.0		0.0	0.0		
6	[illegible]	0.0	0.0	0.0		0.0	0.0		
7	[illegible]	0.0	0.0	0.0		0.0	0.0		
8	[illegible]	0.0	0.0	0.0		0.0	0.0		
Area Totals	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	2.0
Total Soil Type 2 Catchment Area	2.10								
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	8.56		
	0.09	km2	41.63

WH1A - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation **Hyrological soil group:** A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.19	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 2.49	
1		0.00	0.00	0.00		0.09	0.09			
2		0.00	0.00	0.00		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		0.00	0.00	0.00		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.19	0.09	0.09	0.00	2.49	
Total Soil Type 1 Catchment Area	2.68									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation **Hyrological soil group:** D

	Developed Area				Road Servitudes			Open Space	Cane Areas
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.08	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 1.02
1		0.0	0.0	0.0		0.04	0.04		
2		0.0	0.0	0.0		0.0	0.0		
3		0.0	0.0	0.0		0.0	0.0		
4		0.0	0.0	0.0		0.0	0.0		
5		0.0	0.0	0.0		0.0	0.0		
6		0.0	0.0	0.0		0.0	0.0		
7		0.0	0.0	0.0		0.0	0.0		
8		0.0	0.0	0.0		0.0	0.0		
Area Totals	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.0
Total Soil Type 2 Catchment Area	1.09								
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	3.77		44.08
	0.04	km2	

WH2 - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation **Hyrological soil group:** A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.23	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 3.12	
1		0.00	0.00	0.00		0.12	0.12			
2		0.00	0.00	0.00		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		0.00	0.00	0.00		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	0.23	0.12	0.12	0.00	3.12	
Total Soil Type 1 Catchment Area	3.35									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation **Hyrological soil group:** D

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.15	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 2.02	
1		0.0	0.0	0.0		0.08	0.08			
2		0.0	0.0	0.0		0.0	0.0			
3		0.0	0.0	0.0		0.0	0.0			
4		0.0	0.0	0.0		0.0	0.0			
5		0.0	0.0	0.0		0.0	0.0			
6		0.0	0.0	0.0		0.0	0.0			
7		0.0	0.0	0.0		0.0	0.0			
8		0.0	0.0	0.0		0.0	0.0			
Area Totals	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	2.0	
Total Soil Type 2 Catchment Area	2.17									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.43	2.80	0.00	77.19	83.42

Total Catchment Area	5.52		
	0.06	km2	49.84

WH2A - PRE DEVELOPMENT - SPLIT OF AREA FOR CN CALCULATION:

Sub Soil Description: Berea Red Formation **Hyrological soil group:** A

	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 1.03	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.00	(ha) 13.65	
1		0.00	0.00	0.00		0.51	0.51			
2		0.00	0.00	0.00		0.00	0.00			
3		0.00	0.00	0.00		0.00	0.00			
4		0.00	0.00	0.00		0.00	0.00			
5		0.00	0.00	0.00		0.00	0.00			
6		0.00	0.00	0.00		0.00	0.00			
7		0.00	0.00	0.00		0.00	0.00			
8		0.00	0.00	0.00		0.00	0.00			
Area Totals	0.00	0.00	0.00	0.00	1.03	0.51	0.51	0.00	13.65	
Total Soil Type 1 Catchment Area	14.68									
% Split to Total		0.00%	0.00%	0.00%		3.50%	3.50%	0.00%	93.00%	100.00%
CN for use Class		71	39	25		98	39	39	25	
Composite CN :		0.00	0.00	0.00		3.43	1.37	0.00	23.25	28.05

Sub Soil Description: Vryheid Formation **Hyrological soil group:** D

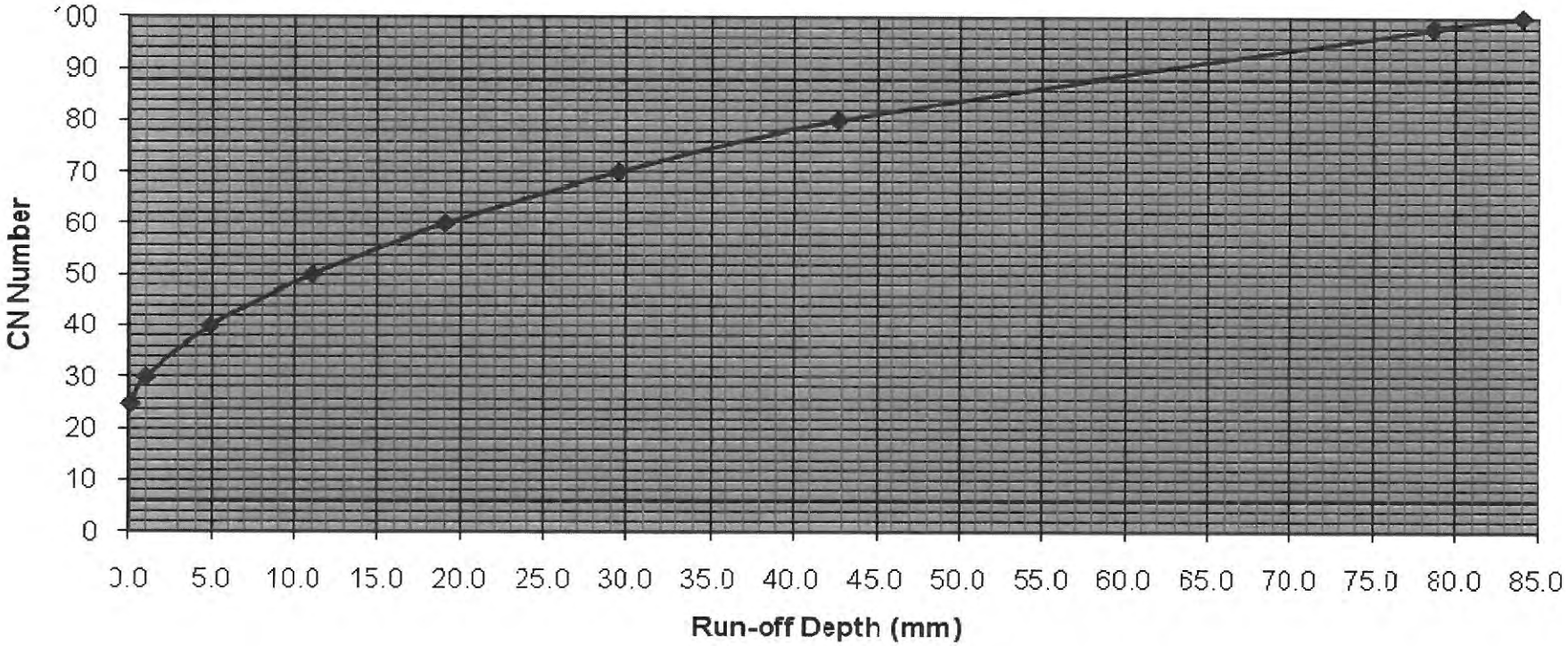
	Developed Area				Road Servitudes			Open Space	Cane Areas	
Sub-Precinct	Gross Area in Catchment(ha)	Building Area (ha) 60%	Soft Landscaping (ha) 10%	Permeable Paving (ha) 30%	Gross Area (ha) 0.07	Impermeable Suface (ha) 50%	Soft Landscaping (ha) 50%	(ha) 0.98	(ha) 0.07	
1		0.0	0.0	0.0		0.03	0.03			
2		0.0	0.0	0.0		0.0	0.0			
3		0.0	0.0	0.0		0.0	0.0			
4		0.0	0.0	0.0		0.0	0.0			
5		0.0	0.0	0.0		0.0	0.0			
6		0.0	0.0	0.0		0.0	0.0			
7		0.0	0.0	0.0		0.0	0.0			
8		0.0	0.0	0.0		0.0	0.0			
Area Totals	0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.0	0.1	
Total Soil Type 2 Catchment Area	1.12									
% Split to Total		0.00%	0.00%	0.00%		3.07%	3.07%	87.72%	6.14%	100.00%
CN for use Class		84	80	32		98	80	80	83	
Composite CN :		0.00	0.00	0.00		3.01	2.46	70.18	5.10	80.74

Total Catchment Area	15.80		
	0.16	km2	31.77

ANNEXURE E5

TYPICAL RUN-OFF DEPTH FOR VARIOUS CN NUMBERS

Typical Run-off Depth for Various CN Numbers



ANNEXURE E6

RAINFALL STATION DATA AND DESIGN RAINFALL INTENSITY DISTRIBUTION MAP

F1: Rainfall Station Data

Rainfall Stations

General Rainfall Station Information: Please Choose from the list of closest Rainfall Stations:

Station Number	SAWB Code	Station Name	Lat / Long DG MN DG MN	MAP (mm)	Altitude (m)	Years	Distance (km)
1	241302	FRASERS	29 32 31 11	971	76	46	7.6
2	241068	NO NAME	29 38 31 3	854	122	44	10.5
3	241131	BLACKBURN	29 41 31 5	922	15	62	12.1
4	241163	NO NAME	29 43 31 6	1043	15	27	14.8
5	241103	CORNUBIA	29 43 31 4	998	91	62	16.1

