INTEGRATED WATER USE LICENCE APPLICATION FOR HIGH SPEED PROVING GROUND FOR LIGHT VEHICLE TESTING IN UPINGTON, NORTHERN CAPE PROVINCE, SOUTH AFRICA

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EXECUTIVE SUMMARY

Applicant:		Mercedes Benz South Africa (Pty) Ltd (MBSA)
Project:		High Speed Proving Ground (HSPG) for light vehicle testing
Location:		Portion 6 of the farm Steenkampspan 419, Upington, //Khara Hais Local Municipality, Northern Cape Province, South Africa (property)
Size:		3.725ha of a 3 732.7ha property
Use:	Current:	Agriculture (livestock watering) – 300 head of cattle
	Future:	Agriculture (livestock watering) – 60 - 80 head of cattle High Speed Proving Ground

WATER USES:

- Section 21 (a): taking water from a water resource – groundwater will be abstracted from the underlying aquifer via boreholes on this and the neighbouring property (Duiker Rand) for use during the construction (22 months over 5 years) and operational (mainly summer months) phases. Seven (7) boreholes will be used.
- Section 21 (b): storing water – the groundwater abstracted will be pumped to and stored in a raised reservoir to ensure a continuous water supply as well as water for emergency supply (power interruption or fire). Less than 200 m^3 of groundwater will be stored to allow for two (2) day storage. The storage of groundwater on the property falls within the scope of the General Authorisation published in GNR399 in Government Gazette 26187 (which permits the storage of up to 50 000m^3 of water)
- Section 21 (c): impeding or diverting the flow of water in a watercourse – culverts and channels will be required to convey drainage around the oval and access road in terms of storm water management.
- Section 21 (g): disposing of waste in a manner which may detrimentally impact on a water resource – wastewater contaminated with hydrocarbons (originating from the car wash, fuel station and workshop areas) and will only be temporarily stored on-site before collection by licensed contractors. Please see Table 6-3 and 6-5. None of these wastewaters will be disposed of on site but will only be stored. The small quantities (< 1 000 m^3) may also only require a General Authorisation (GNR665, 2013) and containment facilities will be designed according to legal specification to prevent overflows, spillages or leakages thereby preventing impacts to the environment.
- Section 21 (i): altering the bed, banks, course or characteristics of a watercourse – relates to Section 21 (c).

SOCIO-ECONOMIC MOTIVATION:

General: MBSA contributed in excess of R2.2 billion to the South African economy in terms of income tax (R1 122.1 million) and duties (R1 176.8 million), in 2013. MBSA employs more than 6 000 people in South Africa at a cost of R2.2 million and in 2013 spend R35.9 million on staff training. The labour force has doubled since 2010. In terms of social upliftment and engagement, MBSA spent R37.5 million in 2013, which included sponsorships, education and HIV/AIDS projects. MBSA has a Level 4 Broad-based Black Economic Empowerment (BBBEE) status.

Financial investment for the proposed HSPG project: The total monthly wage bill for the construction phase is estimated to be in the region of R66 million (2015 rand values). Of this total, R15.8 million would be earned by low skilled workers, R14.4 million by semi-skilled workers and R36 million by skilled workers. Low and semi-skilled workers would therefore earn approximately 45% of the total monthly wage bill. The capital expenditure associated with the construction of the proposed HSPG is estimated to be in the region of R 370-480 million. An annual income of R21.5 million will be realised during the operational phase. Approximately R2.6 million will be spent on water and wastewater management and approximately R16 million on drainage infrastructure.

Job creation: The establishment of the proposed HSPG will create employment and business opportunities for locals during both the construction and operational phases of the project. During the two (2) year construction phase, approximately 200 employment opportunities will be created. Of this approximately 15% (30) will be skilled, 30% (60) semi-skilled and 55% (110) low skilled / unskilled. During the operational phase, eight (8) low skilled / unskilled employment opportunities will exist. The majority of the low and semi-skilled workers will be Historically Disadvantaged Individuals (HDIs). The majority, if not all, of the low and semi-skilled workers employed during the construction phase are also likely to live in Upington and surrounds. 61% of the cost spent on employment will be on Previously Disadvantaged Individuals (PDI). In terms of population breakdown, the majority of the population in Upington is Coloured (65%), followed by Black African (23%) and Whites (10%). Coloured and Black African races will therefore fill a high percentage of the job opportunities. In 2011, the total population in Ward 11, where the proposed development is located, was 7 542 people. Of this total, the majority were Coloured (78%), followed by Black Africans (10%) and Whites (8.5%).

Upliftment of the community: Since locals will be employed, previously disadvantaged people will therefore have the opportunity to improve themselves (skill development and income generation), their community (extended household and families) and be able to contribute to the economy (buying power, taxes etc.). The development will also create an opportunity for MBSA to invest in local community development programmes as part of its corporate social sustainability programme.

Hospitality and tourism: The total number of accommodation days generated by the HSPG over a one (1) year period will be approximately 2 360 - 4 450 days. The demand for accommodation will extend over the operational lifespan of the project, which is anticipated to be decades. This will create significant opportunities for the local hospitality sector in Upington. The timing of the main operational phase (over the hot, summer months) also coincides with the low demand period for tourist accommodation in Upington and the Northern Cape. The majority of tourists visit the area during the cooler, winter months (May - August). The operational phase will therefore generate income for the local hospitality during the quieter, off-peak months. This represents a significant socio-economic benefit for both the owners of accommodation facilities and the staff employed. The Mercedes Benz personnel are also likely to visit areas of interest over weekends, such as the Augrabies Falls National Park, and undertake activities such as river rafting on the Orange River, quad biking, and wine cellar tours etc. Local tourism operators and facilities in the area and Northern Cape will therefore also benefit during the operational phase.

ENVIRONMENTAL MOTIVATION:

Groundwater during the construction phase: Water supply for the project will be obtained from the groundwater resource as no municipal services extend to the area. During the construction phase of approximately two (2) years, large water quantities will be required (±300 m^3/day). Groundwater will be harvested during the construction phase (more water will be abstracted than what is recharged by rainfall) as quantities abstracted will exceed recharge potential. The water storage of the aquifer will however not be depleted as less than 1% of the storage potential will be used. The aquifers from which water is abstracted will take 15 - 20 years after the construction phase to recover.

Groundwater during the operational phase: Water supply for the project will be from the groundwater resource as no municipal services extend to the area. Water quanities used during the operational phase, are low (±10 m^3/day for the HSPG and 6m^3/day for livestock watering) considering the recharge for the property (large property with large surface area allowing recharge). Negligible impact is expected on the groundwater resource and other groundwater users during the operational phase.

Surface water: The project will not impact directly on permanent surface water resources (such as dams, rivers, streams or wetlands) though drainage lines will be diverted in channels and culverts will be constructed to ensure the uninterrupted flow of storm water around proposed infrastructure.

Wetlands: The wetland identified on site has a largely natural Present Ecological State (PES) (class B - Largely natural with few modifications, but with some loss of natural habitats), which can improve to a class A PES through the reduction and maintenance of a moderate grazing pressure, as well as the successful control of the invasive P. glandulosa var. torreyana. The Ecological Importance and Sensitivity (EIS) class of the interdune pan is regarded as High (class B - Wetlands that are considered to be ecologically important and sensitive). All development and activities associated with this project will be more than 500m away from the pan (wetland area) and will therefore not impact on it. Due to the reduced grazing pressure, the PES may improve.

IMPACTS AND MANAGEMENT:

Surface Water Environment:

Wetland: Conserve wetland (no degradation) - no infrastructure will be established within 500m of the wetland. The wetland has a 500m buffer around it to ensure the pan receives adequate water from its catchment - the catchment of the pan will be the minimum boundary of the buffer zone. The pan and related buffer zone will form a corridor linking the inner track area with the outer undeveloped (natural area) to ensure that fauna and flora movement are not totally disrupted by the material sourcing and track development.

Material sourcing (quarry and borrow pit operations): There would be no need to dewater pits as groundwater level is at least 12m below the bottom of the pit and groundwater will therefore not be intercepted during the sourcing of material. Diversion berms around upgradient areas of the pit will minimize rainwater entering the pits. Rain water directly into the pits can be evaporated due to small quantities.

Storm water: The water tracts are incorporated within the storm water management plan and channels and culverts will be constructed to ensure the uninterrupted flow of storm water around the track. Refer to Section 6.9 regarding culvert, channels and other storm water management measures.

Groundwater Environment:

See Table below.

Potential impact:	Significance and considerations to determine significance (refer to Section 5 of report):	Management (refer to Section 6 of report):
CONSTRUCTION PHASE (22 MONTHS OVER 5 YEARS)		
Groundwater quantity - Interception of groundwater Borrow pit - Source sand and calcrete to be used as base fill material. Quarry - Source G1 to G5 material for road construction.	MODERATELY LOW 12 - 21m difference between depth of groundwater table and depth of pit/quarry. No water in BH 9 drilled to 150m in proximity to quarry. Non-aquifer. Low yielding (BH3 & BH4 close to borrow pit) with limited fracturing in the host rock.	Manage storm water to prevent runoff entering the pit/quarry.
Groundwater quantity – Groundwater as water supply source Livestock watering: BH2, 3, 4 (existing on site) HSPG: BH1 (existing on site) H/BH10 (existing, Duiker Rand) BH 5, 8 (new on site)	MODERATELY HIGH All boreholes located within the same catchment area and the aquifer from which water will be harvested, is likely to experience a drawdown. Though the groundwater abstraction will be limited to the construction phase, a period of no more than 24 months, the impact may remain up to 15 – 20 years after construction has been completed because it will take 15 – 20 years to replenish the aquifer after harvesting groundwater during the construction phase. A very conservative approach was taken to calculate the final recommended yields. These recommended yields were further reduced from 350 m^3/d to 300 m^3/d. The actual water demand for construction phase 1 is 276m^3/d and for construction phase 2 is 264m^3/d. For calculation purposes and to be conservative, a water demand for both construction phases of 300 m^3/d was used.	There is no mitigation measure that can reduce the impact as the water quantities are required for the construction phase and there is no alternative water supply source (only groundwater). Alternatives include the import of water from Upington but due to the quantities required, and the associated cost, this will render the project non-feasible. Allow a rest period between Phase I and II of the construction period to allow partial recovery of water levels. The number of cattle on the site will be reduced from ± 300 head to between 60 and 80 head of cattle, thereby reducing the livestock watering requirements. If the adjacent farmers should experience water shortages due to a drawdown in their boreholes, MBSA will deliver water to these farmers. MBSA has made financial provision for importing water from Upington during the construction phase for these farmers.

		Use water scarcely and do not waste water. Utilize four (4) boreholes during construction phase to prevent over-utilization of one borehole. Abstract water at the recommended rates for each individual borehole only. The boreholes that are earmarked to be used for abstraction can easily deliver water according to the yields recommended in the specialist report. Only use required quantities of water from specified boreholes and monitor water quantities used. Do not over use one borehole by pumping one specific borehole at all times. None of the boreholes will therefore be individually over pumped. The aquifer can sustain the water abstraction during the construction phase of 22 months spread over 5 years and the project is therefore considered viable (Geologic, 2015). Complaints register. Monitoring of water levels monthly – see Section 7.
Groundwater quality – Sourcing of material	MODERATELY LOW Groundwater movement in this region of the site in the Blaaubosch Granite will be limited due to the un-weathered state of the host rock. Very low yielding aquifer with limited fracturing in the host rock.	Manage storm water to prevent runoff entering the pit/quarry.

Groundwater quality – Building	MODERATELY LOW Host rock layers above the aquifer are thick enough and will sufficiently protect the aquifer below from on surface leaks. Hydraulic conductivities will be altered to be much lower than measured on site due to filling, compaction and elevation. **Risk:** Excessive water abstraction from BH 1 may alter the groundwater flow directions near the borehole.	Abstraction from BH1 to be limited to quantities advised by geohydrologist (15.1 m^3/day). **Waste management plan:** • Collection and storage of waste on site. • No littering or burning or disposal of waste on site. • Waste separation to allow recycling and minimize quantities requiring disposal. • Off-site removal of waste for disposal by registered contractor. • Disposal to licensed waste disposal facility. **Wastewater management:** • Portable dry chemical toilets will be provided by the construction contractor for workers. • Chemical toilets will be serviced as required to prevent overflows. • Construction contractor will ensure that there are an appropriate number of portable dry chemical toilets on site (typically 1 toilet for 20 people). • Contractor to provide suitable ablution facilities (washing and changing area) for construction workers. • No builders/workers will be housed on the site. • Ablutions outside the provided facilities are not to occur under any circumstances.

OPERATIONAL PHASE (> 20 YEARS)		
Groundwater quantity: Groundwater as water supply source Livestock watering: BH2, 3, 4 (existing on site) HSPG: BH1 (existing on site)	MODERATELY LOW The total demand (HSPG & livestock watering) is 5 840 m^3/annum which is only 31% of the recharge of 18 664 m^3/annum (0.5 mm/annum) for Steenkampspan. Based on the geohydrological study: ○ the abstraction quantities can be provided by the boreholes; ○ these quantities can be sustainably abstracted for the life of the project; and ○ these quantities of abstraction will not negatively impact on surrounding groundwater users.	Livestock watering requirements will reduce to 6m^3/day (60 – 80 head of cattle). HSPG will require 10 m^3/day water during the operational phase. Low water quantities required and used compared to yields determined. Water in the car wash will be recycled. Potable water for human consumption will be imported from Upington. Only use required quantities of water from specified boreholes and monitor water quantities used. Use water scarcely and do not waste water. Complaints register. Monitoring of water levels quarterly – see Section 7.
Groundwater and surface water quality – Building area The building area includes the following potential pollution sources: • Fuel station (mobile with self-containment); • Workshop; • Diesel storage (tanks in bunded area); • Waste storage (hazardous	MODERATELY LOW The location of potential contamination sources, in relation to water resources utilised, is of concern. It is therefore essential that minimum distances between possible contamination sources and the nearest water resource that is in use, be prescribed. The recommended safe distances are based on the acceptable soil's permeability range, in conjunction with the maximum survival times of bacteria, viruses and the breakdown of chemical components. Conservatism has been achieved through the effects	Building area filled, compacted and elevated. Hydraulic conductivities measured on site will be altered to be much lower than measured on site. Water level is expected to be 25 metres below ground level. Sanitation conservancy tank will be 21 to 22 metres above the water table if the tank is constructed 3 to 4 metres deep. This means that water migrating to the water table will have a long travel time before reaching the water table. The following results in a negligible risk to groundwater

and general) before removal for off-site disposal; • Conservancy tank for sewage storage before off-site disposal; and • Oil separator (handling of water from floor cleaning in workshop).	of the harsh environmental conditions prevalent in most of Southern Africa, which lowers maximum pathogen survival periods, and by adding a moderate safety factor of 150m to the calculated distances (this ensures a minimum safe distance of 150m at all times). Production borehole BH1 to be used during the operational phase is located 300 metres from the position of the building site. Other boreholes are located further away.	(Geologic, 2015): • Distance between water supply boreholes and potential contamination sources (>150m). • Groundwater aquifer vulnerability is low risk due to the hydrogeological conditions (Groundwater Protocol document, Version 2, dated March 2003). • Distance from the surface to the aquifer (water table) is long to very long (17 – 21m). • Host rock has a medium capacity to absorb contaminants and a medium capacity to create a fair barrier to the movement of biological contaminants. • The host rock layers above the aquifer is therefore thick enough and will sufficiently protect the aquifer below from on surface leaks. • A high reduction of bacteria and viruses will be evident in the unsaturated aquifer if a leak in the conservancy tank does happen. • The top layer will form a good barrier to the movement of biological contaminants but will have little reduction in chemical contaminants (nitrates, phosphates and chlorides). Incident investigation reports. Monitoring of water quality annually – see Section 7. All fuel storage (for generator and fuel station) would be above ground. This way spillages, leaks, overflows would be highly visible to allow for fast action and clean-up. Visual inspections. Fuel storage containers will be double-walled to prevent leakages. **Fuel station:** Management measures to prevent overflow/spillages:

		• Self contained (bunded or double wall) design • Containment compartment (internal bunding) with pressure vent • Top mounted lockable spill containment box with tank fill / dipstick point and interstitial space dip point • Fill point spill catchment trough **Waste management plan:** • Collection and storage of waste on site. • No littering or burning or disposal of waste on site. • Waste separation to allow recycling and minimize quantities requiring disposal. • Off-site removal of waste for disposal by registered contractor. • Disposal to licensed waste disposal facility. **Wastewater management:** • Capturing and containment of wastewater not suitable for release to the environment to prevent environmental impacts. • Structural integrity of containment structures to prevent overflows, leakages and spillages. • Off-site recycling or disposal of wastewaters that pose an environmental risk. • Refer to Section 6.5.2 for details on conservancy tank and oil separator.

Low significance
Moderate Low significance
Moderate High significance
High significance

LIST OF DEFINITIONS, ABBREVIATIONS AND ACRONYMS

BBBEE	Broad-based Black Economic Empowerment
CBD	Central Business District
DENC	Northern Cape Department of Environment and Nature Conservation
DMR	Department of Mineral Resources
DWA	Department of Water Affairs (now DWS)
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EIS	Ecological Importance & Sensitivity
ELWU	Existing Lawful Water Use
GA	General Authorisation
GDP	Gross Domestic Product
GNR	Government Notice Regulation
GPS	Global Positioning System
HDI	Historically Disadvantaged Individual
HSPG	High Speed Proving Ground
I&AP	Interested and Affected Party
ID	Identification Document
IWUL	Integrated Water Use Licence
IWULA	Integrated Water Use Licence Application
MAE	Mean Annual Evaporation
mamsl	metres above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MBSA	Mercedes Benz South Africa
MFA	Multi-functional Area
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998) as amended
NWA	National Water Act, 1998 (Act 36 of 1998)
OWC	Orange River Wine Cellars
PDI	Previously Disadvantaged Individuals
PES	Present Ecological State
PPP	Public Participation Process
QD	Design flood
SABS	South African Bureau of Standards
SANRAL	South African National Roads Agency Limited
SHEQ	Safety, Health, Environment and Quality
SP6	Small, endorheic pan – identified and delineated wetland on the property
SWMP	Storm Water Management Plan
WMA	Water Management Area
WSP	WSP Parsons Brinckerhoff
WUL	Water Use Licence
WULA	Water Use Licence Application
WWTP	Wastewater Treatment Plant

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APPLICANT: Mercedes-Benz South Africa (Reg. no. 1962/000271/06)

- Company information
- Special power of attorney
- Extract of minutes of meeting (resolutions)
- Identity Document (I.D.): Owen Smith (721216 5010 08 7)
- Broad-based Black Economic Empowerment Certificate
- Tax clearance certificate

PROPERTY: Portion 6 of the farm Steenkampspan 419

- Title deed (T002792/2007) – belongs to Alchris Boerderye CC
- Surveyor-General (SG) diagram (908/2007)
- Land Claims (confirming none)

PROPERTY: Duiker Rand 415

- Title deed (T909/1997) – belongs to Albert Human

PROPERTY OWNER: Alchris Boerderye CC (Reg. no. 1998/048749/23)

- Closed Corporation information
- Resolution
- Power of attorney
- Identity Document (I.D.): Albert Human

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- Document for public review
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- Meetings
    - Department of Water and Sanitation (DWS); 22 January 2015.
    - DWS; 10 July 2015
    - Public meeting (three neighbours); 15 October 2015.
    - Local and district authorities (ZF Mgcawu district & //Khara Hais local); 15 October 2015.
    - Provincial authority (Northern Cape Department of Environment and Nature Conservation); 14 October 2015.
- Comments
    - DWS – Lower Orange; 23 October 2015; Mr SA Manamathela
    - Neighbours – refer to public meeting minutes

Appendix C: Waste and wastewater management

- General solid waste
    - Letter from //Khara Hais Municipality agreeing to accept general waste generated by the project on their site; 4 September 2015
    - Disposal site: Permit to Upington for “Die Duine” (Permit B33/2/442/1/P68; dated 3 August 1993) as Class 2 waste disposal facility on Portion of Kamp K3/325
    - Letter from transporter of waste (municipality cannot collect) – EnviroServ; 4 November 2015
- Hazardous solid waste
    - Letter from EnviroServ agreeing to collect, transport and accept hazardous waste generated by the project on their site; 4 November 2015
    - Disposal site: Certificate of registration (GPL-00-001; 10 February 2015)

  - Disposal site: Permit to EnviroServ Industrial Waste Management (Pty) Ltd (1983/03184/07) for Holfontein (Permit B33/2/321/121/P3; dated 25 April 1996 as H:H facility on Portions 23 & 24 of the farm Holfontein 71 IR, Benoni, Gauteng
- Wastewater
  - Letter from EnviroServ agreeing to collect and transport wastewater generated by the project; 4 November 2015
  - Letter from //Khara Hais Municipality agreeing to accept wastewater generated by the project on their site

Appendix D: Specialist studies

- Transtank: Installation, operation and maintenance manual; Low Profile Tank: T10.
- GEO-LOGIC Hydrogeological Consultants cc, 2015. Geohydrological - and contamination risk assessment study for a high speed proving ground on Portion 6 of the farm Steenkampspan 419 located north east of Upington in the Northern Cape Province. Report No: G2014/031. August 2015.
- Ixhaphozi Enviro Services, 2015. Wetland Delineation and Assessment. 12 January 2015.
- WSP Parsons Brinkerhoff, 2015. MBSA Proving Ground South Africa. Water and Waste Water Detail Design Report. Report No: 19606-04. November 2015.
- WSP Parsons Brinkerhoff, 2015. MBSA Proving Ground South Africa. Drainage and Geometric Detail Design Report. Report No: 19606-01. November 2015.