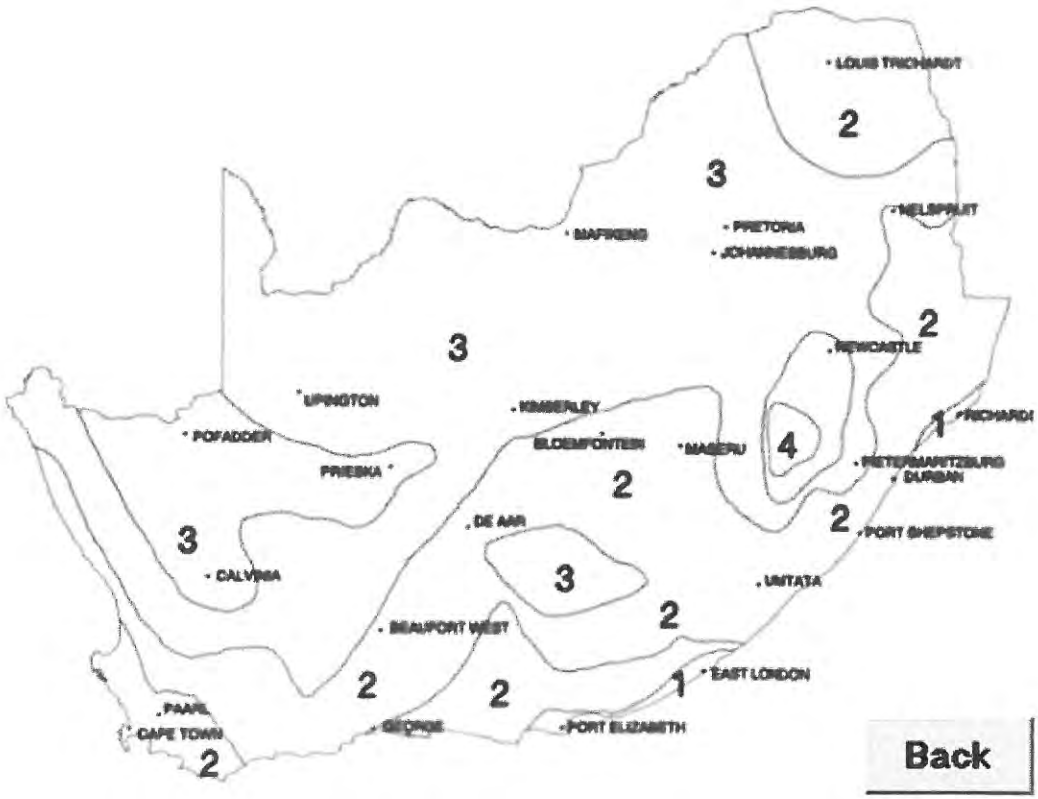
THE CATCHMENT ALTITUDE = 85 m and MAP = 970 mm

The above list gives the 5 closest stations to the specified location. When choosing a station, you should not only consider the distance, but also the years of record, the MAP and the altitude

1-Day Design Rainfall Depth (mm) for the following Return Periods

2	5	10	20	50	100	200
84	122	153	188	241	287	340
86	133	173	218	290	354	428
85	126	161	201	262	316	378
80	114	141	170	215	253	296
89	132	168	208	270	326	389

F2: Design Rainfall Intensity Distribution Map



ANNEXURE E7

SUMMARY OF THE INPUT DATA IN THE ANALYSIS AND OUTPUT RESULTS USING SWMM MODEL

25mm Rainfall Pre-Development Runoff

SN	Element ID	Descripti on	Area (ha)	Drainage Node ID	Weighted Curve Number	Conductivity (mm/hr)	Drying Time (days)	Average Slope (%)	Equivalent Width (m)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (mm)	Impervious Area Manning's Roughness	Pervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m³)	Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	H1		17.33	06	69.12	4.0000	7.00	8.2700	174.40	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.5600	4082.95	0.18	0.00	0 03:49:37
2	HC1		10.01	13	40.27	4.0000	7.00	9.2600	231.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7340	2375.77	0.00	0.00	0 02:14:48
3	HN1		11.93	07	69.44	4.0000	7.00	2.8900	285.04	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.4720	2800.21	0.26	0.00	0 03:07:19
4	HN2		19.00	08	44.67	4.0000	7.00	4.0100	219.18	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7450	4511.55	0.00	0.00	0 04:22:48
5	HN3		5.27	03	46.36	4.0000	7.00	9.4300	166.83	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	1250.62	0.00	0.00	0 01:50:59
6	HN4A		3.65	04	28.05	4.0000	7.00	6.5400	140.54	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	24.0760	878.77	0.00	0.00	0 01:50:09
7	HN4B		10.14	01	37.83	4.0000	7.00	5.6400	321.11	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7440	2407.64	0.00	0.00	0 02:09:27
8	HS1		19.94	05	47.31	4.0000	7.00	7.2600	271.90	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	4731.96	0.00	0.00	0 03:18:58
9	HS2		9.21	17	37.86	4.0000	7.00	11.3500	217.95	0.00	25.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7420	2186.64	0.00	0.00	0 02:04:57
10	Sub-15		6.52	02	36.01	0.1500	7.00	8.0000	186.00	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7470	1548.30	0.00	0.00	0 02:04:05
11	HN4		20.53	02	36.01	0.1500	7.00	8.0000	327.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7470	4875.26	0.00	0.00	0 02:56:03
12	Sub-18		2.66	02	36.01	0.1500	7.00	8.0000	154.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7470	631.67	0.00	0.00	0 01:21:12
13	Sub-19		3.28	02	36.01	0.1500	7.00	8.0000	136.02	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7470	778.90	0.00	0.00	0 01:39:03
14	WH1		8.58	10	41.63	4.0000	7.00	3.7000	261.74	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7440	2037.24	0.00	0.00	0 02:30:12
15	WH1A		3.73	09	44.08	4.0000	7.00	9.2400	114.06	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	885.17	0.00	0.00	0 01:54:01
16	WH2		5.60	12	49.84	4.0000	7.00	8.0400	151.93	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7400	1329.44	0.00	0.00	0 02:07:44
17	WH2A		15.85	11	31.77	4.0000	7.00	2.1000	259.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.9040	3788.78	0.00	0.00	0 04:18:43
18	WH3		3.72	22	72.00	0.1500	7.00	9.0000	150.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	17.8000	662.16	6.26	0.10	0 01:21:51
19	WH4		5.09	21	72.00	0.1500	7.00	7.8000	208.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	17.8000	906.02	6.26	0.13	0 01:24:51
20	WH5		3.61	10	72.00	0.1500	7.00	8.8000	134.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	17.8000	642.58	6.26	0.09	0 01:26:35
			185.65																	Volume infiltration =		43312 m³			

1:2 Yr Pre-Development Runoff

SN	Element ID	Descripti on	Area (ha)	Drainage Node ID	Weighted Curve Number	Conductivity (mm/hr)	Drying Time (days)	Average Slope (%)	Equivalent Width (m)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (mm)	Impervious Area Manning's Roughness	Pervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m³)	Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	H1		17.33	06	69.12	4.0000	7.00	8.2700	174.40	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	52.7610	9143.48	30.01	0.37	0 02:21:22
2	HC1		10.01	13	40.27	4.0000	7.00	9.2600	231.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	72.2440	7231.62	10.52	0.06	0 01:22:59
3	HN1		11.93	07	69.44	4.0000	7.00	2.8900	285.04	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	52.0570	6210.40	30.71	0.33	0 01:55:20
4	HN2		19.00	08	44.67	4.0000	7.00	4.0100	219.18	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	71.0420	13497.98	11.70	0.08	0 02:41:48
5	HN3		5.27	03	46.36	4.0000	7.00	9.4300	166.83	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	68.7260	3621.86	14.02	0.06	0 01:08:19
6	HN4A		3.65	04	28.05	4.0000	7.00	6.5400	140.54	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	77.6550	2834.41	5.12	0.01	0 01:07:49
7	HN4B		10.14	01	37.83	4.0000	7.00	5.6400	321.11	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	73.4120	7443.98	9.34	0.05	0 01:19:42
8	HS1		19.94	05	47.31	4.0000	7.00	7.2600	271.90	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	68.9430	13747.23	13.80	0.14	0 02:02:30
9	HS2		9.21	17	37.86	4.0000	7.00	11.3500	217.95	0.00	25.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	73.3440	6754.98	9.39	0.05	0 01:16:56
10	Sub-15		6.52	02	36.01	0.1500	7.00	8.0000	186.00	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	74.2350	4840.12	8.51	0.03	0 01:16:23
11	HN4		20.53	02	36.01	0.1500	7.00	8.0000	327.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	74.6560	15326.88	8.10	0.07	0 01:48:23
12	Sub-18		2.66	02	36.01	0.1500	7.00	8.0000	154.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	73.9200	1966.27	6.83	0.02	0 00:49:59
13	Sub-19		3.28	02	36.01	0.1500	7.00	8.0000	136.02	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	74.0780	2429.76	8.70	0.02	0 01:00:59
14	WH1		8.58	10	41.63	4.0000	7.00	3.7000	261.74	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	71.6470	6147.31	11.09	0.05	0 01:32:29
15	WH1A		3.73	09	44.08	4.0000	7.00	9.2400	114.06	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	70.0720	2613.69	12.71	0.04	0 01:10:12
16	WH2		5.60	12	49.84	4.0000	7.00	8.0400	151.93	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	66.7840	3739.90	15.97	0.07	0 01:18:38
17	WH2A		15.85	11	31.77	4.0000	7.00	2.1000	259.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	84.00	0.00	0.0000	77.2320	12241.27	5.55	0.03	0 02:39:17
18	WH3		3.72	22	72.00	0.1500	7.00	9.0000	150.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	37.3340	1388.82	45.79	0.48	0 00:50:24
19	WH4		5.09	21	72.00	0.1500	7.00	7.8000	208.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	37.3500	1901.12	45.77	0.65	0 00:52:14
20	WH5		3.61	10	72.00	0.1500	7.00	8.8000	134.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	37.3660	1348.91	45.76	0.46	0 00:53:19
																				Volume infiltration =		124430 m³			

Hlawe subcatchment area	139.47
Tongaat subcatchment are	46.18
Total catchment area	185.65

1:5 Yr Pre-Development Runoff

SN	Element ID	Description	Area (ha)	Drainage Node ID	Weighted Curve Number	Conductivity (mm/hr)	Drying Time (days)	Average Slope (%)	Equivalent Width (m)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (mm)	Impervious Area Manning's Roughness	Pervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m^3)	Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	H1		17.33	06	69.12	4.0000	7.00	8.2700	174.40	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	63.5300	11009.75	57.24	0.98	0 02:01:45
2	HC1		10.01	13	40.27	4.0000	7.00	9.2600	231.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	96.0780	9617.41	24.72	0.25	0 01:11:28
3	HN1		11.93	07	69.44	4.0000	7.00	2.8900	285.04	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	62.6550	7474.74	58.14	0.84	0 01:39:20
4	HN2		19.00	08	44.67	4.0000	7.00	4.0100	219.18	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	93.3180	17730.42	27.46	0.30	0 02:19:21
5	HN3		5.27	03	46.36	4.0000	7.00	9.4300	166.83	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	89.9110	4738.31	30.90	0.23	0 00:58:51
6	HN4A		3.65	04	28.05	4.0000	7.00	6.5400	140.54	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	106.2620	3878.56	14.51	0.04	0 00:58:25
7	HN4B		10.14	01	37.83	4.0000	7.00	5.6400	321.11	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	98.2650	9964.07	22.55	0.23	0 01:08:38
8	HS1		19.94	05	47.31	4.0000	7.00	7.2600	271.90	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	89.9030	17926.66	30.87	0.49	0 01:45:30
9	HS2		9.21	17	37.86	4.0000	7.00	11.3500	217.95	0.00	25.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	98.1710	9041.55	22.63	0.21	0 01:06:15
10	Sub-15		6.52	02	36.01	0.1500	7.00	8.0000	186.00	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	99.7670	6504.81	20.99	0.14	0 01:05:47
11	HN4		20.53	02	36.01	0.1500	7.00	8.0000	327.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	100.3650	20604.93	20.44	0.29	0 01:33:21
12	Sub-18		2.66	02	36.01	0.1500	7.00	8.0000	154.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	99.3670	2643.16	21.44	0.08	0 00:43:03
13	Sub-19		3.28	02	36.01	0.1500	7.00	8.0000	136.02	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	99.5670	3265.80	21.25	0.09	0 00:52:31
14	WH1		8.58	10	41.63	4.0000	7.00	3.7000	261.74	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	94.9210	8144.22	25.83	0.21	0 01:19:39
15	WH1A		3.73	09	44.08	4.0000	7.00	9.2400	114.06	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	92.2230	3439.92	28.59	0.14	0 01:00:27
16	WH2		5.60	12	49.84	4.0000	7.00	8.0400	151.93	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	86.4730	4842.49	34.33	0.25	0 01:07:44
17	WH2A		15.85	11	31.77	4.0000	7.00	2.1000	259.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	122.00	0.00	0.0000	104.8640	16620.94	15.94	0.11	0 02:17:11
18	WH3		3.72	22	72.00	0.1500	7.00	9.0000	150.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	44.2910	1647.63	76.89	0.88	0 00:43:24
19	WH4		5.09	21	72.00	0.1500	7.00	7.8000	208.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	44.3070	2255.23	76.87	1.19	0 00:44:59
20	WH5		3.61	10	72.00	0.1500	7.00	8.8000	134.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	44.3230	1600.06	76.85	0.83	0 00:45:55

1:10 Yr Pre-Development Runoff

SN	Element ID	Description	Area (ha)	Drainage Node ID	Weighted Curve Number	Conductivity (mm/hr)	Drying Time (days)	Average Slope (%)	Equivalent Width (m)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (mm)	Impervious Area Manning's Roughness	Pervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m^3)	Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	H1		17.33	06	69.12	4.0000	7.00	8.2700	174.40	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	70.0130	12133.25	81.78	1.64	0 01:51:12
2	HC1		10.01	13	40.27	4.0000	7.00	9.2600	231.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	112.9650	11307.80	38.85	0.51	0 01:05:17
3	HN1		11.93	07	69.44	4.0000	7.00	2.8900	285.04	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	69.0080	8232.65	82.81	1.39	0 01:30:43
4	HN2		19.00	08	44.67	4.0000	7.00	4.0100	219.18	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	108.7300	20658.70	43.03	0.58	0 02:07:17
5	HN3		5.27	03	46.36	4.0000	7.00	9.4300	166.83	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	104.4610	5505.09	47.34	0.43	0 00:53:45
6	HN4A		3.65	04	28.05	4.0000	7.00	6.5400	140.54	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	127.6120	4657.84	24.17	0.11	0 00:53:21
7	HN4B		10.14	01	37.83	4.0000	7.00	5.6400	321.11	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	116.0000	11762.40	35.78	0.47	0 01:02:41
8	HS1		19.94	05	47.31	4.0000	7.00	7.2600	271.90	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	104.2860	20794.63	47.53	0.94	0 01:36:22
9	HS2		9.21	17	37.86	4.0000	7.00	11.3500	217.95	0.00	25.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	115.9590	10679.82	35.87	0.44	0 01:00:31
10	Sub-15		6.52	02	36.01	0.1500	7.00	8.0000	186.00	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	118.2470	7709.70	33.56	0.28	0 01:00:05
11	HN4		20.53	02	36.01	0.1500	7.00	8.0000	327.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	118.8480	24399.49	32.91	0.62	0 01:25:16
12	Sub-18		2.66	02	36.01	0.1500	7.00	8.0000	154.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	117.7210	3131.38	34.09	0.18	0 00:39:19
13	Sub-19		3.28	02	36.01	0.1500	7.00	8.0000	136.02	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	117.9460	3868.63	33.86	0.18	0 00:47:58
14	WH1		8.58	10	41.63	4.0000	7.00	3.7000	261.74	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	111.3700	9555.55	40.44	0.42	0 01:12:45
15	WH1A		3.73	09	44.08	4.0000	7.00	9.2400	114.06	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	107.6410	4015.01	44.17	0.27	0 00:55:13
16	WH2		5.60	12	49.84	4.0000	7.00	8.0400	151.93	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	99.7710	5587.18	52.04	0.47	0 01:01:52
17	WH2A		15.85	11	31.77	4.0000	7.00	2.1000	259.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	153.00	0.00	0.0000	125.0710	19823.75	26.69	0.24	0 02:05:18
18	WH3		3.72	22	72.00	0.1500	7.00	9.0000	150.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.3920	1800.18	103.84	1.23	0 00:39:38
19	WH4		5.09	21	72.00	0.1500	7.00	7.8000	208.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.4230	2464.73	103.81	1.66	0 00:41:05
20	WH5		3.61	10	72.00	0.1500	7.00	8.8000	134.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.4230	1748.07	103.80	1.17	0 00:41:56