Appendix E: Engineering drawings

- PGSA-WSP-4-B-BD-ML-LP-001-01 Building area layout
- PGSA-WSP-4-B-BD-ST-RE-001-01 Conservancy tank reinforcing
- PGSA-WSP-4-B-BD-ST-RE-001-02 Conservancy tank reinforcing
- PGSA-WSP-4-B-BD-ST-RE-001-03 Conservancy tank reinforcing
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- PGSA-WSP-4-B-BD-SW-DT-001-01 Water supply
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- PGSA-WSP-4-B-BD-WS-LS-001-01 BH1 to buffer tank
- PGSA-WSP-4-R-BD-SW-DT-001-01 Conservancy tank
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Appendix F: Water use registration forms

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- DW901 – property – Portion 6 of the farm Steenkampspan 419
- DW901 – property – Duiker Rand
- DW902 – property owner – Alchris Boerderye CC
- DW902 – property owner – Albert Hertzog Human
- DW760 - section 21(a) - BH1
- DW784 - supplementary - pump technical data
- DW760 - section 21(a) - BH2
- DW784 - supplementary - pump technical data

- DW760 - section 21(a) - BH3
- DW784 - supplementary - pump technical data
- DW760 - section 21(a) - BH4
- DW784 - supplementary - pump technical data
- DW760 - section 21(a) - BH5
- DW784 - supplementary - pump technical data
- DW760 - section 21(a) - BH8
- DW784 - supplementary - pump technical data
- DW760 - section 21(a) - BH10
- DW784 - supplementary - pump technical data
- DW762 - section 21(b) - Storage dam
- DW763 - section 21(c) - Oval (OV) Culverts
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    - OV-C1-04
    - OV-C1-06
    - OV-C2-02
    - OV-C2-04
    - OV-C2-06
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- DW763 - section 21(c) - Access road (AC) Culverts:
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- DW905 - waste management facility

1 INTRODUCTION

1.1 Background

HydroScience CC has been appointed by the General Planner, IngenAix GmbH to handle the requirements in terms of the National Water Act (NWA), 1998 (Act 36 of 1998) on behalf of Mercedez Benz South Africa (MBSA) for their new high speed proving ground (HSPG) for light vehicle testing in Upington, in the Northern Cape Province of South Africa.

1.2 Contact details

1.2.1 Applicant

MBSA is a subsidiary of Daimler AG in Stuttgart, Germany. MBSA has been the supplier of both premium passenger cars and versatile commercial vehicles in South Africa, over the past six (6) decades.

At its award-winning state-of-the-art manufacturing plant in East London, the company manufactures the Mercedes-Benz C-Class model for the local market and exports to global markets. It also produces Mercedes-Benz commercial vehicles and buses, FUSO trucks, and Freightliner trucks.

MBSA contributed in excess of R2.2 billion to the South African economy in terms of income tax (R1 122.1 million) and duties (R1 176.8 million), in 2013. MBSA employs more than 6 000 people in South Africa at a cost of R2.2 million and in 2013 spent R35.9 million on staff training. The labour force doubled since 2010. In terms of social upliftment and engagement, MBSA spent R37.5 million in 2013, which included sponsorships, education and HIV/AIDS projects. MBSA has a Level 4 Broad-based Black Economic Empowerment (BBBEE) status.

Company: Mercedes Benz South Africa (Pty) Ltd

Registration number: 1962/00027/06

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Contact Person: Mr Owen Smith
Email: owen.smith@daimler.com

1.2.2 Consultant

HydroScience CC was established in 2008 after Ms Paulette Jacobs acted as an independent consultant since 2000. HydroScience is an environmental, water and waste management solutions provider. HydroScience strongly believes in sustainable development but we are also passionate about protecting our environment for current and future generations to appreciate.

Ms Paulette Jacobs obtained her qualifications from the Rand Afrikaans University in Johannesburg and has been in the water environment for the last 25 years, first in research for seven (7) years and since then in consulting. Ms Paulette Jacobs assisted Department of Water Affairs and Forestry (now Department of Water and Sanitation, DWS) to compile the Best Practice Guidelines for water resource protection in the mining industry and has successfully completed many water use license applications in terms of the NWA for the industrial, retail, commercial and residential sectors over the last 10 years.

Company:	HydroScience CC
Registration no:	2008/056910/23
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Physical address:	Unit C4 Cascades Office Park Corner of Wasbank & Weiling Street Little Falls Roodepoort 1724 Republic of South Africa
Tel:	082 667 5056
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Contact person:	Ms Paulette Jacobs
E-mail:	paulette@hydroscience.co.za
Cellular:	082 850 5482

1.3 Project description

MBSA is planning to develop a HSPG for light vehicle testing only (no trucks) in Upington. The goal of the project is to undertake all heat-relevant vehicle testing in Upington due to the high temperatures experienced in the area. Refer to Figure 1-3 for layout.

The project will include the following:

- Water supply
  - Abstraction of groundwater from the underlying aquifer as there is no other water supply source available on the site since municipal services do not extend to this area.
  - Abstraction of water through boreholes (existing and new) located on this property and the neighbouring property (Duiker Rand) for use for the project.
  - Use of water for construction phase (22 months over a 5 year period).

- Use of water for operational phase (indefinitely mainly during the summer months).
- Use of water for livestock watering (agriculture by farmer) all year round.
- Potable water for human consumption will be brought in from Upington (bottled water).
- Fresh water storage in a single storey building raised reservoir to ensure continued availability and availability for emergency situations such as fire fighting (volume being calculated to allow for two (2) day storage).

* Power supply (3-phase)
  - Self-sustaining electrical energy supply.
  - Generator (base generator and back-up) as well as separate generator at and/or photovoltaic panels on roof of guard house.
  - Mobile diesel tank (up to 60 m^3 diesel in up to three (3) fixed installed diesel tanks of 20m^3 each.
  - Water supplied to ablution facilities through solar energy (solar panel on roof).
* Waste and wastewater management
  - Closed single storey waste building for solid waste collection (storage < 30 days) – collected by contractor for off-site disposal.
  - Sewage conservancy tank (70 m^3) – sewage to be pumped by honeysucker and disposed of off-site every 10 – 14 days.
  - Oil separators for wastewater contaminated by hydrocarbons originating from the car wash, fuel station and workshop areas – will be removed off-site for recycling. 0.0705 m^3 capacity emptied every 10 days.
* Material sourcing (Quarry/borrow pit)
  - To source material required for road construction on site (G7 – G10 as bulk fill; G3 – G5 as base/sub-base; G1 for asphalt paving).
  - Granite quarry.
  - Calcrete borrow pit.
* High Speed Oval
  - 3-lane (3.75 m and 4.0 m wide).
  - Length: 17 km.
  - One-way track (clockwise driving only).
  - Straights of 4 km length.
  - Even construction of straights (no ripples); one-sided inclination (drainage).
  - Structurally normally executable curves with a radius of 1 250 m.
  - Width of lanes: overall 13 m.
* Handling Track
  - Single lane short-cut track inside oval
  - One-way track with different curves
  - Length: 5.984 km
  - Lane width: overall 16 m asphalt including paved shoulder (surfaced varying between 8, 10 & 12 m)
* Multifunctional Area (MFA)
  - 150 m X 400 m.
  - Acceleration lane 20 m X 600 m.
  - Return lanes 8 m.
* Slope Hill (grades with 10%, 15% and 20% lanes on front side, lane widths approximately 4 m to 8 m, turning area diameter approximately 40 m) including guardrails on outer edge.
* Bad Roads
  - Single lane.
  - 10 km track length as grader profiled dirt road.

- Access road (2 km gravel + 2.5 km asphalt on public side + 2.5 km asphalt on confidential side) from DR3322 and guard house at main entrance as well as security fencing.
- Impact roads (along access road between guard house and building)
  - Five (5) Test Lanes, 400 m length each, width 5 m;
  - Three (3) lanes to get paved with asphalt with different surface textures;
  - One (1) lane to get paved with concrete;
  - One (1) lane to get paved with cobble stones;
  - Will be assembled between test lanes and access road delineators; and
  - Turning area between each test lane turning.
- Bridge along access road crossing high speed oval over western straight near building.
- Building Zone (150 m X 150 m)
  - Office and workshop building (draining to oil separator) including medical centre and dispatcher room (40 m X 37 m).
  - Logistic area.
  - Roofed and semi-closed car wash area draining to oil separator.
  - Roofed mobile fuel station (150m^2) draining to oil separator. 4 X 10 000 litre storage (40 m^3) of fuel (diesel, 95 Octane, 98 Octane & 100 Octane) above ground in double-walled mobile containers; usage will be 1 000 – 2 000 litres/day during operational period).
  - Oil separator (0.0705 m^3 emptied every 10 days).
  - Parking (2 500 m^2 gravel + 3 000 m^2 paved + 2 000 m^2 paved). Overall concrete paving in building zone is approximately 13 000 m^2 in total.
- Farming activities (Fences, cattle loading ramps, water troughs, single lane roads for maintenance and farming purposes along fences, cattle grids on access and service roads where necessary etc.).

1.4 Project location

Province:	Northern Cape
District:	Siyanda now ZF Mgcawu
Municipality:	//Khara Hais
Section:	Gordonia rd
Farm:	Steenkampspan 419 Portion 6
Coordinates:	28^0 11’ 38.8184” South 21^0 29’ 41.0297” East

Refer to Figure 1-1 for regional locality.

1.5 Property

Farm:	Steenkampspan 419 Portion 6
SG code:	C0280000000004190006

Size: Property:	3 732.7185ha
Project area:	3.725ha
Property owner:	Alchris Boerderye CC (1998/048749/23)
Title deed:	T2792/2007
Site selection criteria:	High temperatures in area (location); Availability of site; Accessibility; Shape; Topography; Geology
Project extent:	3.725ha (< 0.1% of property)
Current land use:	Agriculture Livestock – cattle (currently ±300 head of cattle)
Future land use:	Agriculture – livestock (reduced from current 300 to 60-80 head of cattle) MBSA high speed proving ground
Surrounding land use:	Agriculture
Land use zoning:	Agriculture Special consent for project (Town planning application)
Existing buildings:	None
Existing boreholes: Pre-2015:	Four (4) – Three (3) equipped with wind mills and used for livestock watering
New (2015):	Five (5) – Two (2) were equipped; two (2) cased for monitoring purposes and one (1) destroyed
Closest town:	Upington; 35 km south west
Access:	Gravel provincial road travelling north east from airport, DR3322

	
Solar-powered windmill at borehole to supply water to livestock	One of the existing boreholes used for farming water supply

Plate 1: Photos of existing infrastructure associated with current water supply for farming (September 2014)

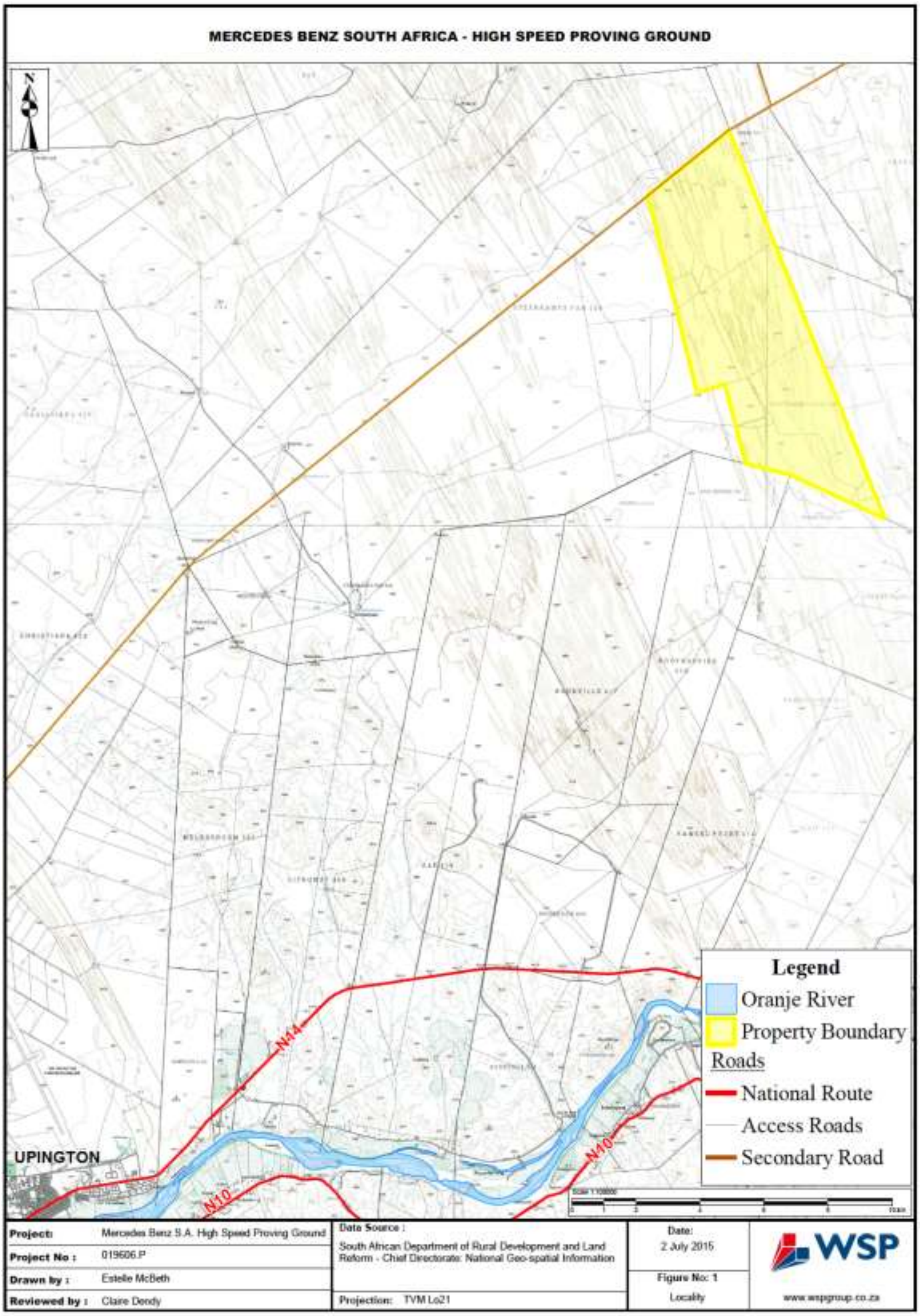

Figure 1-1: Regional locality map (WSP, 2015)

Figure 1-2: Surrounding properties (Geologic, 2015)

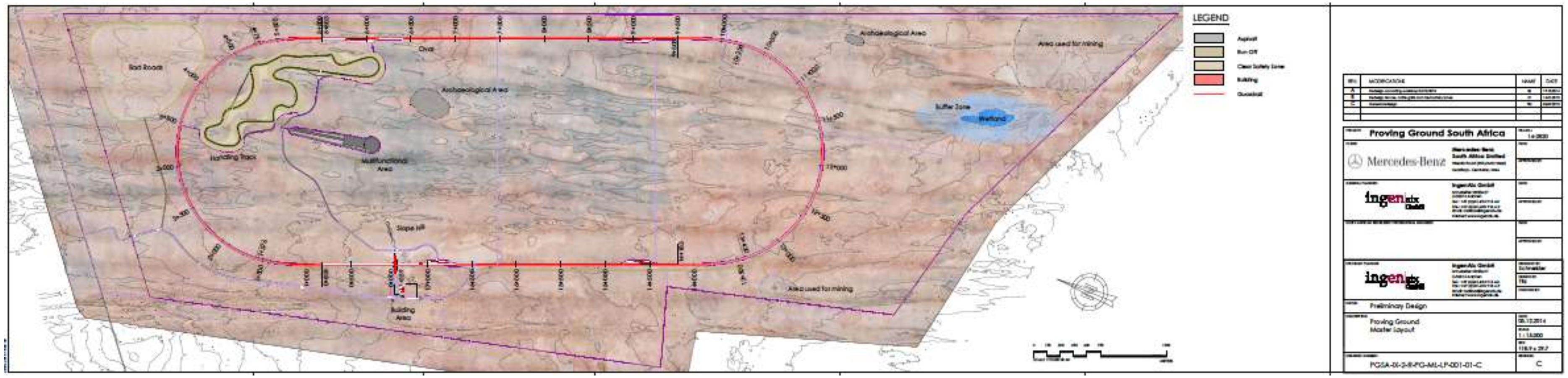

Figure 1-3: Site layout (IngenAix, 2015)

2 LEGAL FRAMEWORK

2.1 Constitution

The Constitution of the Republic of South Africa, 1996 (Act 108 of 1996), places a duty on the State to protect the environment. Section 24 states that:
"Everyone has the right

a. to an environment that is not harmful to their health or well-being; and
b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that
   i. prevent pollution and ecological degradation;
   ii. promote conservation; and
   iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."

This right is given effect in several articles of national legislation, including the NWA, 1998.

2.2 National Water Act (NWA)

2.2.1 Legislation

The NWA states in Section 22 (1) that a person may only use water –

(a) without a licence –
  (i) if that water use is permissible under Schedule 1;
  (ii) if that water use is permissible as a continuation of an existing lawful use; or
  (iii) if that water use is permissible in terms of a general authorisation issued under section 39;
(b) if the water use is authorised by a licence under this Act; or
(c) if the responsible authority has dispensed with a licence requirement under subsection (3).

Section 21 of the NWA defines water use as:

(a) taking water from a water resource;
(b) storing water;
(c) impeding or diverting the flow of water in a watercourse;
(d) engaging in a stream flow reduction activity contemplated in section 36;
(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
(g) disposing of waste in a manner which may detrimentally impact on a water resource;
(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
(i) altering the bed, banks, course or characteristics of a watercourse;
(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
(k) using water for recreational purposes.

2.2.2 Applicability to project

Schedule 1:

Schedule 1 water uses are not applicable to this project.

Existing lawful use:

In terms of Section 32 of the NWA, an existing lawful water use (ELWU) is defined as follows:

"*Water use which has taken place at any time during a period of two years immediately before the date of commencement of the Act (1 October 1996 to 30 September 1998) and which was authorised by or under any law which was in force immediately before the date of commencement of this Act, or which has been declared an existing lawful water use in terms of Section 33 of the Act*".

As the project is a new project, the continuation of an existing lawful use is not applicable although the livestock watering will continue. The legality of the water previously abstracted and used for livestock watering was not assessed. However, the abstraction of water for livestock watering and for supplying the construction and operational needs of the project has been included in the IWULA.

General authorisation:

The storage of water (water supply) falls within the scope of General Authorisation published in Government Notice Regulation (GNR) 399 in Government Gazette 26187 of 2004 (see Section 3.3).

Section 22(3) of the NWA:

The responsible authority, DWS, has not dispensed with the requirement of a water use licence for the project in terms of subsection (3).

Requirements:

The project requires a Water Use Licence (WUL) for the following water uses which have been included in this application and because a number of water uses are applicable, an application for an Integrated Water Use Licence (IWUL) will be lodged with DWS.

- Section 21 (a): taking water from a water resource – groundwater will be abstracted from the underlying aquifer via boreholes on the property and the neighbouring property (Duiker Rand) for use during the construction (22 months over a 5 year period) and operational (mainly summer months) phases.
- Section 21 (b): storing water – the groundwater abstracted will be pumped to and stored in a raised reservoir to ensure a continuous water supply as well as water for emergency supply (power interruption or fire). Since small quantities (< 200 m^3 to allow for two (2) day storage) will be stored this will be a General Authorisation which allows for up to 2 000 m^3 storage (GNR288, 2012).
- Section 21 (c): impeding or diverting the flow of water in a watercourse – culverts and channels will be required to convey drainage around the oval and access road along the water tract (along SP3).

- Section 21 (g): disposing of waste in a manner which may detrimentally impact on a water resource – wastewater contaminated with hydrcarbons (originating from the car wash, fuel station and workshop areas) will be stored on site as well as sewage in conservancy tanks (70 m^3). None of these wastewaters will be disposed of on site but will only be stored. The small quantities (< 1 000 m^3) may also only require a General Authorisation (GNR665, 2013) and containment facilities will be designed according to legal specification to prevent overflows, spillages or leakages thereby preventing impacts to the environment.
- Section 21 (i): altering the bed, banks, course or characteristics of a watercourse – relates to Section 21 (c).

Table 2-1: Water uses identified

NWA, Section 21	Legislation	Project	Requirement
a	Taking water from a water resource	Borehole water use	Licence
b	Storing water	Reservoir of < 200 m^3	General Authorisation
c & i	Impeding or diverting the flow of water in a watercourse & Altering the bed, banks, course or characteristics of a watercourse.	Nothing within 500 m of the identified wetland. Water tract (along SP3) – culverts etc.	Culverts and channels as part of storm water management (diversion drainage lines around infrastructure).
g	Disposing of waste in a manner which may detrimentally impact on a water resource.	Conservancy tank of 70 m^3	General authorization for quantity but Licence since location in proximity (<500 m) to water supply borehole BH1.

2.3 Other legislation

2.3.1 National Environmental Management Act

The principle of sustainable development has been established in the Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) and given effect by the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998) and the Environment Conservation Act (ECA), 1989 (Act 73 of 1989). Section 1(29) of NEMA states that sustainable development means the integration of social, economic and environmental factors into the planning, implementation and decision-making process so as to ensure that development serves present and future generations. Thus, sustainable development requires that:

- The disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimized and remedied;
- That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimized and remedied;
- That the disturbance of landscapes and sites that constitute the nation’s cultural heritage is avoided, or where it cannot be altogether avoided, is minimized and remedied;
- That waste is avoided, or where it cannot be altogether avoided, minimized and re-used or recycled where possible and otherwise disposed of in a responsible manner;
- That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions;
- Negative impacts on the environment, on people’s environmental rights be anticipated; and, prevented, and where they cannot altogether be prevented, are minimized and remedied.

The principles underpinning environmental management contained in the NEMA must be taken into account by any organ of state in the exercise of any power that may impact on the environment.

WSP* Parsons Brinckerhoff *(WSP) was appointed by the General Planner, IngenAix GmbH, on behalf of MBSA to lodge an application with the Northern Cape Department of Environment and Nature Conservation (DENC) to apply for environmental authorisation for the project in terms of GNR 982, 983, 984 and 985 of 3 December 2014 in terms of the Environmental Impact Assessment (EIA) regulations under sections 24(5), 24M and 44 of the NEMA.

3 WATER USES MOTIVATION

3.1 Existing lawful uses

In terms of Section 32 of the NWA, an Existing Lawful Water Use (ELWU) is defined as follows:

"*Water use which has taken place at any time during a period of two years immediately before the date of commencement of the Act (1 October 1996 to 30 September 1998) and which was authorised by or under any law which was in force immediately before the date of commencement of this Act, or which has been declared an existing lawful water use in terms of Section 33 of the Act*".

As the project is a new project, the continuation of an existing lawful use is not applicable though the livestock watering is an existing use continuing. The legality of the water used for livestock watering was not assessed as part of the scope of work for this project.

3.2 Summary of relevant exemptions

No exemptions are applicable to this application.

3.3 Summary of general authorisations

An assessment was done of the General Authorisations (GA) under the NWA, namely:
- General Authorisation published under GNR399 in Government Gazette 26187 of 2004 in respect of Sections 21(a), (b), (e), (f), (g), (h) water uses, as amended by GNR665 of 6 September 2013;
- General Authorisation 665, dated 6 September 2013 in terms of Section 21(e), (f), (g), (h), and (j) water use; and
- General Authorisation published under GNR1199 in Government Gazette 32805, dated 18 December 2009 in respect of Sections 21 (c) and (i) water uses.

Some water uses fall within the above-mentioned General Authorisations and have been included in this document and referred to as such.

General Authorisation for Section 21 (a) and (b) has been published in GNR399 in Government Gazette 26787 of 26 March 2004.

The duration of the authorisation is for a period of five (5) years (expired 2009) unless it is extended, amended or replaced. The validity was extended in GNR970 in Government Gazette 35909 on 30 November 2012.

Registration of water use required for GA:
- Taking more than 50m^3 from surface water or 10 m^3 from groundwater on any given day.
- Combined storage of more than 10 000 m^3 of water per property.

General Authorisation for Section 21 (g) has been published in Government Notice Regulation (GNR) 665 of 6 September 2013.

The following are extracts from GNR 665:

"On-site disposal" refers to the disposal of wastewater on individual properties not permanently linked to a central waste collection, treatment and disposal systems, such as septic tank systems, conservancy tank systems, soakaway systems, french drains, pit latrines, some package plants and related activities.

Storage of domestic and biodegradable industrial waste for the purpose of disposal.

3.8 A person who (a) owns or lawfully occupies property registered in the Deeds Office as at the date of this notice may on that property or land outside the areas set out in Table 3.1 (i) store domestic and biodegradable industrial wastewater for the purpose of disposal of (a) up to 10 000 cubic metres per property or land if the storing of the wastewater (b) does not impact on a water resource or on any other person's water use, property or land; and (c) is not detrimental to the health and safety of the public in the vicinity of the activity.

Registration of wastewater storage

3.11(1) A person who stores wastewater in terms of this authorisation must submit a registration form for registration of the water use before commencement of storage if more than 1 000 cubic metres are stored for disposal.

Location of wastewater storage dams and wastewater disposal sites

3.13 Wastewater storage dams and wastewater disposal sites must be located (a) outside a watercourse; (b) above the 1 in 100 year flood line or riparian habitat whichever is the greatest, or alternatively at least 100 metres from a water resource whichever is the greatest or at least further than a 500 m radius from a borehole that is utilised for drinking water or stockwatering; and (c) at least outside a 500 m radius from the boundary of a wetland, (d) on land that is not, or does not, overlie, a major aquifer.

Table 3-1: General authorisations (GA)

NWA, Section 21	Water use	Details	Locality
b	Storing water	Reservoir Capacity: < 200 m^3	28^0 11' 09.01" South 21^0 28' 28.27" East

3.4 New water uses

Table 3-2: All water uses included in this application

NWA, Section 21	Water use	Details / name	Locality (longitude; latitude; farm)	Construction phase (22 months) water use (volume/capacity)	Operational phase (20 years) water use (volume/capacity)
a	Taking water from a water resource *Borehole water use as no municipal water supply*	BH 1 (existing)	-28.184615° 021.478047° 28° 11' 4.6140" S 21° 28' 40.9692" E Steenkampspan	15.1 m^3/d (HSPG)	10 m^3/d (HSPG) 1.05litres/sec @ 76 m
		BH2 (existing)	-28.21177° 021.49552° 28° 12' 42.3720" S 21° 29' 43.8720" E Steenkampspan	2 m^3/d (livestock watering)	2 m^3/d (livestock watering)

<table>
<tr><th>NWA, Section 21</th><th>Water use</th><th>Details / name</th><th>Locality (longitude; latitude; farm)</th><th>Construction phase (22 months) water use (volume/capacity)</th><th>Operational phase (20 years) water use (volume/capacity)</th></tr>
<tr><td rowspan="5"></td><td rowspan="5"></td><td>BH3
(existing)</td><td>-28.23996°
021.52847°
28° 14' 23.8560" S
21° 31' 42.4920" E
Steenkampspan</td><td>2 m³/d
(livestock watering)</td><td>2 m³/d
(livestock watering)</td></tr>
<tr><td>BH4
(existing)</td><td>-28.23965°
021.52835°
28° 14' 22.7400" S
21° 31' 42.0600" E
Steenkampspan</td><td>2 m³/d
(livestock watering)</td><td>2 m³/d
(livestock watering)</td></tr>
<tr><td>BH5
(new 2015)</td><td>-28.200994°
021.503347°
28° 12' 3.5784" S
21° 30' 12.0492" E
Steenkampspan</td><td>25.9 m³/d
(HSPG)</td><td>0</td></tr>
<tr><td>BH8
(new 2015)</td><td>-28.19842°
021.50554°
28° 11' 54.3120" S
21° 30' 19.9440" E
Steenkampspan</td><td>95 m³/d
(HSPG)</td><td>0</td></tr>
<tr><td>H/BH10
(existing)</td><td>-28.28226°
021.51938°
28° 16' 56.1360" S
21° 31' 9.7680" E
Duiker Rand</td><td>164 m³/d
(HSPG)</td><td>0</td></tr>
<tr><td colspan="4" rowspan="2">Demand for project</td><td>300 m³/d</td><td>10 m³/d</td></tr>
<tr><td>109 500 m³/a</td><td>5 840 m³/a</td></tr>
<tr><td colspan="4" rowspan="2">Total demand on delineated catchment area (see Figure 4.10: For delineated catchment and boreholes located within this catchment and using water. Therefore includes use by other farmers in catchment)</td><td>348.4 m³/d</td><td>58.4 m³/d</td></tr>
<tr><td>127 166 m³/a</td><td>21 316 m³/a</td></tr>
<tr><td colspan="4">Project demand as a percentage of total demand</td><td>86.1%</td><td>17.1%</td></tr>
<tr><td>b</td><td>Storing water – falls within GA (GNR399)</td><td>Reservoir – Aquadam 300 mm above ground</td><td>GA; refer to Table 3-1
28° 11’ 09.01” South
21° 28’ 28.27” East</td><td>150 m³</td><td>200 m³</td></tr>
<tr><td>c & i</td><td>Impeding or diverting the flow of water in a watercourse

Altering the bed, banks, course or characteristics of a watercourse

Nothing within</td><td>Water tract – culverts. Refer to Section 6 for sizes (Table 6.8).</td><td colspan="3">
<table>
<tr><th rowspan="2">Point</th><th colspan="2">OVAL CULVERTS</th></tr>
<tr><th>Start</th><th>End</th></tr>
<tr><td>OV-C1-02</td><td>28° 09' 42.12" S
21° 28' 29.59" E</td><td>28° 09' 42.65" S
21° 28' 30.20" E</td></tr>
<tr><td>OV-C1-04</td><td>28° 09' 42.22" S
21° 28' 29.48" E</td><td>28° 09' 42.74" S
21° 28' 30.09" E</td></tr>
<tr><td>OV-C1-06</td><td>28° 09' 42.31" S
21° 28' 29.38" E</td><td>28° 09' 42.84" S
21° 28' 29.99" E</td></tr>
<tr><td>OV-C2-02</td><td>28° 10' 06.72" S
21° 28' 17.03" E</td><td>28° 10' 06.79" S
21° 28' 17.87" E</td></tr>
<tr><td>OV-C2-04</td><td>28° 10' 06.59" S</td><td>28° 10' 06.66" S</td></tr>
</table>
</td></tr>
</table>

NWA, Section 21	Water use	Details / name	Locality (longitude; latitude; farm)	Construction phase (22 months) water use (volume/capacity)	Operational phase (20 years) water use (volume/capacity)
	500m of the identified wetland. *Culverts etc as part of storm water management*				

	21° 28' 17.04" E	21° 28' 17.89" E
OV-C2-06	28° 10' 06.46" S 21° 28' 17.06" E	28° 10' 06.53" S 21° 28' 17.90" E
OV-C3-02	28° 11' 06.32" S 21° 30' 19.74" E	28° 11' 06.60" S 21° 30' 18.96" E
OV-C3-04	28° 11' 06.20" S 21° 30' 19.69" E	28° 11' 06.48" S 21° 30' 18.90" E
OV-C3-06	28° 11' 06.08" S 21° 30' 19.63" E	28° 11' 06.36" S 21° 30' 18.84" E
OV-C4-02	28° 13' 10.10" S 21° 30' 28.23" E	28° 13' 10.85" S 21° 30' 28.62" E
OV-C4-04	28° 13' 10.15" S 21° 30' 28.10" E	28° 13' 10.91" S 21° 30' 28.49" E
OV-C4-06	28° 13' 10.21" S 21° 30' 27.96" E	28° 13' 10.96" S 21° 30' 28.35" E
OV-C5-02	28° 13' 12.13" S 21° 30' 22.40" E	28° 13' 12.88" S 21° 30' 22.67" E
OV-C6-02	28° 13' 13.95" S 21° 30' 11.49" E	28° 13' 14.70" S 21° 30' 11.54" E
OV-C6-04	28° 13' 13.96" S 21° 30' 11.34" E	28° 13' 14.71" S 21° 30' 11.40" E
OV-C6-06	28° 13' 13.97" S 21° 30' 11.19" E	28° 13' 14.72" S 21° 30' 11.25" E
OV-C6-08	28° 13' 13.98" S 21° 30' 11.05" E	28° 13' 14.73" S 21° 30' 11.10" E
OV-C6-10	28° 13' 13.98" S 21° 30' 10.90" E	28° 13' 14.73" S 21° 30' 10.95" E
OV-C6-12	28° 13' 13.99" S 21° 30' 10.75" E	28° 13' 14.74" S 21° 30' 10.80" E

Point	HANDLING TRACK CULVERTS	
	Start	End
HT-C1-02	28° 09' 45.40" S 21° 29' 21.74" E	28° 09' 46.04" S 21° 29' 21.70" E
HT-C1-04	28° 09' 45.40" S 21° 29' 21.68" E	28° 09' 46.03" S 21° 29' 21.65" E
HT-C1-06	28° 09' 45.40" S 21° 29' 21.63" E	28° 09' 46.03" S 21° 29' 21.60" E
HT-C2-02	28° 09' 48.59" S 21° 29' 22.20" E	28° 09' 51.95" S 21° 29' 23.10" E
HT-C2-04	28° 09' 48.60" S 21° 29' 22.15" E	28° 09' 51.96" S 21° 29' 23.04" E
HT-C2-06	28° 09' 48.61" S 21° 29' 22.10" E	28° 09' 51.97" S 21° 29' 22.99" E
HT-C3-02	28° 09' 54.47" S 21° 29' 10.48" E	28° 09' 55.14" S 21° 29' 08.57" E
HT-C4-02	28° 10' 01.61" S 21° 29' 09.75" E	28° 10' 02.03" S 21° 29' 09.50" E
HT-C5-02	28° 10' 04.80" S 21° 29' 24.98" E	28° 10' 07.91" S 21° 29' 26.20" E
HT-C5-04	28° 10' 04.81" S 21° 29' 24.94" E	28° 10' 07.92" S 21° 29' 26.16" E

NWA, Section 21	Water use	Details / name	Locality (longitude; latitude; farm)	Construction phase (22 months) water use (volume/capacity)	Operational phase (20 years) water use (volume/capacity)

HT-C5-06	28° 10' 04.82" S 21° 29' 24.91" E	28° 10' 07.93" S 21° 29' 26.13" E
HT-C6-02	28° 10' 19.29" S 21° 29' 48.26" E	28° 10' 21.29" S 21° 29' 45.60" E
HT-C7-02	28° 10' 24.05" S 21° 29' 44.01" E	28° 10' 25.02" S 21° 29' 40.74" E
HT-C7-04	28° 10' 23.99" S 21° 29' 43.99" E	28° 10' 24.96" S 21° 29' 40.72" E
HT-C8-02	28° 10' 06.01" S 21° 29' 36.63" E	28° 10' 06.97" S 21° 29' 36.90" E
HT-C9-02	28° 10' 13.64" S 21° 29' 38.80" E	28° 10' 14.52" S 21° 29' 39.05" E

Point	ACCESS ROAD CULVERTS	
	Start	End
AC-C1-02	28° 09' 56.51" S 21° 28' 06.20" E	28° 09' 56.61" S 21° 28' 06.77" E
AC-C2-02	28° 10' 35.80" S 21° 28' 13.54" E	28° 10' 35.67" S 21° 28' 14.10" E
AC-C3-02	28° 11' 28.18" S 21° 28' 42.25" E	28° 11' 28.84" S 21° 28' 42.11" E
AC-C4-02	28° 10' 49.06" S 21° 28' 39.55" E	28° 10' 49.22" S 21° 28' 40.20" E
AC-C4-04	28° 10' 49.10" S 21° 28' 39.54" E	28° 10' 49.26" S 21° 28' 40.19" E
AC-C5-02	28° 10' 28.36" S 21° 28' 50.47" E	28° 10' 28.89" S 21° 28' 51.07" E
AC-C6-02	28° 10' 20.01" S 21° 28' 57.22" E	28° 10' 20.26" S 21° 28' 57.97" E
AC-C7-02	28° 10' 08.65" S 21° 29' 01.33" E	28° 10' 08.92" S 21° 29' 02.01" E
AC-C8-02	28° 10' 04.66" S 21° 29' 06.70" E	28° 10' 05.28" S 21° 29' 06.87" E
AC-C9-02	28° 10' 11.40" S 21° 29' 21.43" E	28° 10' 11.95" S 21° 29' 20.99" E
AC-C9-04	28° 10' 11.38" S 21° 29' 21.39" E	28° 10' 11.93" S 21° 29' 20.95" E
AC-C9-06	28° 10' 11.36" S 21° 29' 21.36" E	28° 10' 11.91" S 21° 29' 20.92" E

Point	BUILDING CULVERTS	
	Start	Finish
BD-C1-02	28° 11' 06.57" S 21° 28' 24.40" E	28° 11' 07.09" S 21° 28' 24.63" E
BD-C2-02	28° 11' 11.33" S 21° 28' 25.81" E	28° 11' 11.50" S 21° 28' 25.31" E

Point	SH CULVERTS	
	Start	Finish
SH-C1-02	28° 10' 57.24" S 21° 28' 45.76" E	28° 10' 57.61" S 21° 28' 46.09" E

NWA, Section 21	Water use	Details / name	Locality (longitude; latitude; farm)	Construction phase (22 months) water use (volume/capacity)	Operational phase (20 years) water use (volume/capacity)
c & i	Impeding or diverting the flow of water in a watercourse Altering the bed, banks, course or characteristics of a watercourse *Nothing within 500m of the identified wetland. Drainage channels as part of storm water management.*	Water tract – channels. Refer to Section 6 for sizes (Table 6.7).			