1:50 Yr Pre-Development Runoff

SN	Element ID	Description	Area (ha)	Drainage Node ID	Weighted Curve Number	Conductivity (mm/hr)	Drying Time (days)	Average Slope (%)	Equivalent Width (m)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (mm)	Impervious Area Manning's Roughness	Pervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m^3)	Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	H1		17.33	06	69.12	4.0000	7.00	8.2700	174.40	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	82.1060	14228.97	157.76	4.05	0 01:32:43
2	HC1		10.01	13	40.27	4.0000	7.00	9.2600	231.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	151.6330	15178.46	88.26	1.61	0 00:54:26
3	HN1		11.93	07	69.44	4.0000	7.00	2.8900	285.04	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	90.8570	9646.24	159.06	3.34	0 01:15:38
4	HN2		19.00	08	44.67	4.0000	7.00	4.0100	219.18	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	143.1300	27194.70	96.72	1.91	0 01:46:07
5	HN3		5.27	03	46.36	4.0000	7.00	9.4300	166.83	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	136.6400	7200.93	103.32	1.20	0 00:44:48
6	HN4A		3.65	04	28.05	4.0000	7.00	6.5400	140.54	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	180.2200	6578.03	59.71	0.40	0 00:44:29
7	HN4B		10.14	01	37.83	4.0000	7.00	5.6400	321.11	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	157.3910	15959.45	82.52	1.54	0 00:52:16
8	HS1		19.94	05	47.31	4.0000	7.00	7.2600	271.90	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	135.7000	27058.58	104.17	2.89	0 01:20:21
9	HS2		9.21	17	37.86	4.0000	7.00	11.3500	217.95	0.00	25.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	157.2300	14480.88	82.67	1.44	0 00:50:27
10	Sub-15		6.52	02	36.01	0.1500	7.00	8.0000	186.00	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	161.6180	10537.49	78.28	0.95	0 00:50:06
11	HN4		20.53	02	36.01	0.1500	7.00	8.0000	327.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	162.4300	33346.88	77.40	2.14	0 01:11:05
12	Sub-18		2.66	02	36.01	0.1500	7.00	8.0000	154.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	160.8970	4279.86	79.03	0.51	0 00:32:47
13	Sub-19		3.28	02	36.01	0.1500	7.00	8.0000	136.02	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	161.1680	5286.31	78.71	0.56	0 00:39:59
14	WH1		8.58	10	41.63	4.0000	7.00	3.7000	261.74	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	148.6380	12753.14	91.26	1.32	0 01:00:39
15	WH1A		3.73	09	44.08	4.0000	7.00	9.2400	114.06	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	142.1820	5303.39	97.76	0.78	0 00:46:02
16	WH2		5.60	12	49.84	4.0000	7.00	8.0400	151.93	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	128.4890	7195.38	111.47	1.29	0 00:51:34
17	WH2A		15.85	11	31.77	4.0000	7.00	2.1000	259.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	241.00	0.00	0.0000	173.8860	27560.93	65.96	0.91	0 01:44:28
18	WH3		3.72	22	72.00	0.1500	7.00	9.0000	150.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	241.00	0.00	0.0000	55.9340	2080.74	184.52	2.36	0 00:33:03
19	WH4		5.09	21	72.00	0.1500	7.00	7.8000	208.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	241.00	0.00	0.0000	55.9610	2848.41	184.48	3.19	0 00:34:15
20	WH5		3.61	10	72.00	0.1500	7.00	8.8000	134.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	241.00	0.00	0.0000	55.9750	2020.70	184.46	2.24	0 00:34:58

1:100 Yr Pre-Development Runoff

SN	Element ID	Description	Area (ha)	Drainage Node ID	Weighted Curve Number	Conductivity (mm/hr)	Drying Time (days)	Average Slope (%)	Equivalent Width (m)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (mm)	Impervious Area Manning's Roughness	Pervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m^3)	Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	H1		17.33	06	69.12	4.0000	7.00	8.2700	174.40	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	86.2710	14950.76	199.65	5.55	0 01:26:27
2	HC1		10.01	13	40.27	4.0000	7.00	9.2600	231.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	167.7030	16787.07	118.21	2.35	0 00:50:45
3	HN1		11.93	07	69.44	4.0000	7.00	2.8900	285.04	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	84.9350	10132.75	201.05	4.51	0 01:10:32
4	HN2		19.00	08	44.67	4.0000	7.00	4.0100	219.18	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	156.9940	29828.86	128.84	2.85	0 01:38:57
5	HN3		5.27	03	46.36	4.0000	7.00	9.4300	166.83	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	149.5330	7880.39	136.51	1.68	0 00:41:47
6	HN4A		3.65	04	28.05	4.0000	7.00	6.5400	140.54	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	203.7390	7436.47	82.23	0.61	0 00:41:28
7	HN4B		10.14	01	37.83	4.0000	7.00	5.6400	321.11	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	174.8580	17730.60	111.10	2.26	0 00:48:44
8	HS1		19.94	05	47.31	4.0000	7.00	7.2600	271.90	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	148.1890	29548.89	137.69	4.26	0 01:14:55
9	HS2		9.21	17	37.86	4.0000	7.00	11.3500	217.95	0.00	25.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	174.6770	16087.75	111.28	2.10	0 00:47:03
10	Sub-15		6.52	02	36.01	0.1500	7.00	8.0000	186.00	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	180.1630	11746.63	105.81	1.40	0 00:46:43
11	HN4		20.53	02	36.01	0.1500	7.00	8.0000	327.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	181.0120	37161.76	104.83	3.29	0 01:06:17
12	Sub-18		2.66	02	36.01	0.1500	7.00	8.0000	154.00	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	179.4070	4772.23	106.66	0.72	0 00:30:34
13	Sub-19		3.28	02	36.01	0.1500	7.00	8.0000	136.02	0.00	0.00	0.0500	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	179.6910	5893.86	106.29	0.81	0 00:37:17
14	WH1		8.58	10	41.63	4.0000	7.00	3.7000	261.74	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	163.9600	14067.77	121.93	1.94	0 00:56:33
15	WH1A		3.73	09	44.08	4.0000	7.00	9.2400	114.06	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	156.2490	5828.09	129.80	1.10	0 00:42:55
16	WH2		5.60	12	49.84	4.0000	7.00	8.0400	151.93	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	139.7450	7825.72	146.29	1.80	0 00:48:05
17	WH2A		15.85	11	31.77	4.0000	7.00	2.1000	259.29	0.00	0.00	2.0000	0.0150	3.8000	0.1000	0.00	FRASER	287.00	0.00	0.0000	195.2150	30941.58	90.63	1.44	0 01:37:25
18	WH3		3.72	22	72.00	0.1500	7.00	9.0000	150.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	287.00	0.00	0.0000	58.5050	2176.39	228.09	3.00	0 00:30:49
19	WH4		5.09	21	72.00	0.1500	7.00	7.8000	208.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	287.00	0.00	0.0000	58.5180	2978.57	228.05	4.06	0 00:31:57
20	WH5		3.61	10	72.00	0.1500	7.00	8.8000	134.00	25.00	25.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	287.00	0.00	0.0000	58.5300	2112.93	228.03	2.85	0 00:32:36