Point	OVAL CHANNELS	
	Start	Finish
OV-CH-01	S28° 10' 13.18" E21° 28' 16.83"	S28° 11' 04.32" E21° 28' 28.72"
OV-CH-02	S28° 10' 11.19" E21° 28' 17.63"	S28° 10' 31.33" E21° 28' 22.82"
OV-CH-03	S28° 09' 29.26" E21° 29' 05.32"	S28° 09' 42.07" E21° 28' 29.55"
OV-CH-04	S28° 09' 30.00" E21° 29' 02.79"	S28° 09' 42.62" E21° 28' 30.16"
OV-CH-05	S28° 09' 30.00" E21° 29' 02.79"	S28° 10' 56.58" E21° 30' 14.35"
OV-CH-06	S28° 09' 31.91" E21° 29' 19.86"	S28° 09' 36.57" E21° 29' 29.85"
OV-CH-07	S28° 09' 50.36" E21° 29' 44.14"	S28° 10' 55.98" E21° 30' 15.13"
OV-CH-08	S28° 11' 34.14" E21° 30' 31.63"	S28° 12' 25.60" E21° 30' 53.56"
OV-CH-09	S28° 11' 34.21" E21° 30' 32.42"	S28° 11' 50.64" E21° 30' 39.92"
OV-CH-10	S28° 12' 11.49" E21° 30' 49.42"	S28° 12' 19.14" E21° 30' 52.46"
OV-CH-11	S28° 12' 46.82" E21° 30' 51.91"	S28° 12' 48.55" E21° 30' 51.19"
OV-CH-12	S28° 12' 53.32" E21° 30' 48.61"	S28° 12' 53.97" E21° 30' 48.19"
OV-CH-13	S28° 13' 04.45" E21° 30' 38.24"	S28° 13' 05.14" E21° 30' 37.29"
OV-CH-14	S28° 13' 07.68" E21° 30' 33.29"	S28° 13' 09.26" E21° 30' 30.25"
OV-CH-15	S28° 13' 11.26" E21° 30' 25.31"	S28° 13' 10.87" E21° 30' 26.40"
OV-CH-16	S28° 13' 11.82" E21° 30' 25.64"	S28° 13' 11.51" E21° 30' 26.52"
OV-CH-17	S28° 12' 58.43" E21° 29' 32.65"	S28° 13' 14.03" E21° 30' 09.22"
OV-CH-18	S28° 13' 14.63" E21° 30' 07.30"	S28° 13' 14.65" E21° 30' 09.13"
OV-CH-19	S28° 12' 08.52" E21° 29' 07.21"	S28° 12' 37.73" E21° 29' 20.56"
OV-CH-20	S28° 12' 20.18" E21° 29' 11.76"	S28° 12' 27.26" E21° 29' 15.00"
OV-CH-21	S28° 11' 17.20" E21° 28' 46.64"	S28° 11' 37.06" E21° 28' 52.82"
OV-CH-22	S28° 11' 18.73" E21° 28' 43.69"	S28° 11' 36.68" E21° 28' 51.89"
OV-CH-23	S28° 11' 02.36" E21° 28' 36.97"	S28° 11' 13.65" E21° 28' 43.60"
OV-CH-24	S28° 11' 02.64" E21° 28' 36.32"	S28° 11' 10.68" E21° 28' 39.99"

Point	HANDLING TRACK CHANNELS	
	Start	End
HT-CH-01	S28° 09' 55.68" E21° 29' 30.61"	S28° 10' 25.04" E21° 29' 40.65"
HT-CH-02	S28° 09' 52.97" E21° 29' 28.76"	S28° 10' 23.98" E21° 29' 44.00"
HT-CH-03	S28° 09' 55.68" E21° 29' 30.61"	S28° 10' 11.42" E21° 29' 21.36"
HT-CH-04	S28° 09' 52.97" E21° 29' 28.76"	S28° 10' 04.80" E21° 29' 24.96"
HT-CH-05	S28° 09' 51.96" E21° 29' 23.06"	S28° 10' 04.78" E21° 29' 24.96"

NWA, Section 21	Water use	Details / name	Locality (longitude; latitude; farm)	Construction phase (22 months) water use (volume/capacity)	Operational phase (20 years) water use (volume/capacity)

HT-CH-06	S28° 10' 04.80" E21° 29' 24.96"	S28° 09' 40.52" E21° 28' 57.92"
HT-CH-07	S28° 10' 02.04" E21° 29' 11.32"	S28° 10' 08.81" E21° 29' 21.48"
HT-CH-08	S28° 09' 37.29" E21° 28' 57.33"	S28° 09' 45.36" E21° 28' 52.55"
HT-CH-09	S28° 09' 40.42" E21° 28' 57.95"	S28° 09' 51.50" E21° 29' 13.87"
HT-CH-10	S28° 09' 37.29" E21° 28' 57.33"	S28° 09' 45.38" E21° 29' 21.68"
HT-CH-11	S28° 09' 45.46" E21° 29' 14.75"	S28° 09' 48.59" E21° 29' 22.14"
HT-CH-12	S28° 09' 46.04" E21° 29' 21.67"	S28° 09' 48.58" E21° 29' 22.16"
HT-CH-13	S28° 09' 46.23" E21° 29' 26.80"	S28° 09' 48.59" E21° 29' 22.14"
HT-CH-14	S28° 09' 45.75" E21° 29' 27.38"	S28° 09' 45.38" E21° 29' 21.68"
HT-CH-15	S28° 09' 45.75" E21° 29' 27.38"	S28° 10' 16.60" E21° 29' 52.56"
HT-CH-16	S28° 09' 54.65" E21° 29' 36.01"	S28° 10' 16.89" E21° 29' 42.49"
HT-CH-17	S28° 10' 15.10" E21° 29' 50.99"	S28° 10' 19.28" E21° 29' 48.28"
HT-CH-18	S28° 10' 23.40" E21° 29' 52.14"	S28° 10' 19.28" E21° 29' 48.28"
HT-CH-19	S28° 10' 23.14" E21° 29' 48.97"	S28° 10' 21.18" E21° 29' 45.40"
HT-CH-20	S28° 10' 23.43" E21° 29' 52.17"	S28° 10' 27.22" E21° 29' 41.01"
HT-CH-21	S28° 10' 23.14" E21° 29' 48.97"	S28° 10' 23.98" E21° 29' 44.00"
HT-CH-22	S28° 09' 49.09" E21° 29' 29.43"	S28° 09' 51.94" E21° 29' 32.78"
HT-CH-23	S28° 09' 49.09" E21° 29' 29.43"	S28° 09' 51.98" E21° 29' 22.87"

Point	ACCESS ROAD CHANNELS	
	Start	Finish
AC-CH-01	S28° 09' 13.05" E21° 27' 59.60"	S28° 09' 13.52" E21° 28' 00.03"
AC-CH-02	S28° 09' 27.01" E21° 28' 04.15"	S28° 09' 27.56" E21° 28' 04.66"
AC-CH-03	S28° 09' 44.64" E21° 28' 11.64"	S28° 10' 03.20" E21° 28' 05.47"
AC-CH-04	S28° 10' 05.50" E21° 28' 06.15"	S28° 10' 06.25" E21° 28' 06.23"
AC-CH-05	S28° 10' 14.71" E21° 28' 07.64"	S28° 10' 21.00" E21° 28' 09.42"
AC-CH-06	S28° 10' 16.64" E21° 28' 08.76"	S28° 10' 20.66" E21° 28' 09.88"
AC-CH-07	S28° 10' 25.33" E21° 28' 10.61"	S28° 10' 52.17" E21° 28' 18.08"
AC-CH-08	S28° 10' 26.98" E21° 28' 11.65"	S28° 10' 33.19" E21° 28' 13.38"
AC-CH-09	S28° 11' 01.03" E21° 28' 21.22"	S28° 11' 03.32" E21° 28' 22.15"
AC-CH-10	S28° 11' 16.33" E21° 28' 28.20"	S28° 11' 26.89" E21° 28' 36.92"
AC-CH-11	S28° 11' 17.07" E21° 28' 27.84"	S28° 11' 27.96" E21° 28' 38.40"
AC-CH-12	S28° 11' 27.18" E21° 28' 46.02"	S28° 11' 23.98" E21° 28' 45.75"
AC-CH-13	S28° 11' 27.74" E21° 28' 46.60"	S28° 11' 25.12" E21° 28' 46.38"

NWA, Section 21	Water use	Details / name	Locality (longitude; latitude; farm)	Construction phase (22 months) water use (volume/capacity)	Operational phase (20 years) water use (volume/capacity)

AC-CH-14	S28° 10' 36.69" E21° 28' 44.28"	S28° 10' 43.54" E21° 28' 41.94"
AC-CH-15	S28° 10' 36.80" E21° 28' 43.66"	S28° 10' 40.73" E21° 28' 42.28"
AC-CH-16	S28° 10' 30.32" E21° 28' 49.21"	S28° 10' 34.58" E21° 28' 45.47"
AC-CH-17	S28° 10' 29.78" E21° 28' 49.07"	S28° 10' 33.72" E21° 28' 45.43"
AC-CH-18	S28° 10' 21.23" E21° 28' 56.76"	S28° 10' 25.26" E21° 28' 54.00"
AC-CH-19	S28° 10' 21.98" E21° 28' 56.95"	S28° 10' 25.55" E21° 28' 54.41"
AC-CH-20	S28° 10' 15.05" E21° 28' 59.66"	S28° 10' 16.34" E21° 28' 59.21"
AC-CH-21	S28° 10' 14.54" E21° 28' 59.29"	S28° 10' 15.39" E21° 28' 58.99"
AC-CH-22	S28° 10' 10.71" E21° 29' 01.19"	S28° 10' 11.88" E21° 29' 00.78"
AC-CH-23	S28° 10' 10.45" E21° 29' 00.73"	S28° 10' 11.80" E21° 29' 00.25"
AC-CH-24	S28° 10' 07.17" E21° 29' 03.19"	S28° 10' 08.06" E21° 29' 02.45"
AC-CH-25	S28° 10' 06.91" E21° 29' 02.75"	S28° 10' 07.31" E21° 29' 02.38"
AC-CH-26	S28° 10' 06.04" E21° 29' 04.70"	S28° 10' 06.89" E21° 29' 03.50"
AC-CH-27	S28° 10' 05.71" E21° 29' 04.28"	S28° 10' 06.06" E21° 29' 03.75"
AC-CH-28	S28° 10' 10.79" E21° 29' 34.50"	S28° 10' 11.36" E21° 29' 21.44"
AC-CH-29	S28° 10' 11.29" E21° 29' 34.42"	S28° 10' 12.19" E21° 29' 30.38"

Point	BUILDING CHANNELS	
	Start	Finish
BD-CH-01	S28° 11' 04.32" E21° 28' 28.72"	S28° 11' 06.56" E21° 28' 24.40"
BD-CH-02	S28° 11' 05.00" E21° 28' 29.30"	S28° 11' 11.31" E21° 28' 25.87"
BD-CH-03	S28° 11' 07.11" E21° 28' 24.64"	S28° 11' 11.29" E21° 28' 25.91"
BD-CH-04	S28° 11' 09.62" E21° 28' 27.40"	S28° 11' 10.31" E21° 28' 25.48"

Point	MULTIFUNCTIONAL AREA CHANNELS	
	Start	Finish
MA-CH-1	S28° 10' 06.44" E21° 29' 11.47"	S28° 10' 14.57" E21° 29' 11.43"
MA-CH-2	S28° 10' 08.31" E21° 29' 11.86"	S28° 10' 14.53" E21° 29' 12.11"
MA-CH-3	S28° 10' 08.36" E21° 29' 11.90"	S28° 10' 11.56" E21° 29' 12.35"
MA-CH-4	S28° 10' 10.40" E21° 29' 13.69"	S28° 10' 40.49" E21° 29' 19.29"
MA-CH-5	S28° 10' 21.13" E21° 29' 12.55"	S28° 10' 41.53" E21° 29' 19.50"

NWA, Section 21	Water use	Details / name	Locality (longitude; latitude; farm)	Construction phase (22 months) water use (volume/capacity)	Operational phase (20 years) water use (volume/capacity)
g	*Disposing of waste in a manner which may detrimentally impact on a water resource* *GA for quantity but Licence since location in proximity (<500m) to water supply borehole BH1* *The location of a possible contamination source, in relation to water sources utilised for human consumption, is of primary concern.*	Conservancy tank - Concrete	28^0 11’ 08.80” South 21^0 28’ 29.25” East	70 m^3	70 m^3

3.5 Section 27 motivation

27(1)(a) Water uses

- Existing lawful water use – none.
- Unlawful water use – the water use applied for is a new planned water use.
- New use – the new water use applied for is defined in Chapter 2.

27(1)(b) Redressing results of past racial and gender discrimination

During the two (2) year construction phase, approximately 200 employment opportunities will be created. Of this approximately 15% (30) will be skilled, 30% (60) semi-skilled and 55% (110) low skilled / unskilled.

During the operational phase, eight (8) low skilled / unskilled employment opportunities will exist.

Suppliers and service providers will be selected based on BBBEE status and a formal preferential procurement process will therefore be followed to enhance opportunities for the local market and to recruit the majority of the labour force from the local community wherever possible.

The majority of the low and semi-skilled workers will be Historically Disadvantaged Individuals (HDIs). The majority, if not all, of the low and semi-skilled workers employed during the construction phase are also likely to live in Upington and surrounds. 61% of the cost spend on employment will be on Previously Disadvantaged Individuals (PDI).

In order to facilitate training and education, it will be recommended that the contractors, where possible, recruit their employees from previously disadvantaged groups and from adjoining low income areas.

Where appropriate, labour intensive construction methods will be utilised to maximise the potential number of employment opportunities whilst mitigating the impact of the use of machinery on site.

Since locals will be employed, previously disadvantaged people will therefore have the opportunity to improve themselves (skill development and income generation), their community (extended household and families) and be able to contribute to the economy (buying power, taxes etc.).

In terms of population breakdown, the majority of the population in Upington is Coloured (65%), followed by Black African (23%) and Whites (10%). Coloured and Black African races will therefore fill a high percentage of the job opportunities. The total population in Ward 11, where the proposed development is located, in 2011, was 7 542 people. Of this total, the majority were Coloured (78%), followed by Black Africans (10%) and Whites (8.5%).

27(1)(c) Efficient and beneficial use in the public interest

MBSA will only use large quantities of water during the construction phase to minimise the impact on the neighbours.

Water used at the car wash will be recycled.

27(1)(d) i and ii Socio-economic impact of the water uses if authorised or failure to authorise

(i) The establishment of the proposed HSPG will create employment and business opportunities for locals during both the construction and operational phases of the project.

The development will also create an opportunity for MBSA to invest in local community development programmes as part of its corporate social sustainability programme.

(ii) The employment opportunities associated with the construction and operational phase, as well as the benefits for the local and regional hospitality and tourism sector, would be lost if the project does not proceed.

The facility will not be able to operate if the water use is not authorised.

Authorising the water uses and therefore allowing the establishment of the HSPG, will have a benefit to society in the long-term though in the short term (construction phase), the project will place pressure on the groundwater aquifer in terms of groundwater abstraction and supply.

27(1)(e)Catchment management strategy applicable to the relevant water resource

The geographic extent of the Lower Orange Water Management Area (WMA) largely corresponds with that of the Northern Cape Province, with very small components falling within the Western Cape and Free State Provinces on the southern and eastern boundaries, respectively. It borders on Namibia in the north-west and on Botswana in the northern extreme. The Orange River, which forms a green strip in an otherwise arid but beautiful landscape, also forms the border between South Africa and Namibia over about 550 km to the west of the 20 degree longitude.

The main river in the WMA is the Orange River, which is the largest and longest river in South Africa, stretching over 2 300 km from its origins in the highlands of Lesotho to where it discharges in the Atlantic Ocean at Alexander Bay. Minerals and water from the Orange River were the key elements for economic development in the region, and still remain so. Economic activity is therefore largely concentrated along the Orange River, with several towns located on the banks of the river, and at mining developments.

The Lower Orange WMA (Figure 3-1) is characterised by a harsh climate with minimal rainfall and prolonged droughts, sometimes to be terminated by severe flooding. Rainfall usually occurs during late summer to autumn. The Lower Orange WMA is the largest, but also the driest and most sparsely populated, WMA in South Africa.

Less than 1% of the Gross Domestic Product (GDP) of South Africa originates from the Lower Orange WMA, which is the second lowest of all WMA in the country.

The WMA was divided into sub-areas to enable improved representation of the water resource situation in the WMA under varied conditions and to facilitate applicability and better use of information for strategic management purposes. Delineation of the sub-areas was based on practical considerations such as size and location of sub-catchments, homogeneity of natural characteristics, location of pertinent water infrastructure and economic development.

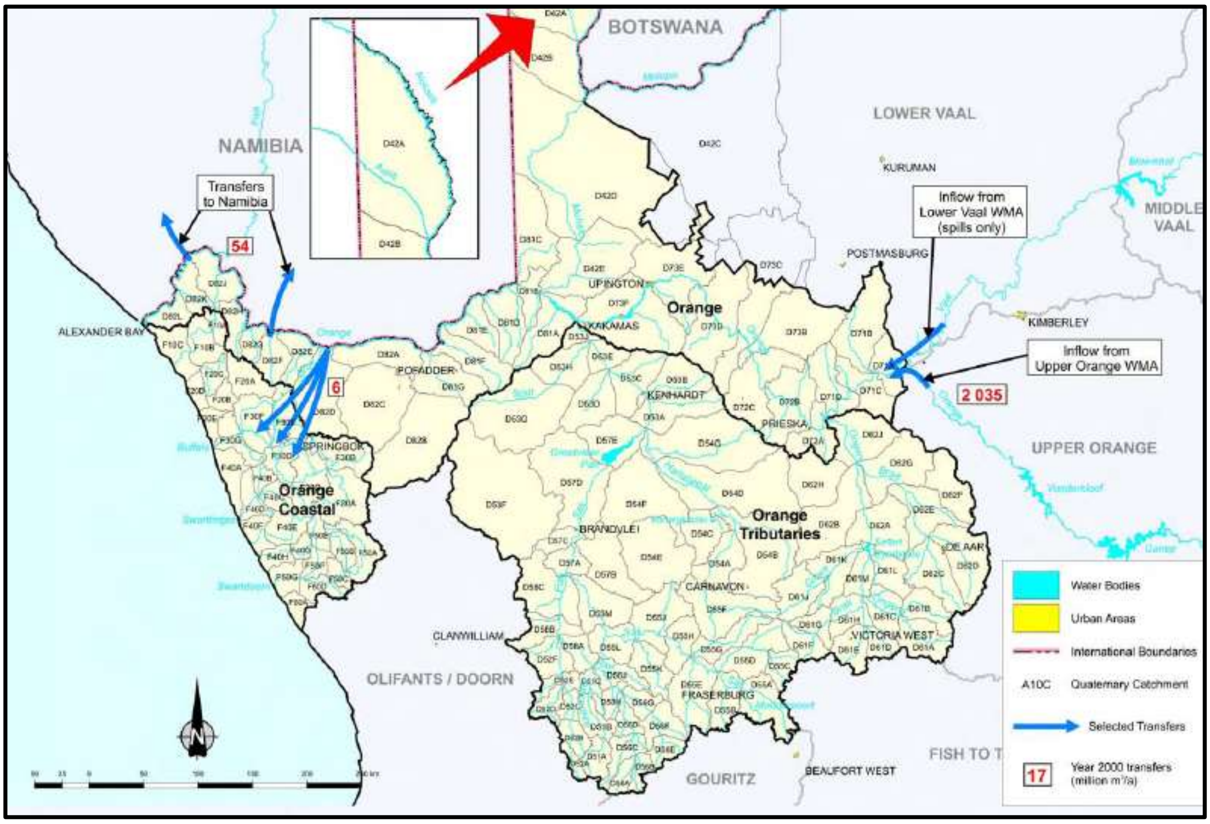

Figure 3-1: Sub-catchment of the Lower Orange WMA (DWAF, 2003)

Strategies to be considered:

- Coordinate water resource management with other inter-dependent WMA and view in an integrated systems context.
- Manage water resources within the framework of international agreements with neighbouring countries.
- Manage water quality in close co-operation with upstream WMA since the water quality in the Orange River may be seriously impacted upon by upstream developments.
- Consider differential tariffs to account for the quality of water abstracted as well as the quantity and quality of return flows.
- Improve management of both water quantity and quality through additional regulation infrastructure in the lower reaches of the Orange River. Such infrastructure could also facilitate the management of environmental releases to correspond with flows in the Fish River.
- Give specific attention to the improved management of abstractions of water from the river, particularly with respect to the irrigation sector which is by far the largest user of water in the WMA.
- Improve measurement, monitoring and control of abstractions and estimation of return flows.
- Develop appropriate licensing criteria to ensure the efficient and most beneficial use of water.

27(1)(f) Likely effect of water use on water resources and other water users (quality and quantity)

Water supply for the project will be from the groundwater resource as no municipal services extend to the area. During the construction phase of approximately two (2) years, large water quantities will be required (±300 m^3/day). Groundwater will be harvested during the construction phase as quantities abstracted will exceed recharge potential. The water storage of the aquifer will however not be depleted as less than 1% of the storage potential will be used. Water will take 5 – 15.5 years after the construction phase to recover.

Water quantities used during the operational phase, are low (±10 m^3/day for the HSPG and 6m^3/day for livestock watering) considering the recharge for the property (large property with large surface area allowing recharge). Negligible impact is expected on the groundwater resource and other groundwater users during the operational phase.

27(1)(g) Likely effect of the water use on the class and resource quality objectives

Surface water: The flow regime of the Orange River has been highly altered by water resource developments (dams and inter-catchment transfers) in the upstream WMA. Water quality in the river is also impacted upon by these developments, together with high salinity return flows to the river.

The project will not impact on permanent surface water resources (such as dams, rivers, streams or wetlands) though drainage lines will be diverted in channels and culverts will be constructed to ensure the uninterrupted flow of storm water around the proposed infrastructure.

Sensitive areas: The wetland identified on site has a largely natural Present Ecological State (PES) (class B - Largely natural with few modifications, but with some loss of natural habitats), which can improve to a class A PES through the reduction and maintenance of a moderate grazing pressure, as well as the successful control of the invasive P. glandulosa var. torreyana.

The Ecological Importance and Sensitivity (EIS) class of the interdune pan is regarded as High (class B - Wetlands that are considered to be ecologically important and sensitive.)

All development and activities associated with this project will be more than 500m away from the pan (wetland area) and will therefore not impact on it. Due to the reduced grazing pressure, the PES may improve.

Groundwater: Aquifers located in the topographical low areas are more productive in terms of yields and therefore have a much higher sustainability in terms of long term water abstraction. The main reason for this is that the high water tables in the valleys forms a thicker aquifer with deeper saturated weathered host rock.

Groundwater will be used as a water supply source and due to the large volumes required during the construction phase, groundwater will be harvested at volumes above the recharge during the two-year construction phase. The aquifer will not be depleted as less than 1% of the storage potential will be used over this period but water in the aquifer will take 5 – 15 years to recover on Steenkampspan and 6 – 20 years on Duiker Rand.

Existing high calcium levels in the water may lead to high Calcium Carbonate in the water (hard water) resulting in scaling in water infrastructure. This will require water softening (treatment) or regular maintenance. Existing elevated nitrate levels in water due to cattle farming activities make water unsuitable for human consumption. The water is, however, still suitable for livestock watering and potable water for human consumption will be imported from Upington (bottled water). With mitigation measures, the project is not expected to impact on groundwater qualities.

27(1)(h) Investments already made and to be made by the water users in respect of the water use

The total monthly wage bill for the construction phase is estimated to be in the region of R66 million (2015 rand values). Of this total, R15.8 million would be earned by low skilled workers, R14.4 million by semi-skilled workers and R36 million by skilled workers. Low and semi-skilled workers would therefore earn approximately 45% of the total monthly wage bill.

The capital expenditure associated with the construction of the proposed HSPG is estimated to be in the region of R370-480 million.

An annual income of R21.5 million will be realised during the operational phase.

Water and wastewater management	± R2.6 million
Drainage infrastructure	± R16 million

27(1)(i) Strategic importance of the water use to be authorised

Benefits to the local community include:

- Benefit to local hospitality and tourism sector due to regular visitors from outside the area (rest of South Africa and Germany);
- Creation of employment and business opportunities; and
- Investment in local development initiatives and raised profile of Upington.

The total number of accommodation days generated by the HSPG over a year period will be approximately 2 360 - 4 450 days. The demand for accommodation will extend over the operational lifespan of the project, which is anticipated to be decades. This will create significant opportunities for the local hospitality sector in Upington.

The timing of the main operational phase (over the hot, summer months) also coincides with the low demand period for tourist accommodation in Upington and the Northern Cape. The majority of tourists visit the area during the cooler, winter months (May - August). The operational phase will therefore generate income for the local hospitality during the quieter, off-peak months. This represents a significant socio-economic benefit for both the owners of accommodation facilities and the staff employed.

The Mercedes Benz personnel are also likely to visit areas of interest over weekends, such as the Augrabies Falls National Park, and undertake activities such as river rafting on the Orange River, quad biking, and wine cellar tours etc. Local tourism operators and facilities in the area and Northern Cape will therefore also benefit during the operational phase.

27(1)(j) Quality and quantity of the water in the water resource which may be required for the Reserve and for meeting international obligations

The DWS is responsible for the Reserve Determination.

The Orange River's water quality is categorized as Moderately Transformed (Class C) due to existing agricultural activities along the river banks. The Orange River's major inflow of water is from the Vaal River which has high nutrient levels which sometimes result in algal blooms. Slow water flow rates also cause siltation and turbidity of the water which leads to water quality degradation within the river (WSP Parsons Brinckerhoff, September 2015).

Virtually all of the irrigation developments are situated along the Orange River, being dependent on water abstractions from the river. Irrigation for high value orchard type crops, requires a high assurance of supply. Most of the urban and mining requirements for water in the WMA are also in the Orange Mainstream sub-area.

Little change is foreseen with respect to future urban and rural requirements for water in the WMA, and a small reduction may be experienced in these sectors as a result of the expected decline in population. With strong economic development, a moderate increase in urban, industrial and mining water requirements may result.

Projected future requirements considered the additional development of 4 000 ha of irrigation for poverty relief and settlement of emerging farmers.

Table 3-3: Projected water requirements for 2025 for the Orange Mainstream Sub-area of the Lower Orange WMA (million m^3/annum)

Sector	Water requirement in 2025 (million m^3/annum)
Irrigation	1 008
Urban *	11 - 25
Rural *	9
Mining and bulk industrial	7
Power generation	0
Afforestation	0
Total Local Requirements	**1 035 - 1049**
Transfer out	60 - 65
TOTAL	**1 095 – 1 114**

* Includes component of Reserve for basic human needs at 25l/c/d

27(1)(k) Probable duration of any undertaking for which a water use is to be authorised

The duration of the proposed project will be 20 years.

4 ENVIRONMENTAL STATUS QUO

4.1 Climate

The Northern Cape is known for its extreme climatic conditions and the ZF Mgcawu District Municipal area is by no means an exception to the rule. The Northern Cape is characterised by a harsh climate which includes prolonged droughts. Due to the intense heat of the dry summer months, evaporation is high (ZF Mgcawu District Municipality, 2015).

The Northern Cape's weather is typical of desert and semi desert areas. This area experiences fluctuating temperature and varying topographies. The annual rainfall is sparse, only 50 mm – 400 mm per annum (Figure 4-2). In January, afternoon temperatures usually range from 20 - 30°C (Figure 4-1). During winter, dew and frost is often experienced to supplement the low rainfall of the region (WSP Parsons Brinckerhoff, September 2015).

The property shows a typical semi-desert or dry savannah climate. It is located in the summer rainfall region of South Africa and approximately 70% of the average rainfall occurs during the period October to April each year. Summer is very hot with maximum temperatures of up to 40°C and winters are cool to cold with average temperatures of 10°C, although it could drop below 0°C coupled with typical frost. (WSP Parsons Brinckerhoff, September 2015).

Weather bureau section:	0317
Rainfall zone:	D7D
Closest rainfall station:	0282823 (at Keimoes police station, 40km south east of Upington)
Mean annual precipitation (MAP):	155.4 mm/a (Data from 1920 – 1989)
Evaporation zone:	3B
Closest evaporation station:	D7E003 (in Upington, 35km south west of site)
Mean annual evaporation (MAE):	2 750 (S-pan) 3 728 (A-pan) Data from 1957 – 1979
Hydrozone:	L
Mean annual runoff (MAR):	2.5mm/a

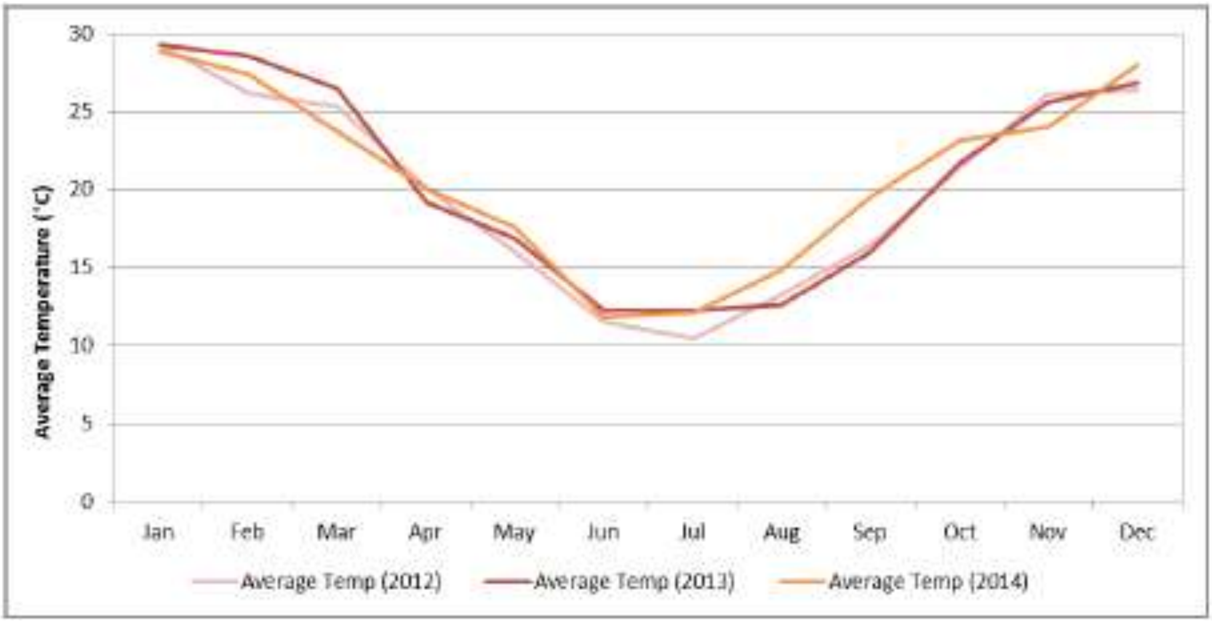

Figure 4-1: Average temperatures (2012 – 2014) for Upington (WSP, 2015)

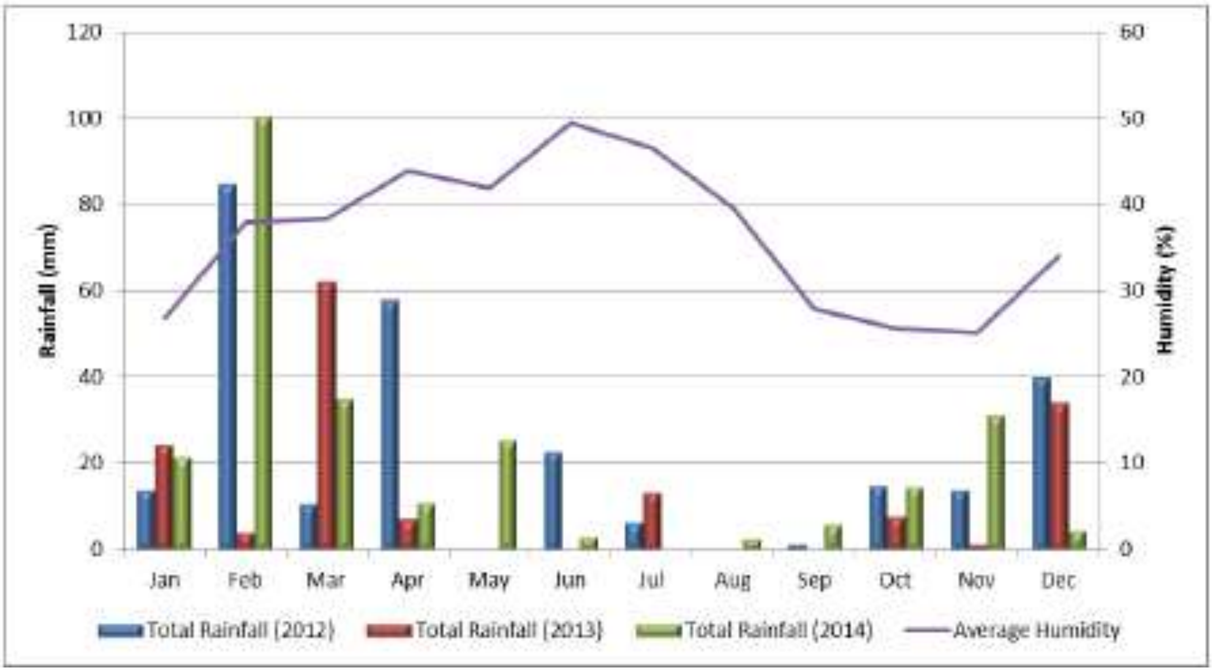

Figure 4-2: Total rainfall (2012 – 2014) for Upington (WSP, 2015)

4.2 Soil and land capability

4.2.1 Soil (WSP, 2015)

The soil for this area can be described as aeolian sand underlain by calcrete of the Kalahari Group. Mostly fixed parallel sand dunes with *Af* land type (Figure 4-3), while sandy soil of the Namib soil form may be expected on the flat plains. Outcrops of calcrete can be expected in certain duneveld types (WSP Parsons Brinckerhoff, September 2015).

Af land type denotes areas with dominantly deep red high base status soils (eutrophic and lime containing) with regularly occurring dunes (WSP Parsons Brinckerhoff, September 2015).

Soils are red coloured, eutrophic sandy soils derived from Aeolian deposits. The depths vary according to position in the landscape with soils overlying rock outcrops being shallow and soils comprising dunes being relatively deep (WSP Parsons Brinckerhoff, September 2015).

Two (2) main soil zones or associations can be found at the proposed site, namely 1) rocky and shallow soils and 2) red dune soils. The rocky and shallow zones occur interspersed with dune areas. In both cases, the dominant soils are of the Mispah (orhtic A horizon / hard rock), Glenrosa (orthic A horizon / lithocutanic B horizon) and Hutton (orthic A horizon / red apedal B horizon / unspecified - usually hard or weathering rock in the area) types. Calcrete areas are limited and the dominant soils are Coega (orthic A horizon / hardpan carbonate). An endorheic type depressions is found in the south where soils of the Brandvlei (othic A horizon / soft carbonate B horizon) dominate. In the specific context, the Brandvlei soils indicate areas with secondary lime accumulation due to more regular wetness when compared to the surrounding landscape (WSP Parsons Brinckerhoff, September 2015).

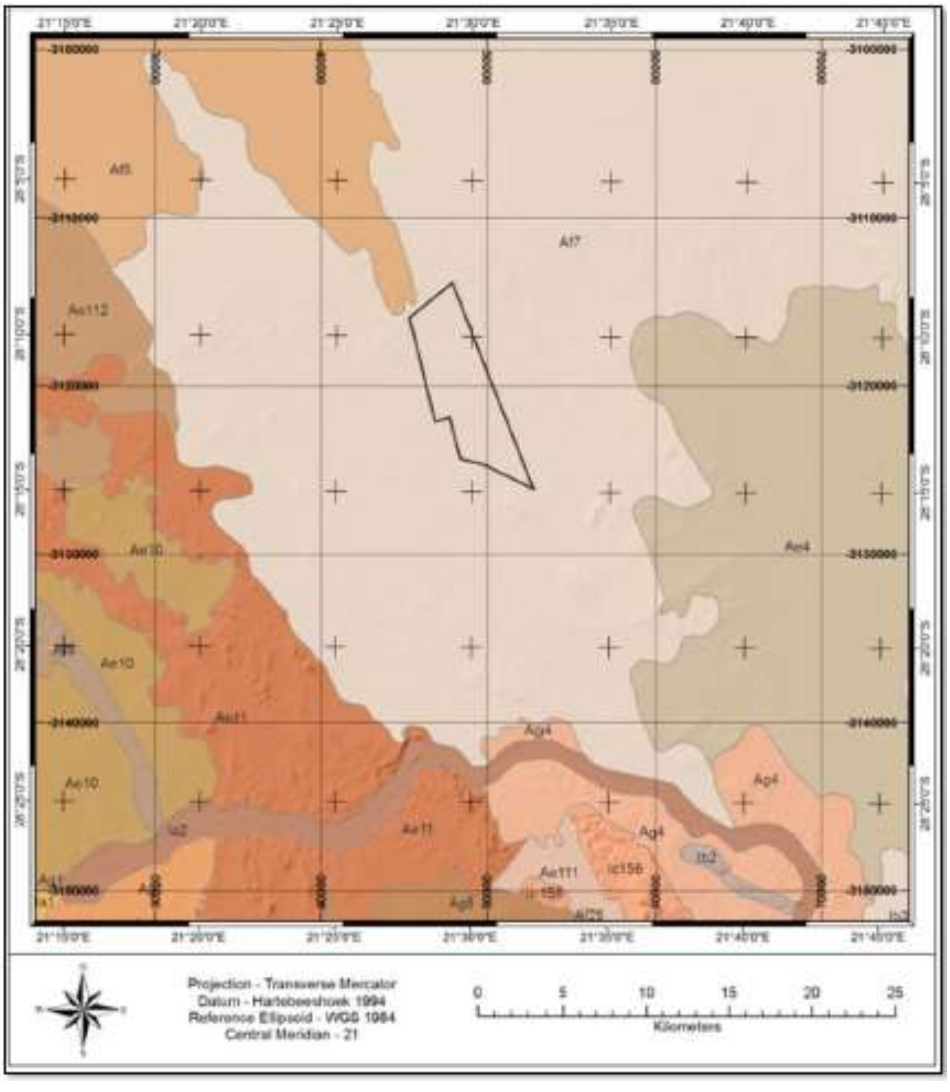

Figure 4-3: Land type map (WSP, 2015)

4.2.2 Land capability and use (WSP, 2015)

The Kalahari area is predominantly used for stock and game farming. It is important to note that there is a definite shift amongst commercial farms on the Botswana border to change from stock farming to game farming, due to the change in weather conditions and the poor access to water for their stock (WSP Parsons Brinckerhoff, September 2015).

Steenkampspan has been used for cattle and sheep farming over a long period of time, and although the effect of continual mono-species grazing can be seen, the property remains largely natural, with very little permanent impacts associated with the current land use option. In itself, the soils of the Kalahari have very little to no opportunities for productive use and without access to water, productive agriculture is limited to game farming. With access to groundwater, live-stock farming becomes a possibility as is the case at Steenkampspan. The land use of Steenkampspan and its immediate surroundings are expected to remain natural veld. According to the biodiversity summaries, 99.6% of the area is still covered by natural veld (only 0.4% of the area transformed) (WSP Parsons Brinckerhoff, September 2015).

The agricultural potential is therefore very low due to the low rainfall and aridity. The distinct presence of dunes in this landscape precludes the area from being developed for irrigated agriculture purposes due to the significant effort required to level the terrain. (WSP Parsons Brinckerhoff, September 2015).

The soils are considered to be of low agricultural potential due to the shallow and rocky profiles. The sandy deeper dune soils have a low water holding capacity and are not suited for irrigation land uses due to significant local topographical variation. This constitutes a very arid environment with a subsequent poor biomass production which is a further limitation on agricultural potential (WSP Parsons Brinckerhoff, September 2015).

Current agricultural practices (cattle farming) on Speenkampspan will continue. Eighty (80) cattle will be kept on the farm.

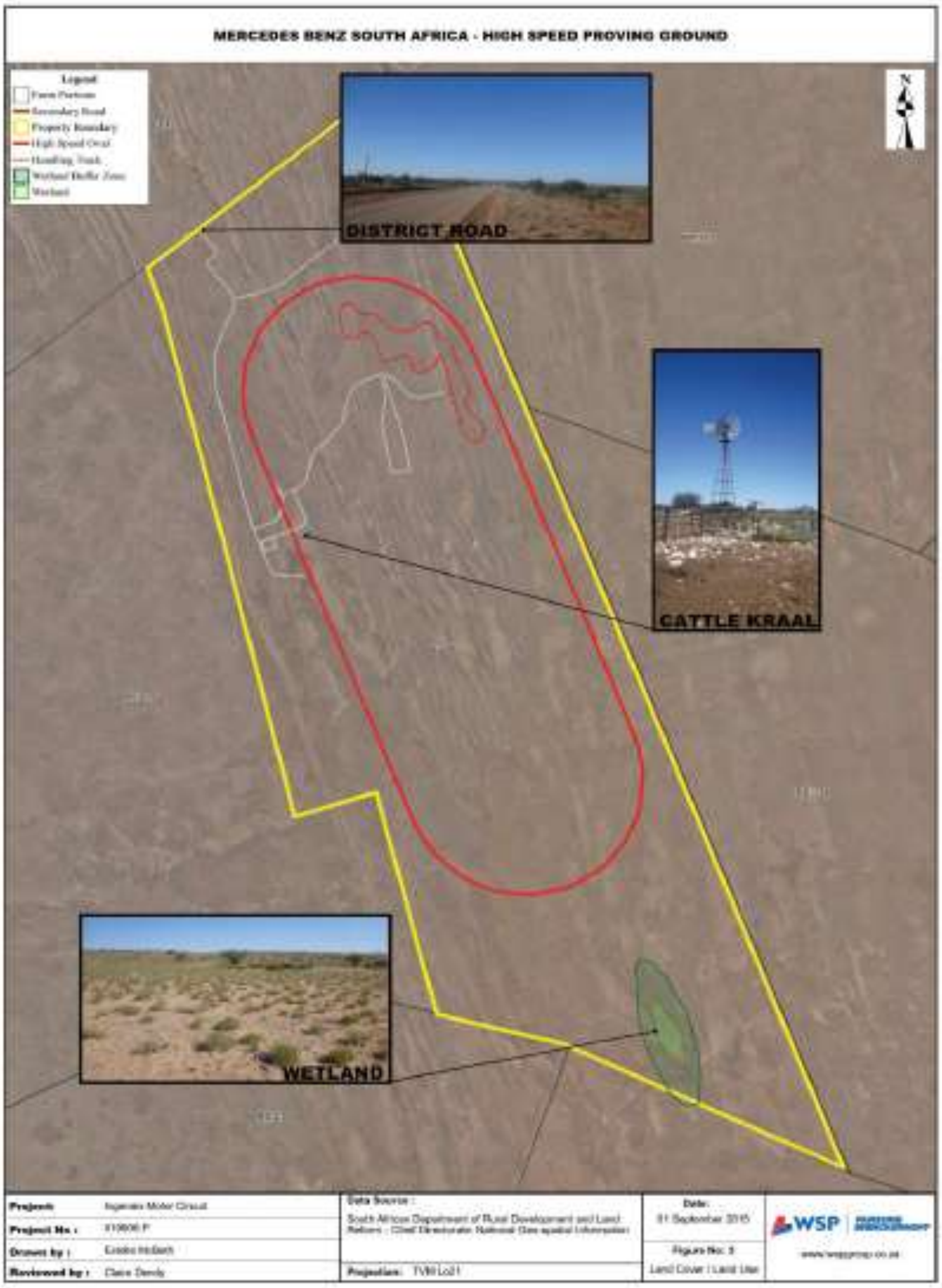

Figure 4-4: Current and future land use (WSP, 2015)

4.3 Surface water

4.3.1 General

The property falls within the Lower Orange WMA which is generally characterised by its arid climate with minimal rainfall and drought conditions. Evaporation (including evapotranspiration) is as high as 3 000 mm per annum, exceeding the mean annual rainfall approximately 15 times. As a result of the extremely low and infrequent rainfall, little useable runoff is generated over most of the area.