25mm Rainfall Post-Development Runoff

SN	Element ID	Description	Area (ha)	Drainage Node ID	Modified Curve Number	Conductivity (mm/hr)	Drying Time (days)	Average Slope (%)	Pavement Width (m)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (mm)	Impervious Area Manning's Roughness	Pervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration Pond pumped (m³)	Total Infiltration Roof after swales (m³)	Total Infiltration Road swales (m³)	Total Runoff (cms)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	RF3B		1.89	21	76.40	0.1500	7.00	2.0000	129.15	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	426.95	283.50		0.63	0.00	0 01:51:18
2	RFP18B-1		1.91	RSTR4B	76.40	0.1500	7.00	5.0000	104.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	431.47	286.50		0.68	0.00	0 01:36:52
3	RFP18B-2		1.15	61	76.40	0.1500	7.00	5.0000	108.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	259.79	172.50		0.78	0.00	0 01:09:44
4	RFP5		2.47	36	65.00	0.1500	7.00	5.0000	119.76	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	586.16	370.50		0.00	0.00	0 01:43:56
5	RFP9A		0.69	48	76.40	0.1500	7.00	6.1500	86.11	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	155.87	103.50		0.83	0.00	0 00:55:09
6	RMR1		0.26	28	65.00	0.1500	7.00	1.0000	90.58	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	61.70		109.20	0.00	0.00	0 00:51:21
7	RMR2		0.28	28	65.00	0.1500	7.00	1.0000	91.79	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	66.45		117.60	0.00	0.00	0 00:53:22
8	RMR3		0.69	28	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	163.74		289.80	0.00	0.00	0 02:49:52
9	RMR4		0.61	28	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	144.76		256.20	0.00	0.00	0 02:37:51
10	RMR5		2.00	31	65.00	0.1500	7.00	1.0000	38.20	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	474.62		840.00	0.00	0.00	0 04:54:16
11	RMR6		1.15	32	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	272.91		483.00	0.00	0.00	0 03:50:40
12	RMR7		1.44	31	65.00	0.1500	7.00	1.0000	62.84	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	341.73		604.80	0.00	0.00	0 02:59:46
13	RPF1		6.30	26	69.40	0.1500	7.00	0.5000	357.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	1495.05	945.00		0.00	0.00	0 03:08:55
14	RPF10		0.49	49	76.40	0.1500	7.00	2.9000	72.61	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	110.69	73.50		0.80	0.00	0 01:02:48
15	RPF11		2.77	43	76.40	0.1500	7.00	2.9000	150.06	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	625.74	415.50		0.62	0.00	0 01:54:25
16	RPF12		1.37	49	65.00	0.1500	7.00	2.9000	108.15	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	325.11	205.50		0.00	0.00	0 01:31:32
17	RPF14		2.61	60	65.00	0.1500	7.00	2.8000	92.83	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	619.38	391.50		0.00	0.00	0 02:28:53
18	RPF15		3.42	44	65.00	0.1500	7.00	2.9000	115.73	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	811.60	513.00		0.00	0.00	0 02:31:59
19	RPF16A		7.45	51	76.40	0.1500	7.00	4.2000	239.57	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	1682.96	1117.50		0.55	0.00	0 02:20:03
20	RPF16B		2.27	63	69.40	0.1500	7.00	5.0000	144.74	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	538.69	340.50		0.00	0.00	0 01:28:12
21	RPF17A		2.32	64	76.40	0.1500	7.00	2.3000	143.73	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	524.09	348.00		0.63	0.00	0 01:53:12
22	RPF17B		1.58	52	76.40	0.1500	7.00	2.3000	111.66	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	356.92	237.00		0.65	0.00	0 01:44:29
23	RPF18A		1.01	52	76.40	0.1500	7.00	2.5000	64.55	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	228.16	151.50		0.64	0.00	0 01:48:16
24	RPF2A		1.80	21	72.00	0.1500	7.00	0.5000	167.33	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7340	427.21	270.00		0.00	0.00	0 02:20:09
25	RPF2B		1.38	21	98.00	0.1500	7.00	0.5000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	4.4800	61.82	207.00		15.66	0.05	0 01:02:10
26	RPF3A		3.37	59	76.40	0.1500	7.00	2.0000	296.24	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	761.28	505.50		0.68	0.00	0 01:35:40
27	RPF4A		18.76	41	76.40	98.0000	7.00	2.5000	339.33	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	4237.88	2814.00		0.36	0.00	0 03:51:15
28	RPF4B		10.13	33	76.40	80.0000	7.00	5.6000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	2288.37	1519.50		0.67	0.00	0 01:39:24
29	RPF6		2.11	62	76.40	0.1500	7.00	5.0000	120.93	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	476.65	316.50		0.69	0.00	0 01:34:07
30	RPF7		8.87	37	76.40	0.1500	7.00	0.5000	219.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	2003.73	1330.50		0.26	0.00	0 05:10:49
31	RPF8		4.47	29	76.40	0.1500	7.00	5.0000	182.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	1009.77	670.50		0.62	0.00	0 01:55:28
32	RPF9A		2.38	46	76.40	0.1500	7.00	2.0000	150.22	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	537.64	357.00		0.62	0.00	0 01:56:45
33	RPF9B		0.89	46	76.40	0.1500	7.00	0.5000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	22.5900	201.05	133.50		0.86	0.00	0 00:47:39
34	RSR10B		0.51	54	65.00	0.1500	7.00	6.6000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	121.03		214.20	0.00	0.00	0 01:20:44
35	RSR11B		0.55	54	65.00	0.1500	7.00	6.6000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	130.52		231.00	0.00	0.00	0 01:23:52
36	RSR5A		0.50	61	65.00	0.1500	7.00	2.0000	18.80	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	118.66		210.00	0.00	0.00	0 02:39:09
37	RSR5B		0.33	42	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	78.31		138.60	0.00	0.00	0 02:27:09
38	RSR6A		0.45	61	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	106.79		189.00	0.00	0.00	0 02:57:24
39	RSR6B		0.27	42	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	64.07		113.40	0.00	0.00	0 02:11:29
40	RSR9		0.81	47	65.00	0.1500	7.00	1.2000	41.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	192.22		340.20	0.00	0.00	0 02:35:10
41	RSTR10		1.32	27	65.00	0.1500	7.00	6.6000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	313.25		554.40	0.00	0.00	0 00:27:54
42	RSTR10A		0.25	47	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	59.33		105.00	0.00	0.00	0 01:32:59
43	RSTR11A		0.31	47	65.00	0.1500	7.00	0.5000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	73.57		130.20	0.00	0.00	0 02:08:46
44	RSTR4B		8.89	38	80.00	0.1500	7.00	0.5000	214.02	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.15	0.0000	18.0130	1601.36		3733.80	1.70	0.00	0 05:15:43
45	RSTR5A		5.98	32	80.00	0.1500	7.00	2.0000	188.93	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	21.1890	1267.10		2511.60	1.36	0.00	0 02:56:52
46	RSTR6		5.28	20	80.00	0.1500	7.00	0.5000	412.11	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	21.1890	1118.78		2217.60	1.44	0.00	0 02:35:53
47	RSTR7		1.27	24	80.00	0.1500	7.00	0.5000	212.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	21.1890	269.10		533.40	1.67	0.00	0 01:38:47
48	RSTR8A		2.50	51	80.00	0.1500	7.00	2.6600	101.32	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	21.1890	529.73		1050.00	1.50	0.00	0 02:19:57
49	RSTR8B		3.90	63	72.00	0.1500	7.00	0.5000	57.27	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7340	925.63		1638.00	0.00	0.00	0 07:04:27
50	RSTR9		1.68	21	56.00	0.1500	7.00	0.5000	303.97	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7460	398.93		705.60	0.00	0.00	0 01:34:03
51	RUND1A		2.44	48	80.00	0.1500	7.00	2.7800	98.98	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	21.1890	517.01			1.51	0.00	0 02:17:58
52	RUND1B		1.39	47	80.00	0.1500	7.00	2.7800	74.39	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	21.1890	294.53			1.59	0.00	0 01:56:34
53	RUND2		2.51	46	80.00	0.1500	7.00	21.0000	103.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	21.1890	531.84			1.77	0.00	0 01:14:39
54	SR1		1.39	33	65.00	0.1500	7.00	4.4000	20.24	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	329.86		563.80	0.00	0.00	0 03:42:38
55	SR2		1.42	32	65.00	0.1500	7.00	4.4000	22.34	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	336.98		596.40	0.00	0.00	0 03:31:52
56	SR3		0.85	40	65.00	0.1500	7.00	2.0000	19.94	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	201.71		357.00	0.00	0.00	0 03:31:37
57	SR4		1.08	39	65.00	0.1500	7.00	2.0000	19.32	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	256.29		453.60	0.00	0.00	0 04:08:24
58	SR7		0.62	44	65.00	0.1500	7.00	2.0000	19.25	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	147.13		260.40	0.00	0.00	0 02:58:51
59	SR8		0.32	49	65.00	0.1500	7.00	2.0000	17.54	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	25.00	0.00	0.0000	23.7310	75.94		134.40	0.00	0.00	0 02:08:16
																				Volume infiltration =		32769.62	14079.00	19702.20 m³			
																				Total infiltration =		66551 m³					