The closest and predominant perennial surface water feature in the vicinity of Steenkampspan is the Orange River, approximately 15km south and south west of the property. The Orange River is the main water source for the ZF Mgcawu District and //Khara Hais Municipality and large scale agricultural irrigation is practiced on its banks.

Water Management Area (WMA):	Lower Orange (WMA 14)
Quarternary catchment:	D73E
Size of catchment:	3 873 km^2
Major rivers in catchment:	Ongers, Orange, Haartes
Closest watercourse:	Orange (Gariep) River; 15.1km south of property. Refer to Figure 4-5.

4.3.2 Quality

Due to the distance between the property and the Orange River (15 km), no biomonitoring or aquatic health determinations were conducted on the Orange River as part of this study. No surface water sources will be utilized or impacted on as part of this project and therefore this section contains limited and summarized information only. Drainage lines are discussed under storm water management.

The Orange River's water quality is categorized as Moderately Transformed (Class C) due to existing agricultural activities along the river banks. The Orange River's major inflow of water is from the Vaal River which has high nutrient levels which sometimes result in algal blooms. Slow water flow rates also cause siltation and turbidity of the water which leads to water quality degradation within the river (WSP Parsons Brinckerhoff, September 2015).

4.3.3 Quantity and hydrology

The project area is characterised by a fairly flat to undulating landform with rolling sand dunes and flat bottomed drainage features. Surface water is managed by small natural drainage channels. The soils in the study area are extremely permeable and therefore a large portion of rainfall infiltrates the subsurface (WSP Parsons Brinckerhoff, October 2015).

Figure 4-6 shows the watershed on the property influencing surface water flow directions.

The project area is influenced by two (2) main catchment areas:

Catchments:	Size:	Slope:
Catchment 1	1.2305 ha	0.4%
Catchment 2	2.670 ha	1%

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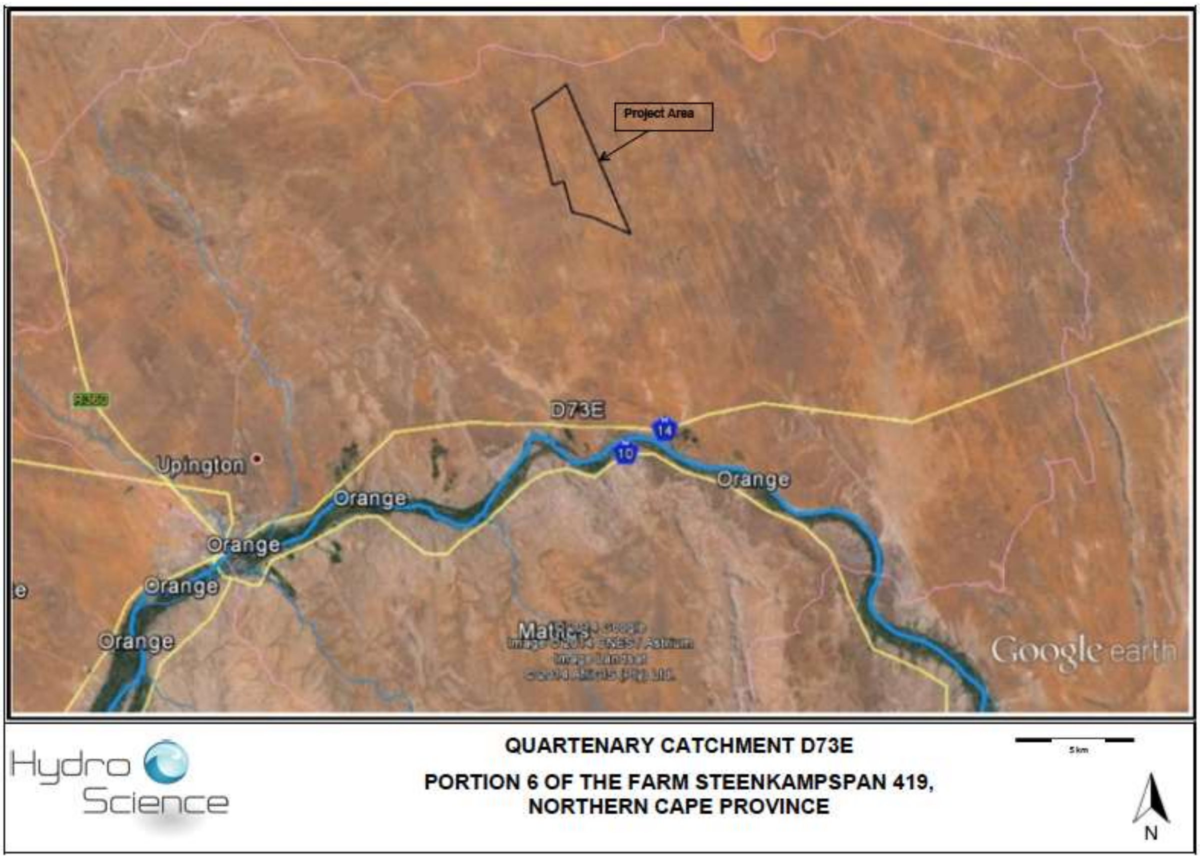


Figure 4-5: Surface water environment

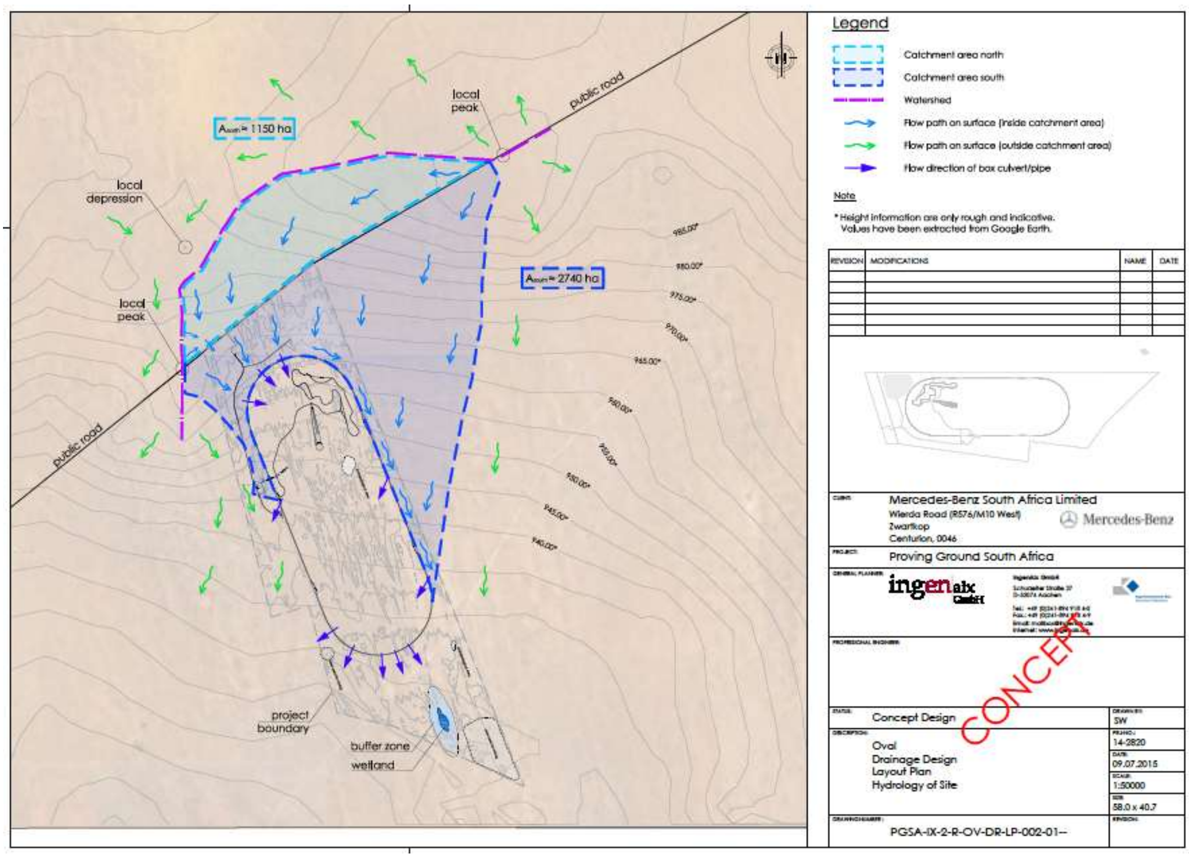


Figure 4-6: Watershed and general site hydrology (IngenAix, 2015)

4.4 Sensitive areas (Ixhaphozi, 2014)

With the exception of salt pans, wetlands are not frequently encountered in the arid Kalahari Duneveld Bioregion as the MAE exceeds the MAP approximately 15 times. However, the highly permeable dune sands (Namib soil form) are interspersed with interdune depressions where shallow, impermeable calcrete horizons may result in rapid saturation and even inundation of the shallow, overlying soils during high rainfall events.

Information in this section has been taken from a specialist study conducted by Ixhaphozi Enviro Services CC in 2014. Ixhahozi Enviro Services conducted the study with the specific purpose of providing input to the water use license application documentation. A copy of the full study is included as an appendix (Appendix D).

4.4.1 Definition

"A wetland is defined as land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil" (NWA in DWAF, 2005).

4.4.2 Wetlands on site

Wetlands are not expected in this arid Kalahari Duneveld Bioregion. However, the highly permeable dune sand underlain by shallow impermeable layers of calcrete result in rapid inundation of depression features with impermeable calcrete lined floors, during relatively high rainfall events. A high rate of evaporation occurs but inundation is just deep and long enough for temporary wetland features to develop in places.

4.4.3 Identification and delineation

The wetlands have been delineated by making use of the following wetland indicators (DWAF, 2005):

- **Terrain unit** indicator helps to identify those parts of the landscape where wetlands are most likely to occur. Wetlands occupy characteristic positions in the landscape. ***Depressions and pans were noted on this site.***
- The **Soil form** indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation. 32 samples were taken and the South African Soil Classification System (MacVicar et al., 1994) was used. ***The Brandvlei soils found on site indicate temporary wetland conditions.***
- **Soil wetness** indicator identifies the morphological signatures developed in the soil profile as a result of prolonged and frequent saturation. Notes were taken on soil chroma to a depth of 50cm and this was related to hydrological conditions in terms of the criteria for distinguishing different soil saturation zones within a wetland (Kotze *et al.*, 1994). ***Movement of free lime was used as an indicator.***
- The **Vegetation** indicator identifies hydrophytic vegetation associated with frequently saturated soils. The characterisation of wetland vegetation indicators provided by DWAF (2005) is however not applicable to this part of the arid Kalahari region and was therefore of little use to the current study. **The site exhibits floristic and structural characteristics of the vegetation of typical salt pans of the southern Kalahari with the following species recorded: *Stipagrostis obtusa* and *Monechma genistifolium* subsp. *austral.***

According to the wetland definition used in the NWA, vegetation is the primary indicator, which must be present under normal circumstances. However, in practice, the soil wetness indicator tends to be the most important, and the other three indicators have a confirmatory role.

Vegetation that potentially indicates wetland conditions was found at only one of the seven (7) sites surveyed during the study by Ixhaphozi, namely site SP6. The vegetation found in the interdune depression at site SP6 is indicative of a small, endorheic pan that experiences brief soil saturation, or possibly even briefer soil inundation, periodically at very long intervals of many years or even decades. The pan is not inundated frequently enough and does not hold sufficient volumes of water to have formed a highly saline central zone comprising unvegetated (bare) soils, as is found in the typical salt pans of the southern Kalahari described by Leistner (1967).

The location of SP6 is indicated on Figure 4-8.

Plate 2: Looking towards the wetland area (change in soil colour and vegetation evident

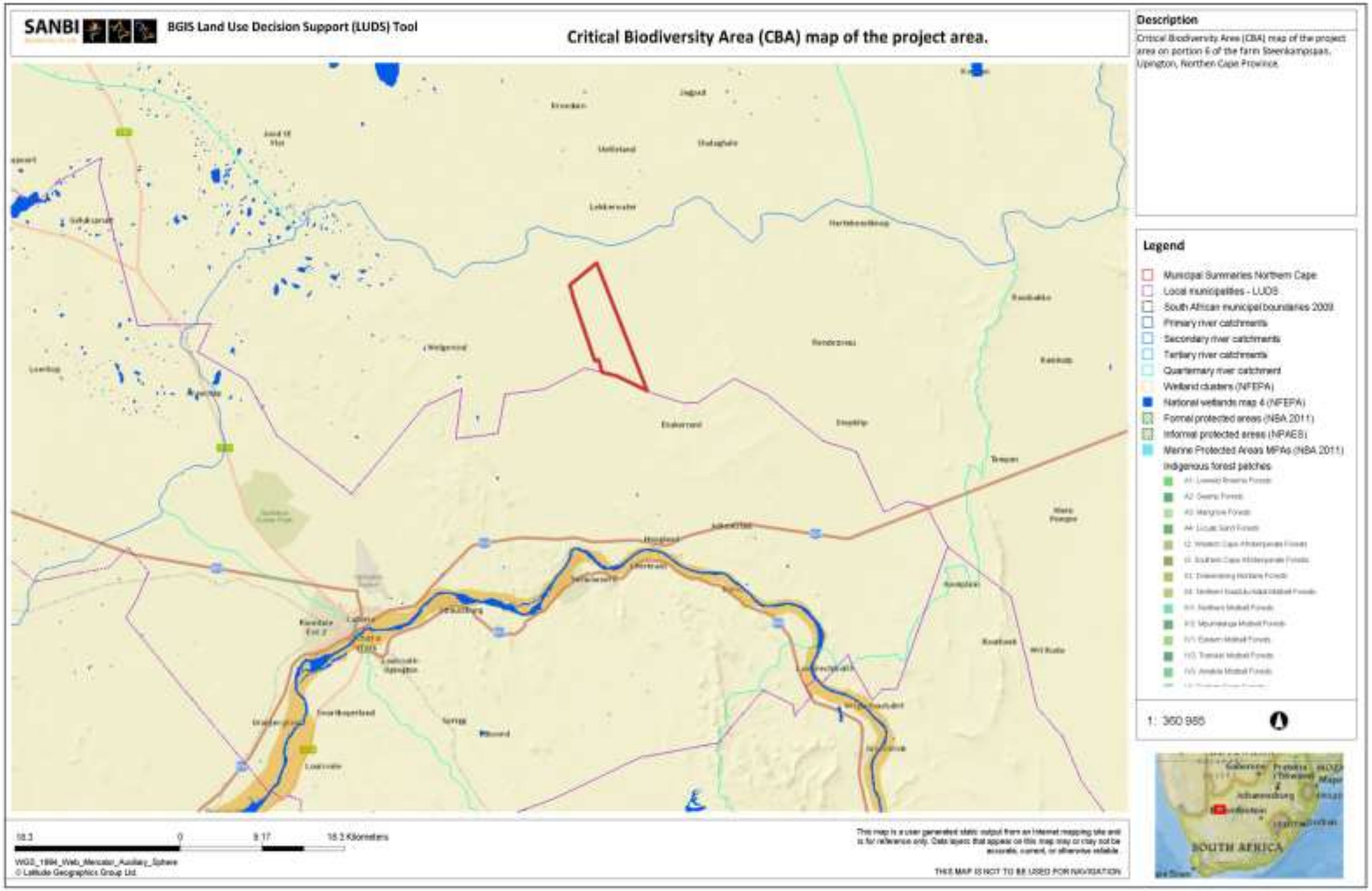


Figure 4-7: Sensitivity map (SANBI, 2016)

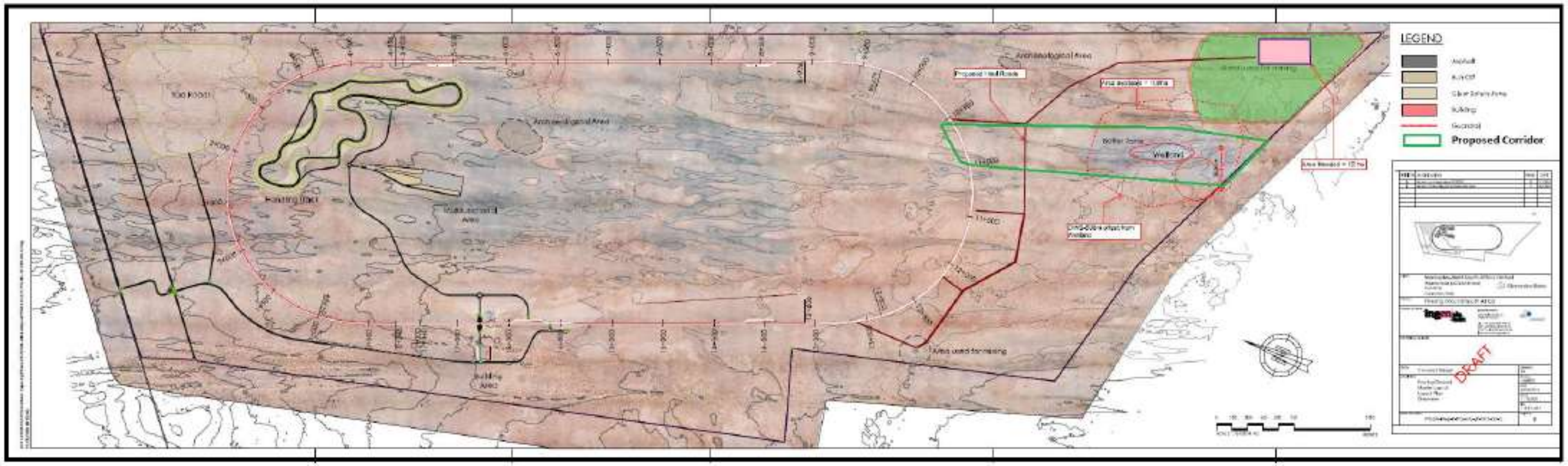


Figure 4-8: Wetland identified and delineated on the property (Ixhaphozi, 2015)

4.4.4 Classification

Site SP6 has a largely natural PES (class B - Largely natural with few modifications, but with some loss of natural habitats), which can improve to a class A PES through the reduction and maintenance of a moderate grazing pressure, as well as the successful control of the invasive *P. glandulosa* var. *torreyana.*

The EIS class of the interdune pan is regarded as High (class B - Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water in major rivers.)

Ephemeral pans such as that found at Site SP6 are abundant in the southern Kalahari but represent a unique and spatially restricted habitat within the study area and its immediate surrounds. ***The pan represents a watercourse that is of conservation value and should therefore be protected.***

4.5 Geohydrology

Information in this section has been taken from a specialist study conducted by Geo-logic Hydrogeological Consultants CC in 2015. Geo-logic Hydrogeological Consultants CC conducted the study with the specific purpose of providing input to the water use license application documentation. A copy of full study is included as an appendix (Appendix D).