1:2 Yr Post-Development Runoff

SN	Element ID	Description	Area (ha)	Drainage Node ID	Weighted Curve Number	Conductivity (mm/hr)	Drainage Time (days)	Average Slope (%)	Equivalent Width (m)	Pervious Area (%)	Impervious Area No Depression (%)	Impervious Area Manning's Roughness (min)	Impervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Pervious Area Depression Depth (mm)	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m³)		Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	RF3B		1.89	21	76.40	0.1500	7.00	2.0000	129.15	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.1370	853.09	283.50		37.65	0.12	0 01:08:32
2	RFP18B-1		1.91	RSTR4B	76.40	0.1500	7.00	5.0000	104.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.0340	860.15	286.50		37.77	0.14	0 00:59:38
3	RFP18B-2		1.15	61	76.40	0.1500	7.00	5.0000	108.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	44.8270	515.51	172.50		38.01	0.11	0 00:42:56
4	RFP5		2.47	36	65.00	0.1500	7.00	5.0000	119.76	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.6350	1398.88	370.50		26.15	0.09	0 01:04:00
5	RFP9A		0.69	48	76.40	0.1500	7.00	6.1500	86.11	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	44.7230	308.59	103.50		38.15	0.07	0 00:33:57
6	RMR1		0.26	28	65.00	0.1500	7.00	1.0000	90.58	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.2100	146.15		109.20	26.65	0.02	0 00:31:37
7	RMR2		0.28	28	65.00	0.1500	7.00	1.0000	91.79	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.2100	157.39		117.60	26.63	0.02	0 00:32:51
8	RMR3		0.69	28	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.2030	394.70		289.80	25.55	0.01	0 01:44:35
9	RMR4		0.61	28	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.1180	348.42		256.20	25.66	0.01	0 01:37:11
10	RMR5		2.00	31	65.00	0.1500	7.00	1.0000	38.20	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	58.3940	1167.88		840.00	24.36	0.02	0 03:01:11
11	RMR6		1.15	32	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.7700	664.36		483.00	24.98	0.02	0 02:22:01
12	RMR7		1.44	31	65.00	0.1500	7.00	1.0000	62.84	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.3180	825.35		604.80	25.46	0.03	0 01:50:41
13	RPF1		6.30	26	69.40	0.1500	7.00	0.5000	357.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	53.3090	3358.47	945.00		29.45	0.15	0 01:56:19
14	RPF10		0.40	49	76.40	0.1500	7.00	2.9000	72.61	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	44.7750	219.40	73.50		38.07	0.05	0 00:38:40
15	RPF11		2.77	43	76.40	0.1500	7.00	2.9000	150.06	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.1720	1251.26	415.50		37.62	0.17	0 01:10:26
16	RPF12		1.37	49	65.00	0.1500	7.00	2.9000	108.15	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.5220	774.35	205.50		26.26	0.06	0 00:56:21
17	RPF14		2.61	60	65.00	0.1500	7.00	2.8000	92.83	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.0330	1488.56	391.50		25.74	0.06	0 01:31:40
18	RPF15		3.42	44	65.00	0.1500	7.00	2.9000	115.73	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.0610	1951.49	513.00		25.71	0.08	0 01:33:34
19	RPF16A		7.45	51	76.40	0.1500	7.00	4.2000	239.57	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.3610	3379.39	1117.50		37.41	0.37	0 01:26:14
20	RPF16B		2.27	63	69.40	0.1500	7.00	5.0000	144.74	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	52.4400	1190.39	340.50		30.35	0.13	0 00:54:18
21	RPF17A		2.32	64	76.40	0.1500	7.00	2.3000	143.73	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.1550	1047.60	348.00		37.63	0.15	0 01:09:42
22	RPF17B		1.58	52	76.40	0.1500	7.00	2.3000	111.66	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.0860	712.36	237.00		37.71	0.11	0 01:04:19
23	RPF18A		1.01	52	76.40	0.1500	7.00	2.5000	64.55	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.1200	455.71	151.50		37.67	0.07	0 01:06:39
24	RPF2A		1.80	21	72.00	0.1500	7.00	0.5000	167.33	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	50.2540	904.57	270.00		32.52	0.07	0 01:26:17
25	RPF2B		1.38	21	98.00	0.1500	7.00	0.5000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	4.9540	68.37	207.00		74.26	0.30	0 00:38:16
26	RPF3A		3.37	59	76.40	0.1500	7.00	2.0000	296.24	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.0170	1517.07	505.50		37.78	0.25	0 00:58:54
27	RPF4A		18.76	41	76.40	98.0000	7.00	2.5000	339.33	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.5170	8538.99	2814.00		36.66	0.54	0 02:22:22
28	RPF4B		10.13	33	76.40	80.0000	7.00	5.6000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.0510	4563.67	1519.50		37.75	0.72	0 01:01:12
29	RPF6		2.11	62	76.40	0.1500	7.00	5.0000	120.93	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.0170	949.86	316.50		37.79	0.16	0 00:57:57
30	RPF7		8.87	37	76.40	0.1500	7.00	0.5000	219.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.5170	4037.36	1330.50		35.98	0.18	0 03:11:22
31	RPF8		4.47	29	76.40	0.1500	7.00	5.0000	182.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.1720	2019.19	670.50		37.62	0.27	0 01:11:06
32	RPF9A		2.38	46	76.40	0.1500	7.00	2.0000	150.22	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	45.1890	1075.50	357.00		37.60	0.14	0 01:11:53
33	RPF9B		0.89	46	76.40	0.1500	7.00	0.5000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	44.6550	397.43	133.50		38.22	0.11	0 00:29:20
34	RSR10B		0.51	54	65.00	0.1500	7.00	6.6000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.4370	287.83		214.20	26.36	0.02	0 00:49:42
35	RSR11B		0.55	54	65.00	0.1500	7.00	6.6000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.4650	310.56		231.00	26.33	0.02	0 00:51:38
36	RSR5A		0.50	61	65.00	0.1500	7.00	2.0000	18.80	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.1180	285.59		210.00	25.65	0.01	0 01:37:59
37	RSR5B		0.33	42	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.0040	188.11		138.60	25.76	0.01	0 01:30:36
38	RSR6A		0.45	61	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.2880	257.80		189.00	25.48	0.01	0 01:49:13
39	RSR6B		0.27	42	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.8620	153.53		113.40	25.90	0.01	0 01:20:57
40	RSR9		0.81	47	65.00	0.1500	7.00	1.2000	41.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.0890	462.42		340.20	25.68	0.02	0 01:35:32
41	RSTR10		1.32	27	65.00	0.1500	7.00	6.6000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.0110	739.35		554.40	26.93	0.14	0 00:17:10
42	RSTR10A		0.25	47	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.5500	141.38		105.00	26.25	0.01	0 00:57:14
43	RSTR11A		0.31	47	65.00	0.1500	7.00	0.5000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.8620	176.27		130.20	25.92	0.01	0 01:19:17
44	RSTR4B		8.89	38	80.00	0.1500	7.00	0.5000	214.02	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	8.11	0.0000	37.5880	3341.57		3733.80	48.85	0.25	0 03:14:23
45	RSTR5A		5.98	32	80.00	0.1500	7.00	2.0000	188.93	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	40.0950	2397.68		2511.60	41.62	0.28	0 01:48:53
46	RSTR6		5.28	20	80.00	0.1500	7.00	0.5000	412.11	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	40.0950	2117.02		2217.60	41.78	0.29	0 01:35:58
47	RSTR7		1.27	24	80.00	0.1500	7.00	0.5000	212.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	40.0950	509.21		533.40	42.22	0.11	0 01:00:49
48	RSTR8A		2.50	51	80.00	0.1500	7.00	2.6600	101.32	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	40.0950	1002.38		1050.00	41.90	0.15	0 01:26:10
49	RSTR8B		3.90	63	72.00	0.1500	7.00	0.5000	57.27	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	51.5920	2012.09		1638.00	29.90	0.04	0 04:21:20
50	RSTR9		1.68	21	56.00	0.1500	7.00	0.5000	303.97	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	63.6210	1068.83		705.60	19.15	0.04	0 00:57:54
51	RUND1A		2.44	48	80.00	0.1500	7.00	2.7800	98.98	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	40.0950	978.32			41.91	0.15	0 01:24:56
52	RUND1B		1.39	47	80.00	0.1500	7.00	2.7800	74.39	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	40.0950	557.32			42.08	0.10	0 01:11:46
53	RUND2		2.51	46	80.00	0.1500	7.00	21.0000	103.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	40.0950	1006.38			42.42	0.26	0 00:45:57
54	SR1		1.39	33	65.00	0.1500	7.00	4.4000	20.24	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.7130	802.21		583.80	25.06	0.02	0 02:17:04
55	SR2		1.42	32	65.00	0.1500	7.00	4.4000	22.34	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.6000	817.92		596.40	25.16	0.02	0 02:10:26
56	SR3		0.85	40	65.00	0.1500	7.00	2.0000	19.94	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.6000	489.60		357.00	25.16	0.01	0 02:10:17
57	SR4		1.08	39	65.00	0.1500	7.00	2.0000	19.32	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.9400	625.75		453.60	24.81	0.02	0 02:32:56
58	SR7		0.62	44	65.00	0.1500	7.00	2.0000	19.25	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	57.2880	355.19		260.40	25.47	0.01	0 01:50:07
59	SR8		0.32	49	65.00	0.1500	7.00	2.0000	17.54	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	84.00	0.00	0.0000	56.8620	181.96		134.40	25.93	0.01	0 01:18:58

Volume infiltration =	68807.69	14079.00	19702.20	m³
Total infiltration =	102589	m³		