4.5.1 Hydro-census

Figure 4-9 and Table 4-1 below summarises the results of the hydrocensus.

4.5.2 Water level depth

From the water level depths, it is clear that the boreholes located on or near catchment boundaries, which are located along the topographical high areas, present water level depths of 20 m to 30 m deeper than boreholes located topographically lower in regional valleys. For instance borehole H/BH 10 (on farm Duiker Rand), which is located in a large regional valley, presents a water level depth of only 16.82 metres below ground level (mbgl) and borehole H/BH 18 (on portion 3 of farm Steenkampspan), which is located on a quaternary catchment boundary presents a water level depth of 46.50mbgl. (Geologic, 2015).

4.5.3 Groundwater contours and flow direction

The water level depths of 26 boreholes were used to generate groundwater contours. Figure 4-10 shows the surface contours, groundwater contours and the groundwater flow directions. From the data available, it can be seen that the water level elevation to a large degree follow the surface contours. It is important to note that the groundwater contours are at 5 metre intervals and the surface contours are at 10 m intervals. The groundwater level depth increase towards the topographical high areas and decrease towards topographical low areas. Groundwater movement therefore to a large degree is perpendicular to the surface contours. Groundwater movement will overall be in a southern direction towards the Orange River. (Geologic, 2015).

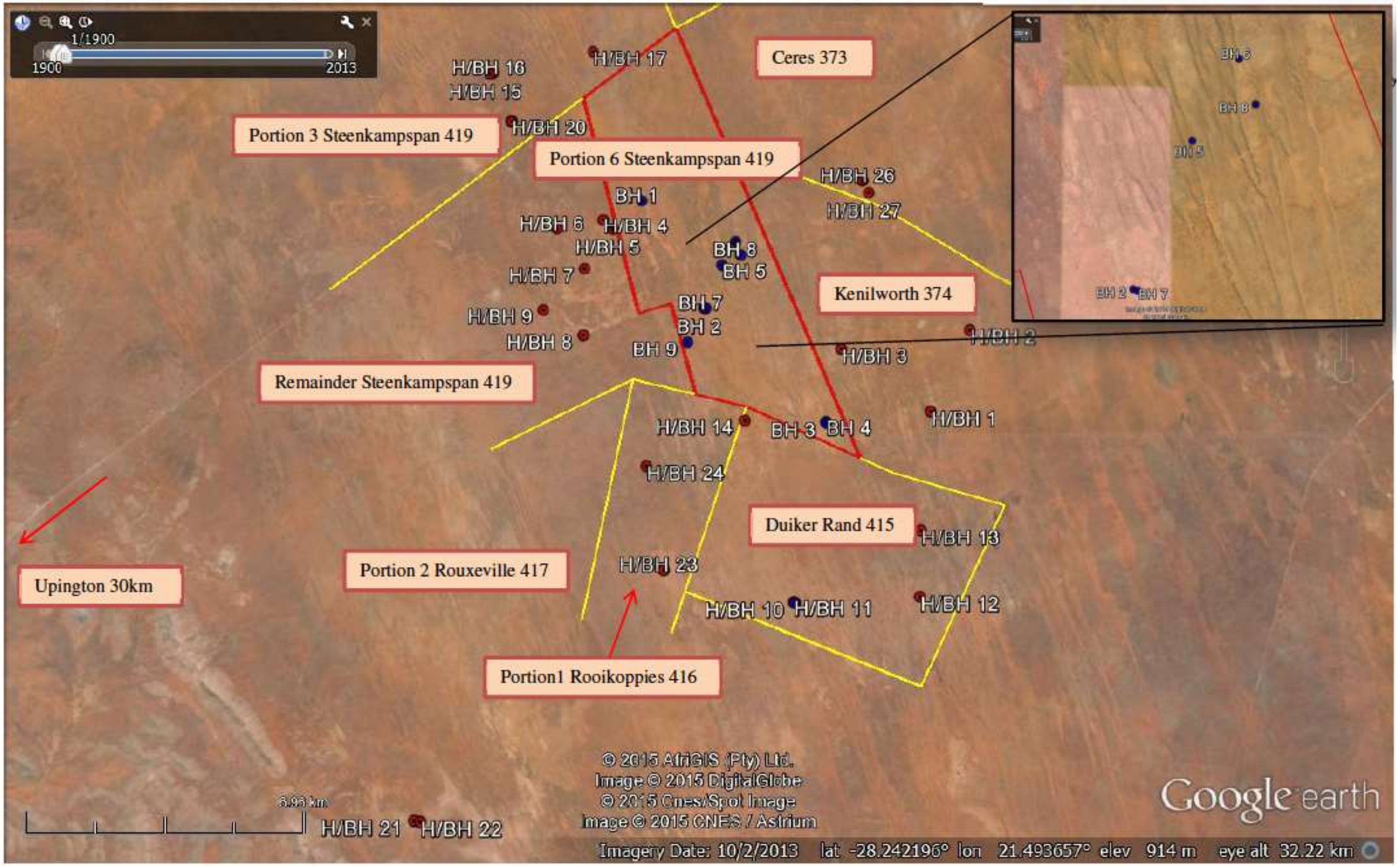


Figure 4-9: Boreholes included in hydrocensus (Geologic, 2015)

Table 4-1: Hydro-census results (Geologic, 2015)

Borehole number	Co- ordinates		Water level (mbgl)	Groundwater Elevation (mamsl)	Remarks
	Latitude And Longitude	Ground Elevation (mamsl)			
Boreholes located on Portion 6 of the farm Steenkampspan 419					
Owner: Albert Human: 082 774 1781					
BH 1	-28.184615° 021.478047°	940	24.72	915	Submersible pump. Can be used as water supply borehole for development. Pump water to large cement dam which feeds four drinking troughs.
BH 2	-28.21177° 021.49552°	932	51.40	881	Located in field. Windmill. Low yielding BH. Life stock watering. Delivers water to 6 X 10 000l tanks. Delvers water to 3 drinking troughs. Low yielding borehole.
BH 3	-28.23996° 021.52847°	922	23.15	899	Casing only. Can be used as water supply borehole for development. **Submitted to yield testing.** Located near BH 4
BH 4	-28.23965° 021.52835°	923	22.90	900	Windmill. Pump water into cement reservoir. Live stock watering.
BH 5	-28.200994° 021.503347°	937	25.73	911	Newly drilled borehole. Blow out yield 0.9l/s. BH depth 144.0m
BH 6	-28.19505° 021.50417°	938	26.10	912	Newly drilled borehole. Blow out yield <0.1 ℓ/s. BH depth 90m
BH 7	-28.21187° 021.49589°	932	±50	882	Newly drilled borehole. Blow out yield <0.1 ℓ/s. BH depth 150m
BH 8	-28.19842° 021.50554°	938	26.5	911	Newly drilled borehole. Blow out yield >2.1 ℓl/s. BH depth 150m
BH 9	-28.220260° 021.490910°	925	Dry	---	Newly drilled borehole. Blow out yield <0.1 ℓ/s. BH depth 150m
Boreholes located on land outside the proposed development area					
Owner: Phillip Coreejes: 082 491 7402, Kenilworth 374. Foreman Pieter vd Heefer: 082 727 4331					
H/BH 1	-28.23715° 021.55677°	926	24.72	901	BH located at farm house. Submersible pump with solar panels. 40mm pipe. Domestic and animal use. Borehole yield ± 9000l/h. BH depth is 45metres.

H/BH 2	-28.21718° 021.56816°	930	29.66	900	BH located in field. Submersible pump with solar panels. Delivers water to 3 cement dams. Live-stock watering. 32mm pipe. BH depth is 33metres.
H/BH 3	-28.22190° 021.53291°	928	25.37	903	BH located in field. Windmill not working. Submersible pump with solar panels. Delivers water to 2 cement dams plus 10 000l tank. Live-stock watering. 32mm pipe.
Owner: Siebert Myburg: Remainder Steenkampspan 419					
H/BH 4	-28.18950° 021.46738°	939	46.33 Dynamic WL	893	BH located in field. Windmill working. Low yielding BH. Life stock watering. Delivers water to cement dam.
H/BH 5	-28.19189° 021.47006°	938	35.11	903	BH located in field. Submersible pump with solar panel. 40mm pipe. Live-stock watering.
H/BH 6	-28.19181° 021.45452°	935	38.99	896	BH located in field. Submersible pump with solar panels. Delivers water to 2 X 5000 l tanks. Live-stock watering.
H/BH 7	-28.20194° 021.46243°	934	31.31	903	BH located in field. Submersible pump with solar panels. Delivers water to 2 X 10 000 l tanks. Live-stock watering. 25mm pipe.
H/BH 8	-28.21855° 021.46240°	927	28.83	898	Pit located at homestead. Windmill working. Life-stock watering. Pit depth is 30m.
H/BH 9	-28.21228° 021.45127°	926	29.71	896	BH located in field. Life-stock watering. Submersible pump with solar panels.
Owner: Albert Human: 082 774 1781. farm Duiker Rand 415					
H/BH 10	-28.28226° 021.51938°	900	16.82	883	BH located in field. Casing only. No equipment not used. High yielding borehole. **Submitted to yield testing.**
H/BH 11	-28.28208° 021.51907°	899	17.65	881	BH located in field. Windmill. Working. Delivers water to large cement dam. Water used for life-stock farming.
H/BH 12	-28.28080° 021.55229°	910	25.80	884	Pit located at homestead. Windmill working. Life-stock watering. Delivers water to 10 000ltank and feeds 3 drinking troughs.
H/BH 13	-28.26546° 021.55308°	920	33.19	887	BH located in field. Windmill. Working. Delivers water to cement dam. Water used for life-stock farming.
H/BH 14	-28.23936° 021.50644°	919	29.46	890	BH located in field. Windmill. Working. Delivers water to cement dam. Water used for life-stock farming.
Owner: Innes Burger: 072 731 7957 and Pieter Coetzee: 083 607 6272, Portion 3 of the farm Steenkampspan 419					
H/BH 15	-28.15137° 021.43464°	972	38.37	934	BH located in field. Submersible pump with solar panels. Delivers water to entire farm. Domestic and Live-stock watering.
H/BH 16	-28.15113° 021.43560°	971	40.89	930	BH located in field. Windmill, broken. Submersible pump no solar panels. Borehole not used.

H/BH 17	-28.14545^o 021.46381^o	972	±45	±927	BH located in field. Windmill. Working. Delivers water to cement dam. Water used for life-stock farming.
H/BH 18	-28.16393^o 021.44106^o	955	46.50	909	BH located near workers house. PVC Casing only. Borehole never used.
H/BH 19	-28.16391^o 021.44128^o	955	Closed up	909	BH located near workers houses. Windmill, broken. Not used.
H/BH 20	-28.16397^o 021.44120^o	955	Closed up	909	BH located near workers houses. No equipment. Not used.
Owner: S. A. (Fanie) Le Rouxe: 054 332 5483 or 074 489 3429, Portion 1 of the farm Rooikoppies 416 (Also called Kameelvlakte)					
H/BH 21	-28.33086^o 021.42123^o	871	18.6	852	Pit located near homestead. Windmill on top of pit. Windmill badly broken. Not working. Submersible pump but no solar panels. Water used for life-stock farming.
H/BH 22	28.33108^o 021.42275^o	869	Closed up	---	BH located near homestead. Windmill working. BH closed up. Can not measure WL. Delivers water to homestead and is used for live-stock farming.
H/BH 23	-28.274750^o 021.484787^o	899	±20	±879	BH located in field. Windmill working. Did not visit borehole. Delivers water to dam for live-stock farming.
H/BH 24	-28.250317^o 021.479901^o	907	±20	887	BH located in field. Windmill working. Did not visit borehole. Delivers water to dam for live-stock farming.
Owner: Gert Fortuin: 061 778 7126, Farm Ceres 373					
H/BH 25	-28.17932^o 021.53969^o	951	36.73	914	BH located near homestead. Windmill not working. Windmill badly broken. BH not used.
H/BH 26	-28.17940^o 021.53975^o	951	37.02	914	BH located near homestead. No equipment. BH not used.
H/BH 27	-28.274750^o 021.484787^o	950	44.83 Dynamic WL	905	BH located in field. Windmill not connected. Submersible pump with solar panels. Solar pump working.

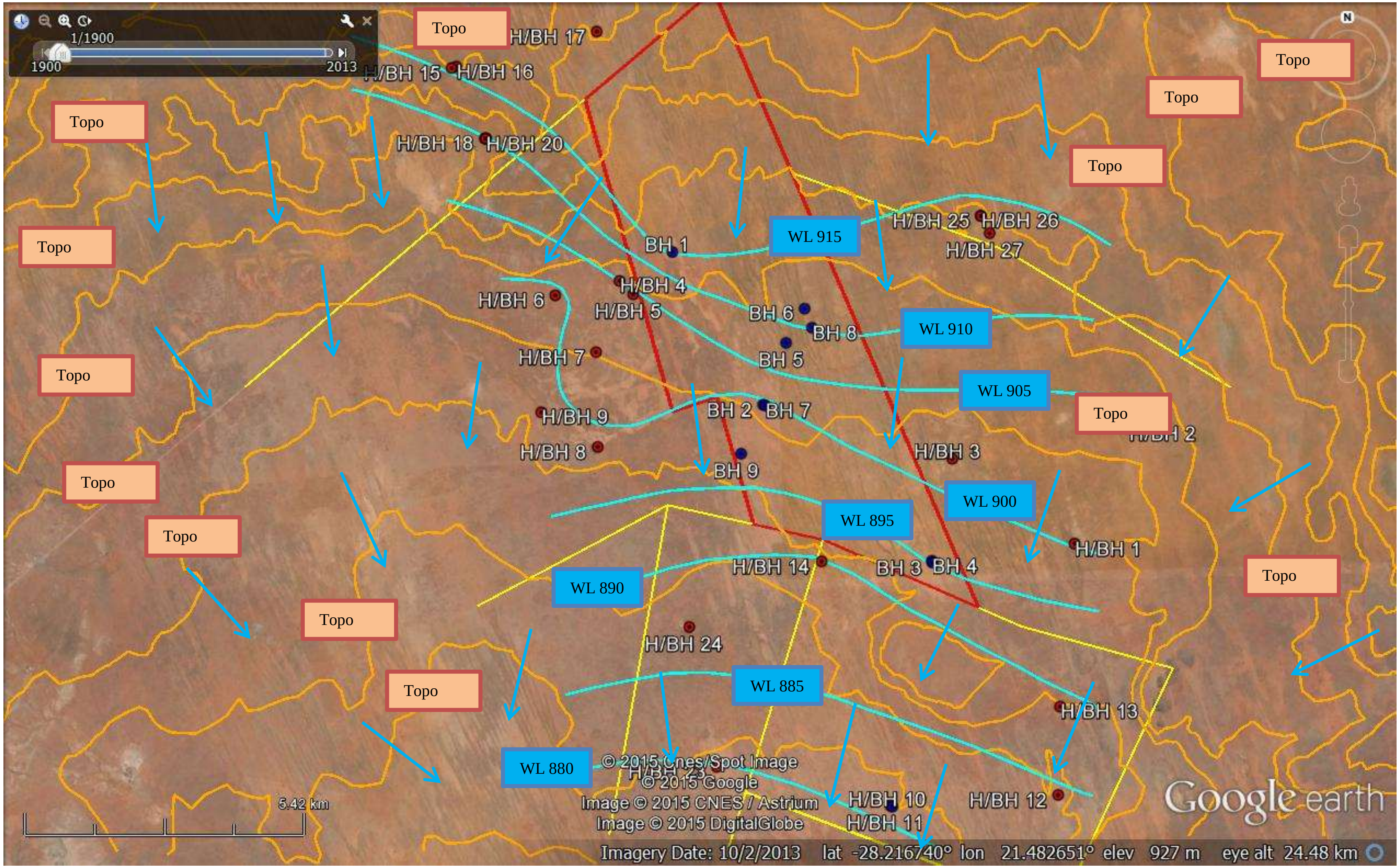


Figure 4-10: Surface (yellow) and groundwater (blue) contours with groundwater flow direction (blue arrows) (Geologic, 2015)

4.5.4 Groundwater quantity

From the water level depths and groundwater contours, an important assumption can be made, that the aquifers located in the topographical low areas will be much more productive in terms of yields and will have a much higher sustainability in terms of long term water abstraction. The main reason for this is that the high water tables in the valleys forms a thicker aquifer with deeper saturated weathered host rock. (Geologic, 2015)

The site is located in the upper end of quaternary drainage region D73E. To the north is quaternary drainage region D42D (green line indicate catchment boundary in Figure 4-10) in which groundwater and surface water drains towards the north to the Kuruman River (therefore does not contribute to the site's catchment). In quaternary drainage region D73E, groundwater and surface water drains towards the south to the Orange River. (Geologic, 2015).

A groundwater catchment area for the production boreholes on site was generated (dark blue outlined area in Figure 4-11) based on available information. The delineated catchment has a surface area of 288.6 km^2. The proposed production boreholes can therefore gain water from this catchment area but not from outside this area. Groundwater movement from groundwater recharged in this area will be towards the boreholes (dark blue arrows), which can gain water from the aquifer whereas groundwater movement from groundwater recharged outside this area will be away from the production boreholes (light blue arrows) and therefore not available for use. Groundwater movement is however, not inhibited by man-made boundaries but is mainly constrained by the geology and the topography. For water use licence purposes, man-made boundaries must be used to calculate volumes available on a specific portion of land. (Geologic, 2015).

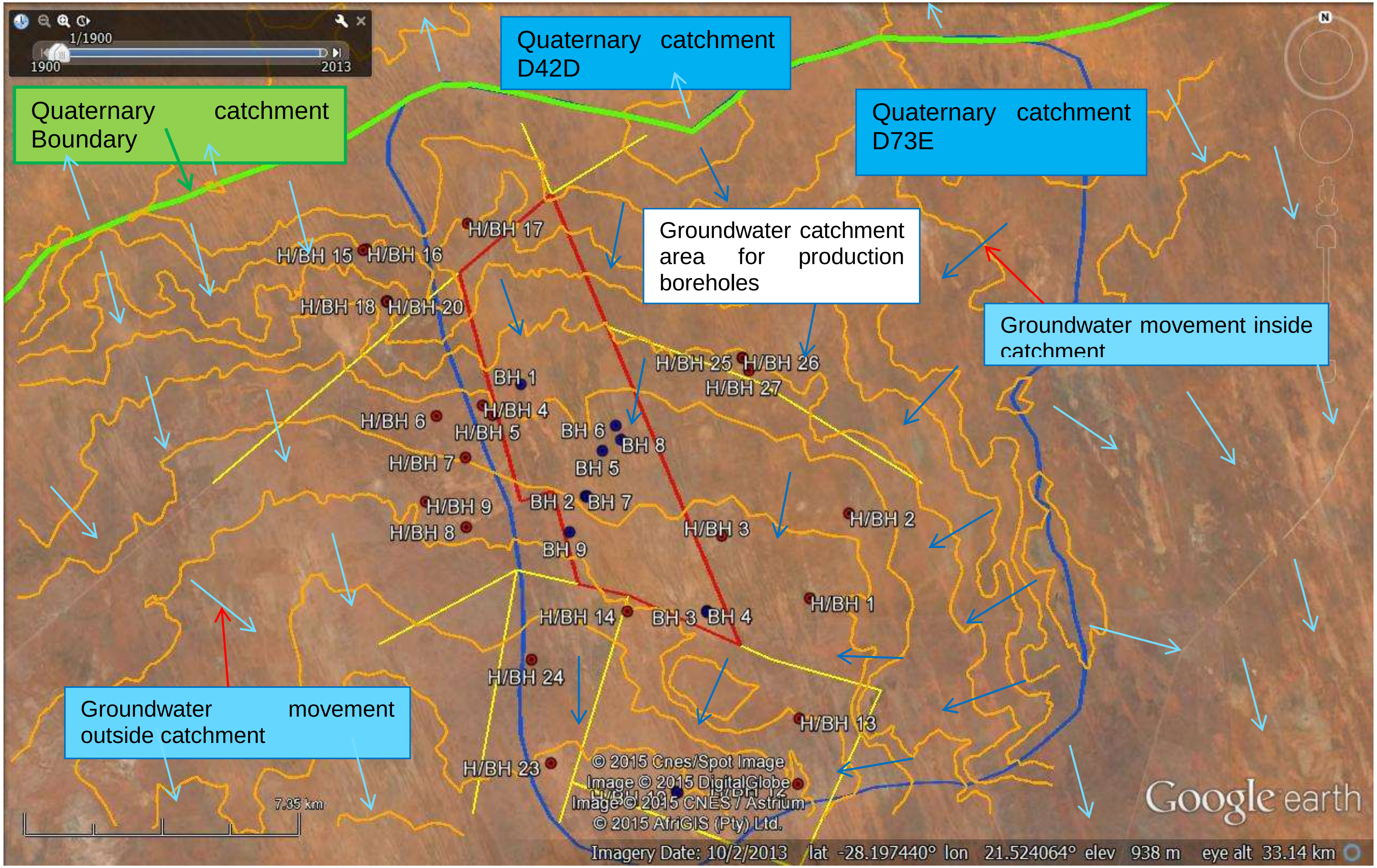


Figure 4-11: Groundwater catchment area for proposed production boreholes (Geologic, 2015)

4.5.5 Groundwater quality

The groundwater quality was determined through the sampling and analyses of a number of boreholes on the property and neighbouring properties. Table 4-2 indicates water quality found in the boreholes sampled.