1:5 Yr Post-Development Runoff

SN	Element ID	Description	Area (ha)	Discharge Node ID	Weighted Curve Number	Conductivity (mm/hr)	Dynamic Time (Min)	Average Slope (%)	Equivalent Width (m)	Impervious Area (%)	Impervious Area No Depression Depth (mm)	Impervious Area Manning's Roughness	Impervious Area Depression Depth (mm)	Pervious Area Manning's Roughness	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m³)		Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	RF3B		1.89	21	76.40	0.1500	7.00	2.0000	129.15	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.3900	990.17	283.50		68.45	0.27	0 00:59:01
2	RFP18B-1		1.91	RSTR4B	76.40	0.1500	7.00	5.0000	104.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.2740	998.43	286.50		68.59	0.30	0 00:51:22
3	RFP18B-2		1.15	61	76.40	0.1500	7.00	5.0000	108.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.0610	598.70	172.50		68.87	0.22	0 00:36:59
4	RFP5		2.47	36	65.00	0.1500	7.00	5.0000	119.76	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.2510	1710.50	370.50		51.58	0.25	0 00:55:07
5	RFP9A		0.69	48	76.40	0.1500	7.00	6.1500	86.11	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	51.9290	358.31	103.50		69.04	0.16	0 00:29:14
6	RMR1		0.26	28	65.00	0.1500	7.00	1.0000	90.58	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	68.7110	178.65		109.20	52.21	0.04	0 00:27:13
7	RMR2		0.28	28	65.00	0.1500	7.00	1.0000	91.79	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	68.7410	192.47		117.60	52.18	0.04	0 00:28:18
8	RMR3		0.69	28	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.9100	482.38		289.80	50.88	0.04	0 01:30:04
9	RMR4		0.61	28	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.7900	425.72		256.20	51.00	0.04	0 01:23:42
10	RMR5		2.00	31	65.00	0.1500	7.00	1.0000	38.20	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	71.2300	1424.60		840.00	49.52	0.07	0 02:36:02
11	RMR6		1.15	32	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	70.5400	811.21		483.00	50.22	0.05	0 02:02:18
12	RMR7		1.44	31	65.00	0.1500	7.00	1.0000	62.84	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	70.0000	1008.00		604.80	50.77	0.09	0 01:35:19
13	RPF1		6.30	26	69.40	0.1500	7.00	0.5000	357.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	63.9260	4027.34	945.00		56.87	0.43	0 01:40:11
14	RPF10		0.49	49	76.40	0.1500	7.00	2.9000	72.61	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	51.9950	254.78	73.50		68.95	0.10	0 00:33:18
15	RPF11		2.77	43	76.40	0.1500	7.00	2.9000	150.06	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.4230	1452.12	415.50		68.42	0.39	0 01:00:40
16	RPF12		1.37	49	65.00	0.1500	7.00	2.9000	108.15	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.1310	947.09	205.50		51.72	0.16	0 00:48:32
17	RPF14		2.61	60	65.00	0.1500	7.00	2.8000	92.83	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.7000	1819.17	391.50		51.10	0.19	0 01:18:57
18	RPF15		3.42	44	65.00	0.1500	7.00	2.9000	115.73	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.7300	2384.77	513.00		51.07	0.24	0 01:20:35
19	RPF16A		7.45	51	76.40	0.1500	7.00	4.2000	239.57	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.4720	3909.16	1117.50		68.18	0.89	0 01:14:16
20	RPF16B		2.27	63	69.40	0.1500	7.00	5.0000	144.74	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	62.9420	1428.78	340.50		57.91	0.31	0 00:46:46
21	RPF17A		2.32	64	76.40	0.1500	7.00	2.3000	143.73	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.4060	1215.82	348.00		68.43	0.33	0 01:00:02
22	RPF17B		1.58	52	76.40	0.1500	7.00	2.3000	111.66	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.3400	826.97	237.00		68.51	0.24	0 00:55:24
23	RPF18A		1.01	52	76.40	0.1500	7.00	2.5000	64.55	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.3730	528.97	151.50		68.48	0.15	0 00:57:25
24	RPF2A		1.80	21	72.00	0.1500	7.00	0.5000	167.33	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	59.5920	1072.66	270.00		61.23	0.18	0 01:14:19
25	RPF2B		1.38	21	98.00	0.1500	7.00	0.5000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	5.0240	69.33	207.00		112.32	0.49	0 00:32:58
26	RPF3A		3.37	59	76.40	0.1500	7.00	2.0000	296.24	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.2740	1761.63	505.50		68.60	0.53	0 00:50:44
27	RPF4A		18.76	41	76.40	98.0000	7.00	2.5000	339.33	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.4720	9843.75	2814.00		67.37	1.37	0 02:02:37
28	RPF4B		10.13	33	76.40	80.0000	7.00	5.6000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.2910	5297.08	1519.50		68.56	1.57	0 00:52:42
29	RPF6		2.11	62	76.40	0.1500	7.00	5.0000	120.93	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.2580	1102.64	316.50		68.61	0.34	0 00:49:54
30	RPF7		8.87	37	76.40	0.1500	7.00	0.5000	219.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.4720	4654.27	1330.50		66.65	0.46	0 02:44:49
31	RPF8		4.47	29	76.40	0.1500	7.00	5.0000	182.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.4390	2344.02	670.50		68.41	0.63	0 01:01:14
32	RPF9A		2.38	46	76.40	0.1500	7.00	2.0000	150.22	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	52.4390	1248.05	357.00		68.40	0.33	0 01:01:54
33	RPF9B		0.89	46	76.40	0.1500	7.00	0.5000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	51.8800	461.73	133.50		69.14	0.22	0 00:25:16
34	RSR10B		0.51	54	65.00	0.1500	7.00	6.6000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.0110	351.96		214.20	51.85	0.06	0 00:42:48
35	RSR11B		0.55	54	65.00	0.1500	7.00	6.6000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.0410	379.73		231.00	51.81	0.07	0 00:44:28
36	RSR5A		0.50	61	65.00	0.1500	7.00	2.0000	18.80	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.7900	348.95		210.00	50.99	0.03	0 01:24:23
37	RSR5B		0.33	42	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.6700	229.91		138.60	51.12	0.02	0 01:18:02
38	RSR6A		0.45	61	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	70.0000	315.00		189.00	50.80	0.03	0 01:34:04
39	RSR6B		0.27	42	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.5210	187.71		113.40	51.29	0.02	0 01:09:43
40	RSR9		0.81	47	65.00	0.1500	7.00	1.2000	41.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.7600	565.06		340.20	51.03	0.06	0 01:22:16
41	RSTR10		1.32	27	65.00	0.1500	7.00	6.6000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	68.5010	904.21		554.40	52.55	0.30	0 00:14:47
42	RSTR10A		0.25	47	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.1310	172.83		105.00	51.71	0.03	0 00:49:18
43	RSTR11A		0.31	47	65.00	0.1500	7.00	0.5000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.4910	215.42		130.20	51.32	0.03	0 01:08:17
44	RSTR4B		8.89	38	80.00	0.1500	7.00	0.5000	214.02	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	14.73	0.0000	43.3620	3854.88		3733.80	87.67	0.61	0 02:47:24
45	RSTR5A		5.98	32	80.00	0.1500	7.00	2.0000	188.93	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	45.3740	2713.37		2511.60	73.99	0.65	0 01:33:47
46	RSTR6		5.28	20	80.00	0.1500	7.00	0.5000	412.11	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	45.3740	2395.75		2217.60	74.16	0.65	0 01:22:39
47	RSTR7		1.27	24	80.00	0.1500	7.00	0.5000	212.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	45.3740	576.25		533.40	74.65	0.22	0 00:52:23
48	RSTR8A		2.50	51	80.00	0.1500	7.00	2.6600	101.32	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	45.3740	1134.35		1050.00	74.29	0.34	0 01:14:12
49	RSTR8B		3.90	63	72.00	0.1500	7.00	0.5000	57.27	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	60.7520	2369.33		1638.00	58.37	0.12	0 03:45:04
50	RSTR9		1.68	21	56.00	0.1500	7.00	0.5000	303.97	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	80.4290	1351.21		705.60	40.39	0.13	0 00:49:52
51	RUND1A		2.44	48	80.00	0.1500	7.00	2.7800	98.96	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	45.3740	1107.13			74.31	0.33	0 01:13:09
52	RUND1B		1.39	47	80.00	0.1500	7.00	2.7800	74.39	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	45.3740	630.70			74.49	0.22	0 01:01:48
53	RUND2		2.51	46	80.00	0.1500	7.00	21.0000	103.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	45.3740	1138.89			74.88	0.51	0 00:39:35
54	SR1		1.39	33	65.00	0.1500	7.00	4.4000	20.24	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	70.4500	979.26		583.80	50.31	0.07	0 01:58:03
55	SR2		1.42	32	65.00	0.1500	7.00	4.4000	22.34	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	70.3600	999.11		596.40	50.43	0.07	0 01:52:20
56	SR3		0.85	40	65.00	0.1500	7.00	2.0000	19.94	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	70.3600	598.06		357.00	50.43	0.04	0 01:52:13
57	SR4		1.08	39	65.00	0.1500	7.00	2.0000	19.32	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	70.7500	764.10		453.60	50.03	0.05	0 02:11:43
58	SR7		0.62	44	65.00	0.1500	7.00	2.0000	19.25	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	70.0000	434.00		260.40	50.78	0.04	0 01:34:50
59	SR8		0.32	49	65.00	0.1500	7.00	2.0000	17.54	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	122.00	0.00	0.0000	69.4910	222.37		134.40	51.32	0.03	0 01:08:01

1:10 Yr Post-Development Runoff

SN	Element ID	Description	Area (ha)	Dummy Node ID	Weighted Curve Number	Conductivity (mm/hr)	Drying Time (days)	Average Slope (%)	Equivalent Width (m)	Impervious Area (%)	Impervious Area No Depression (%)	Impervious Area Depression Depth (mm)	Impervious Area Manning's n (Roughness)	Pervious Area Depression Depth (mm)	Pervious Area Manning's n (Roughness)	Curb & Gutter Length (m)	Rain Gage ID	Total Precipitation (mm)	Total Runon (mm)	Total Evaporation (mm)	Total Infiltration (mm)	Total Infiltration (m³)		Total Runoff (mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	RF3B		1.89	21	76.40	0.1500	7.00	2.0000	129.15	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	1064.16	283.50		95.37	0.41	0 00:53:54
2	RFP18B-1		1.91	RSTR4B	76.40	0.1500	7.00	5.0000	104.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	1075.43	286.50		95.53	0.44	0 00:46:55
3	RFP18B-2		1.15	61	76.40	0.1500	7.00	5.0000	108.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.1810	646.08	172.50		95.85	0.33	0 00:33:46
4	RFP5		2.47	36	65.00	0.1500	7.00	5.0000	119.76	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.0450	1903.01	370.50		74.82	0.41	0 00:50:20
5	RFP9A		0.69	48	76.40	0.1500	7.00	6.1500	86.11	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.0570	386.79	103.50		96.05	0.23	0 00:26:42
6	RMR1		0.26	28	65.00	0.1500	7.00	1.0000	90.58	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	76.5050	198.91		109.20	75.54	0.07	0 00:24:52
7	RMR2		0.28	28	65.00	0.1500	7.00	1.0000	91.79	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	76.5050	214.21		117.60	75.51	0.07	0 00:25:50
8	RMR3		0.69	28	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.7650	536.58		289.80	74.04	0.08	0 01:22:16
9	RMR4		0.61	28	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.6450	473.63		256.20	74.18	0.07	0 01:16:27
10	RMR5		2.00	31	65.00	0.1500	7.00	1.0000	38.20	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	79.1740	1583.48		840.00	72.60	0.12	0 02:22:31
11	RMR6		1.15	32	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	78.4550	902.23		483.00	73.34	0.09	0 01:51:43
12	RMR7		1.44	31	65.00	0.1500	7.00	1.0000	62.84	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.8850	1121.54		604.80	73.93	0.15	0 01:27:04
13	RPF1		6.30	26	69.40	0.1500	7.00	0.5000	357.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	70.2900	4428.27	945.00		81.52	0.72	0 01:31:30
14	RPF10		0.49	49	76.40	0.1500	7.00	2.9000	72.61	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.1190	274.98	73.50		95.94	0.15	0 00:30:25
15	RPF11		2.77	43	76.40	0.1500	7.00	2.9000	150.06	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	1559.65	415.50		95.34	0.58	0 00:55:25
16	RPF12		1.37	49	65.00	0.1500	7.00	2.9000	108.15	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	76.9250	1053.87	205.50		74.97	0.25	0 00:44:20
17	RPF14		2.61	60	65.00	0.1500	7.00	2.8000	92.83	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.5550	2024.19	391.50		74.28	0.32	0 01:12:06
18	RPF15		3.42	44	65.00	0.1500	7.00	2.9000	115.73	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.5850	2653.41	513.00		74.25	0.42	0 01:13:37
19	RPF16A		7.45	51	76.40	0.1500	7.00	4.2000	239.57	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	4194.72	1117.50		95.09	1.37	0 01:07:50
20	RPF16B		2.27	63	69.40	0.1500	7.00	5.0000	144.74	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	69.2800	1572.66	340.50		82.65	0.46	0 00:42:43
21	RPF17A		2.32	64	76.40	0.1500	7.00	2.3000	143.73	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	1306.28	348.00		95.35	0.49	0 00:54:50
22	RPF17B		1.58	52	76.40	0.1500	7.00	2.3000	111.66	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	889.62	237.00		95.44	0.35	0 00:50:36
23	RPF18A		1.01	52	76.40	0.1500	7.00	2.5000	64.55	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	568.68	151.50		95.40	0.22	0 00:52:26
24	RPF2A		1.80	21	72.00	0.1500	7.00	0.5000	167.33	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	65.0820	1171.48	270.00		86.77	0.29	0 01:07:52
25	RPF2B		1.38	21	98.00	0.1500	7.00	0.5000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	5.0550	69.76	207.00		143.41	0.65	0 00:30:06
26	RPF3A		3.37	59	76.40	0.1500	7.00	2.0000	296.24	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	1897.48	505.50		95.54	0.78	0 00:46:20
27	RPF4A		18.76	41	76.40	98.0000	7.00	2.5000	339.33	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	10562.82	2814.00		94.24	2.18	0 01:52:00
28	RPF4B		10.13	33	76.40	80.0000	7.00	5.6000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	5703.70	1519.50		95.50	2.31	0 00:48:08
29	RPF6		2.11	62	76.40	0.1500	7.00	5.0000	120.93	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	1188.04	316.50		95.56	0.50	0 00:45:35
30	RPF7		8.87	37	76.40	0.1500	7.00	0.5000	219.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	4994.25	1330.50		93.52	0.76	0 02:30:32
31	RPF8		4.47	29	76.40	0.1500	7.00	5.0000	182.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	2516.83	670.50		95.33	0.94	0 00:55:55
32	RPF9A		2.38	46	76.40	0.1500	7.00	2.0000	150.22	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	56.3050	1340.06	357.00		95.32	0.50	0 00:56:33
33	RPF9B		0.89	46	76.40	0.1500	7.00	0.5000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	55.9950	498.36	133.50		96.16	0.32	0 00:23:05
34	RSR10B		0.51	54	65.00	0.1500	7.00	6.6000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	76.8050	391.71		214.20	75.12	0.10	0 00:39:06
35	RSR11B		0.55	54	65.00	0.1500	7.00	6.6000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	76.8350	422.59		231.00	75.07	0.10	0 00:40:37
36	RSR5A		0.50	61	65.00	0.1500	7.00	2.0000	18.80	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.6450	388.23		210.00	74.17	0.06	0 01:17:05
37	RSR5B		0.33	42	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.5250	255.83		138.60	74.31	0.04	0 01:11:16
38	RSR6A		0.45	61	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.8550	350.35		189.00	73.96	0.05	0 01:25:55
39	RSR6B		0.27	42	65.00	0.1500	7.00	2.0000	14.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.3450	208.83		113.40	74.49	0.04	0 01:03:41
40	RSR9		0.81	47	65.00	0.1500	7.00	1.2000	41.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.6150	628.68		340.20	74.21	0.10	0 01:15:09
41	RSTR10		1.32	27	65.00	0.1500	7.00	6.6000	500.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	76.2650	1006.70		554.40	75.93	0.45	0 00:13:30
42	RSTR10A		0.25	47	65.00	0.1500	7.00	1.0000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	76.9250	192.31		105.00	74.96	0.04	0 00:45:02
43	RSTR11A		0.31	47	65.00	0.1500	7.00	0.5000	33.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.3150	239.68		130.20	74.52	0.04	0 01:02:22
44	RSTR4B		8.89	38	80.00	0.1500	7.00	0.5000	214.02	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	20.52	0.0000	46.4870	4132.69		3733.80	121.32	0.99	0 02:32:54
45	RSTR5A		5.98	32	80.00	0.1500	7.00	2.0000	188.93	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.2000	2882.36		2511.60	101.91	1.00	0 01:25:39
46	RSTR6		5.28	20	80.00	0.1500	7.00	0.5000	412.11	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.2000	2544.96		2217.60	102.09	0.98	0 01:15:30
47	RSTR7		1.27	24	80.00	0.1500	7.00	0.5000	212.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.2000	612.14		533.40	102.61	0.32	0 00:47:50
48	RSTR8A		2.50	51	80.00	0.1500	7.00	2.6600	101.32	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.2000	1205.00		1050.00	102.22	0.51	0 01:07:47
49	RSTR8B		3.90	63	72.00	0.1500	7.00	0.5000	57.27	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	65.9730	2572.95		1638.00	83.82	0.20	0 03:25:34
50	RSTR9		1.68	21	56.00	0.1500	7.00	0.5000	303.97	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	91.4370	1536.14		705.60	60.43	0.22	0 00:45:33
51	RUND1A		2.44	48	80.00	0.1500	7.00	2.7800	98.98	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.2000	1176.08			102.24	0.50	0 01:06:49
52	RUND1B		1.39	47	80.00	0.1500	7.00	2.7800	74.39	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.2000	669.98			102.44	0.32	0 00:56:27
53	RUND2		2.51	46	80.00	0.1500	7.00	21.0000	103.00	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	48.2000	1209.82			102.87	0.76	0 00:36:09
54	SR1		1.39	33	65.00	0.1500	7.00	4.4000	20.24	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	78.3650	1089.27		583.80	73.43	0.12	0 01:47:49
55	SR2		1.42	32	65.00	0.1500	7.00	4.4000	22.34	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	78.2450	1111.08		596.40	73.56	0.12	0 01:42:37
56	SR3		0.85	40	65.00	0.1500	7.00	2.0000	19.94	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	78.2450	665.08		357.00	73.56	0.07	0 01:42:29
57	SR4		1.08	39	65.00	0.1500	7.00	2.0000	19.32	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	78.6350	849.26		453.60	73.14	0.08	0 02:00:18
58	SR7		0.62	44	65.00	0.1500	7.00	2.0000	19.25	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.8850	482.89		260.40	73.94	0.06	0 01:26:37
59	SR8		0.32	49	65.00	0.1500	7.00	2.0000	17.54	0.00	0.00	0.0500	0.0100	5.0000	0.1000	0.00	FRASER	153.00	0.00	0.0000	77.3150	247.41		134.40	74.53	0.05	0 01:02:07