Table 4-2: Groundwater quality (Aquatico Laboratories & Geologic, 2015)

Determinant	Unit	SANS 241:2011	BH 1	BH2	BH3	BH5	BH8	H/BH 10	H/BH 14	H/BH 15
Existing/New 2015			Existing	Existing	Existing	New 2015	New 2015	Existing	Existing	Existing
Property			Farm Steenkampspan, Portion 6					Farm Duiker Rand		Farm Steenkamps pan, Portion 3
GPS coordinates			28.184615° S 21.478047° E	-28.21177° 021.49552°	-28.23996° 021.52847°	28.200994° S 21.5033247° E	28.1984° S 21.50554° E	28.282260° S 21.519380° E	-28.23936° 021.50644°	-28.15137° 021.43464°
Planned use			HSPG – construction & operation: 300 to 400 metres from the planned buildings	Livestock watering	Livestock watering	HSPG – construction	HSPG – construction	HSPG – construction Livestock watering	Livestock watering	Domestic & Livestock watering
pH value at 25°C	pH	≥5 - ≤9.7	7.42	8.31	7.63	7.69	7.25	7.61	8.35	7.88
Electrical Conductivity (EC) at 25°C	mS/m	≤170	192	125	115	137	140	156	163	120
Total Dissolved solids (TDS)	mg/ℓ	≤1200	1 263	965	860	881	857	1 245	1 240	895
Total Alkalinity	mg $CaCO_3$/ℓ		298	327	367	353	268	427	373	420
Chloride as Cl	mg/ℓ	≤300	275	167	121	139	120	221	321	151
Sulphate as SO_4	mg/ℓ	≤500	95.6	75.0	54.8	72.3	70.1	78.3	104	33.9
Nitrate (NO_3) mg/l N	mg/ℓ	≤50	77.7	51.2	41.1	41.6	50.8	64.2	40.5	35.8
Ammonia as N	mg/ℓ	≤1.5	0.036	0.034	0.029	0.02	0.104	0.025	0.045	0.022
Orthophosphate (PO_4) as P	mg/ℓ		0.097	0.045	0.045	0.079	<0.002	0.045	0.041	0.047

Determinant	Unit	SANS 241:2011	BH 1	BH2	BH3	BH5	BH8	H/BH 10	H/BH 14	H/BH 15
Fluoride as F	mg/ℓ	≤1.5	0.714	0.567	0.914	0.409	0.473	0.879	0.687	0.520
Calcium as Ca	mg/ℓ		191	134	108	140	145	149	128	157
Magnesium as Mg	mg/ℓ		89.2	75.4	62.4	57.5	59.6	97.0	91.9	57.5
Sodium as Na	mg/ℓ	≤200	78.8	79.4	98.4	66.1	66.9	162	176	75.1
Potassium as K	mg/ℓ		7.07	6.61	8.92	6.46	6.41	10.6	12.0	6.10
Aluminium as Al	mg/ℓ	≤0.3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Iron as Fe	mg/ℓ	≤2	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Manganese as Mn	mg/ℓ	≤0.5	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chemical Oxygen Demand (COD)	mg/ℓ		<5.1		<5.1	<5.1	17.2			
Oil and grease (SOG)	mg/ℓ		1.9		2.0	1.7				
E.coli	CFU/100mℓ	Not Detected	<1	<1	<1	<1	<1	<1	<1	<1
Total Coliform	CFU/100mℓ	≤10	14	<1	350	6	<1	1	130	3
Total Hardness	mg $CaCO_3$/ℓ		844	648	527	587	608	698	697	628

Chloride: The chloride (Cl) levels in all the boreholes can be regarded as marginally high with only borehole H/BH 14 (not earmarked for use) elevated above the SANS 241 Standard limits. The chloride levels in a borehole give a relative idea of the groundwater recharge in an area. It also gives a relative idea of the age of the water if compared to each other. For instance, boreholes that are used for a number of years in an arid region normally presents water with a higher level of chloride (for example BH 1 with a chloride level of 275mg/l) than newly drilled boreholes in areas where water abstraction did not yet take place (for example BH 8 with a chloride level of 120mg/l) (Geologic, 2015).

Nitrate: The nitrate (NO_3) levels of boreholes BH 1, BH 2, BH 8 and H/BH 10 is above the Standard limits of SANS 241. Highly elevated nitrate levels result in elevated EC and TDS. Nitrate is the end product of the oxidation of ammonia or nitrite. Nitrates typically occur due to the oxidation of vegetable and animal debris and of animal and human excrement. The source is probably the animal excrement due to the livestock farming currently taking place on the farms. Boreholes BH 1, BH 2 and H/BH 10 are also in proximity of animal watering troughs and feeding lots. The levels of nitrate only pose a risk when ingested by humans but is suitable for livestock watering.

Calcium and Magnesium: High calcium levels in the water may lead to high Calcium Carbonate in the water. The water will require softening or regular maintenance as the calcium (Ca) and magnesium (Mg) concentrations may impair lathering and cause scaling in water conveyance infrastructure (pumps, pipes etc). For road building, the calcium carbonate load in the water will effectively help to bond soil particles. For domestic and industrial uses, such as car wash and heating elements, the water needs to be treated by reverse osmosis or chemical water softening or a maintenance programme should be implemented.

Bacteriological Water Quality: The E.coli count of the water analysed is below detection limits. The Total coliform bacteria count of boreholes BH 1, BH 3 and H/BH 14 is above the Standard limits and need to be chlorinated prior to human consumption.

4.6 Socio-economic environment (Barbour, 2015)

4.6.1 Geographics

The proposed site is located approximately 38 km north-east of Upington (//Khara Hais Local Municipality), which forms part of the larger ZF Mgcawu District Municipality. The ZF Mcgawu District Municipality is the second largest district (approximately 103 871 km^2) in the Northern Cape and forms the mid-northern section of the Province. It covers an area of more than 100 000 km^2 (almost 30% of the entire Province) of which 65 000 km^2 comprise the vast Kalahari Desert, Kgalagadi Transfrontier Park and the former Bushman Land (ZF Mgcawu District Municipality, 2015).

ZF Mgcawu District Municipality comprises six (6) Local Municipalities namely: Mire; Kai! Garb; //Kara Hais; Tsantsabane, Kheis and Kgatelopele. Upington is the district municipal capital housing the municipal government. ZF Mgcawu District Municipality, a category C Municipality, excecutes some of the functions of local government for a district (ZF Mgcawu District Municipality, 2015). The main land uses in the area are linked to grape farming and agriculture along the Gariep River (Orange River) and livestock farming away from the river. (WSP Parsons Brinckerhoff, September 2015).

4.6.2 Population distribution

Despite having the largest surface area of all the Provinces in South Africa, the Northern Cape has the smallest population (1 145 861 people), 2.28% of the population of South Africa. The population has increased from 991 919 in 2001 to 1 145 861 in 2011. In terms of age, 30.1% are younger than 15 years of age and 64.2% fall within the economically active age group of 15 - 64 years of age. The female proportion makes up approximately 52.7% of the total with males making up the remaining 47.3% (WSP Parsons Brinckerhoff, September 2015).

The increase in the population in the //Khara Hais Local Municipality was linked to an increase in the 15 - 64 and 65 + age groups. There was a decrease in the less than 15 age group (2001-2011). The Northern Cape has a population density of 3 people per square km, which is the lowest in the country (The Department of Economic Development and Tourism).

In terms of breakdown, the majority of the population are Coloured (65%), followed by Black African (23%) and Whites (10%). The total population in Ward 11, where the proposed development is located, in 2011, was 7 542 people. Of this total, the majority were Coloured (78%), followed by Black Africans (10%) and Whites (8.5%). The main language spoken in the //Khara Hais Local Municipality was Afrikaans (85.2%), followed by Setswana (3.5%) and English (1.9%) (WSP Parsons Brinckerhoff, September 2015).

As expected, the number of households in the //Khara Hais Local Municipality increased from 17 934 to 23 245 (2001 - 2011). The average household size decreased from 4.1 to 3.9 over the same period. The number of formal dwellings also decreased from 81.2% to 75.2% over this period. This implies that a number of the increased households in the //Khara Hais Local Municipality are informal dwellings, which is a concern in terms of service delivery. The increase in the number of informal dwellings is likely to be linked to an influx of people into the urban areas from the rural areas (WSP Parsons Brinckerhoff, September 2015).

The dependency ratio in the //Khara Hais Local Municipality decreased from 58.7% to 54.7% (2001 - 2011). The improvement indicates that there are fewer people who are dependent on the economically active 15 - 64 age group. This represents a socio-economic improvement (WSP Parsons Brinckerhoff, September 2015).

4.6.3 Income and living standard

Based on the data from the 2011 Census, 10.5% of the population of the //Khara Hais Local Municipality had no formal income, 2.6% earn between R1 and R4 800 per annum, 4.3% earn between R4 801 and R9 600 per annum, 16.3% between R9 601 and R19 600 per annum and 21.2 % between R19 601 and R38 200 per annum (WSP Parsons Brinckerhoff, September 2015).

Over the past 8 years (2008 – 2015), there has been little to no variance in the Human Development Index figures for the Northern Cape, indicating no increase or decrease in the overall standard of living. This trend is unlikely to change in the foreseeable future, mainly due to the marginal economic base of the poorer areas, and the consolidation of the economic base in the relatively better-off areas (WSP Parsons Brinckerhoff, September 2015).

The percentage of Northern Cape residents living below the poverty line has decreased from 40% in 1995 to 27% in 2011, while the poverty gap has decreased from 11% in 1995 to 8% in 2011. The goal set by the Province is to decrease the percentage of people living below the poverty line to 20% by 2015 (WSP Parsons Brinckerhoff, September 2015).

4.6.4 Economic contribution and sectors

The Northern Cape growth slowed down from a growth of 1.8% in 2008 to -1.5% in 2009 and then increased to 1.9% in 2010. This can be attributed to the net growth in the primary, secondary and tertiary industries of the Northern Cape (The Department of Economic Development and Tourism). The provincial economy reached a peak of 3.7% in 2003/2004 and remained the lowest of all provinces in South Africa. The Northern Cape is the smallest contributing province to South Africa's economy (only 2% to South Africa Gross Domestic Product (GDP) per region in 2007) (WSP Parsons Brinckerhoff, September 2015).

The mining sector is the largest contributor to the provincial GDP, contributing 28.9% to the GDP in 2002 and 27.6% in 2008. The mining sector is also important at a national level. In this regard, the Northern Cape produces approximately 37% of South Africa's diamond output, 44% of its zinc, 70% of its silver, 84% of its iron-ore, 93% of its lead and 99% if its manganese (WSP Parsons Brinckerhoff, September 2015).

Agriculture and the agri-processing sector is also a key economic sector. Approximately 2% of the province is used for crop farming, mainly under irrigation in the Orange River Valley and Vaalharts Irrigation Scheme. Approximately 96% of the land is used for stock farming, including beef cattle and sheep or goats, as well as game farming. The agricultural sector contributed 5.8% to the Northern Cape GDP per region in 2007 which was approximately R1.3 billion. The sector is experiencing significant growth in value-added activities, including game farming. Food production and processing for the local and export market is also growing significantly (WSP Parsons Brinckerhoff, September 2015).

The agricultural sector is largely linked to irrigation along the Orange (Gariep) River, specifically table and wine grapes. In this regard, the //Khara Hais region accounts for ~ 40% of South Africa's grape exports. Most of Upington's wines are produced by Orange River Wine Cellars (OWC). The company has six (6) depots in the area (all of them located adjacent to the Orange River) at Upington, Kanoneiland, Grootdrink, Kakamas, Keimoes and Groblershoop. The wines from OWC are exported, inter alia, to Europe and the USA. A number of privately owned cellars also exist in the area (WSP Parsons Brinckerhoff, September 2015).

In terms of the agricultural sector, there are eight (8) smaller rural settlements and various farms. Settlements include: Lambrechtsdrift, Karos, Leerkrans, Leseding, Raaswater, Sesbrugge and Klippunt, and Kalksloot. The inhabitants of these settlements are mainly reliant upon agricultural activities for their livelihoods (WSP Parsons Brinckerhoff, September 2015).

There was negative growth in the primary industries in 2008 and 2009, but positive growth in 2010. This was mainly because of the positive growth in mining and quarrying. In 2010, there was negative growth in agriculture, forestry and fishing. Both the secondary and tertiary industries showed an overall positive growth for 2010. The biggest contributor to the Northern Cape GDP-R (Gross Domestic Product by Region) is mining and quarrying. The smallest contributor is construction.

4.6.5 Employment

Between quarter four of 2011 and quarter one of 2012, the largest employment losses were observed in the construction and manufacturing industries. Employment increased mostly in the private households and agriculture industries. (The Department of Economic Development and Tourism).

The community and social services sector is the largest employer in the province at 29%, followed by the agricultural sector (16%), wholesale and retail trade (14%), finance (8%) manufacturing (6%) and mining (6%), etc. (WSP Parsons Brinckerhoff, September 2015).

The official unemployment rate in the //Khara Hais Local Municipality decreased between 2001 and 2011, falling from 34.0% to 22.1% of the economically active population. Youth unemployment in the //Khara Hais Local Municipality also dropped over the same period, from 42.3% to 29%. While unemployment figures appear to be low, specifically within the context of the figures for the Northern Cape Province as a whole (27.4% unemployment and 34.5% youth unemployment in 2011), they do not reflect the fact that the majority of the employment in the //Khara Hais Local Municipality is seasonal and linked to the agricultural sector (WSP Parsons Brinckerhoff, September 2015).

4.6.6 Education levels

The average adult education attainment levels in the Northern Cape are lower than the adult education attainment levels of South Africa as a whole. Approximately 19.7% of the Northern Cape adults have no schooling in comparison to South Africa's 18.1%. The Northern Cape has the second lowest percentage of adult individuals (5.5%) that obtained a tertiary education in South Africa (WSP Parsons Brinckerhoff, September 2015).

The Northern Cape also has the smallest portion (11.1%) of highly skilled formal employees in South Africa and Gauteng has the highest (14.3%). Linked to this, the Northern Cape has the second largest portion of semi and unskilled formal employees in the country. A lack of skilled people often results in both the public and the private sector being unable to implement planned growth strategies and achieve the desired productivity, service delivery and service quality (WSP Parsons Brinckerhoff, September 2015).

Education levels in the //Khara Hais Local Municipality improved between 2001 and 2011 with the percentage of the population over 20 years of age with no schooling dropping from 13.6% to 7.1%. The percentage of the population over the age of 20 with matric also increased from 20.9% to 26.0%. This is higher than the average for the ZF Mgcawu District Municipality (21.7%) and the Northern Cape (22.7%). This is linked to the important economic role played by the town of Upington and the associated well developed educational facilities in the town (WSP Parsons Brinckerhoff, September 2015).

4.6.7 Service delivery

There has been a marginal decrease in the percentage of households with access to flush toilets in the //Khara Hais Local Municipality. For the other three categories (piped water inside dwelling, access to weekly municipal refuse removal and households that use electricity) there was an improvement in the access to municipal services. The decrease in number of households with flush toilets is likely to be linked to the increase in the number of informal dwellings in the //Khara Hais Local Municipality between 2001 and 2011. It is also worth noting that the level of services in the //Khara Hais Local Municipality is higher than the levels for the ZF Mgcawu District Municipality and the Northern Cape Province (WSP Parsons Brinckerhoff, September 2015).

4.6.8 Amenities

Schools: The //Khara Hais Local Municipality area currently has seven (7) high schools and 23 primary schools. In addition, the following institutions for higher education have campuses or satellite campuses in the town (WSP Parsons Brinckerhoff, September 2015):

- Upington College for vocational education;
- Vaal Triangle University of Technology;
- Universal College Outcomes;
- Technikon SA.

Hospitals and clinics*:* The //Khara Hais Local Municipality area currently has two (2) hospitals and 14 clinics.

Police Stations: The //Khara Hais Local Municipality is serviced by four (4) police stations; a bomb squad, dog unit and a satellite police station provide services to the community (WSP Parsons Brinckerhoff, September 2015).

Sports and recreation*:* Formal sports facilities include a golf course, three (3) swimming pools and eight (8) formal sports fields. In many of the suburbs and rural settlements there are public open areas used as sports fields, especially for soccer. The sports fields are usually not grass-covered, and are viewed as informal fields. Most of the schools also have their own sports facilities for the use of their learners (WSP Parsons Brinckerhoff, September 2015).

4.6.9 Tourism

Upington is well situated as a base for exploration of the region, and has an outstanding infrastructure in the form of accommodation. Various areas are classified as nature conservation areas. Spitskop Nature Reserve lies 13 km north of Upington. This nature reserve, of approximately 6 000 hectares, supports gemsbok, zebra, springbok, ostrich, eland, blue wildebeest, as well as smaller game, and can be viewed from a circular route running through the park. Other nature areas within the jurisdiction of //Khara Hais are Gariep Lodge and Uizip. The Kalahari Oranje Museum Complex has the status of a regional- and provincial museum. There are also a number of declared national monuments, including (WSP Parsons Brinckerhoff, September 2015):

- Roman Catholic Church in Le Roux Street (still in use);

- NG Mother Community in Schroder Street (still in use);
- Hortentia water mill; and
- Missionary complex in Schroder Street (building is being used as a museum).

Upington has a well-defined business centre with numerous residential areas. Secondary activities in the study area are mainly light industrial, warehousing, and light engineering works. Main traffic routes connect Upington, the hub of activities in the region, to cities such as Kimberley, Johannesburg, Cape Town and Namibia. Upington also serves as the 'Portal' to Namibia and vice versa, the 'Frontier' to the Kalahari and the Kgalagadi Transfrontier Park, the 'Oasis' in the desert', the Agricultural hub of the Northern Cape, and the 'Portal to the Kalahari's hunting ground'. Furthermore, two (2) major national parks are situated within a few hours' drive from Upington (WSP Parsons Brinckerhoff, September 2015).

5 RISK/IMPACT ASSESSMENT

5.1 Definition

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under investigation for meeting a project need.

5.2 Methodology

The significance of the environmental impacts identified was assessed in terms of their:
- Duration;
- Extent;
- Probability; and
- Severity.

The above were used to determine the significance of an impact without any mitigation, as well as with mitigation.

Nature of an impact: An impact's nature can be positive (+) or negative (-).

Consequence: Considers duration, extent and severity

Consequence = duration + extent + severity

Table 1 provides the environmental risk and impact assessment criteria.

Table 5-1: Environmental risk and impact assessment criteria

DURATION		
Immediate	Less than 1 month	1
Short term	< 3 months	2
Construction	24 months	3
Life of project	Operational phase (20 years)	4
Post closure	Time of rehabilitation and for re-establishment of natural systems	5
Residual	A permanent impact (100 years or more)	6
EXTENT / SCALE		
Site specific	Site of the proposed development (Steenkampspan)	1
Local	Property and surrounding properties	2
District	//Khara Hais Local Municipality	3
Regional	ZF Mgcawu District Municipality	4
Provincial	Northern Cape Province	5
National	Republic of South Africa	6
PROBABILITY (likelyhood of impact occuring)		
Rare	< 5% probability of occurrence – may occur in exceptional circumstances	1
Unlikely	15% - 6% probability of occurrence – could occur at some time	2
Possible	45% - 16% chance of occurrence – might occur at some time	3
Likely	65% - 46% probability of occurrence – will probably occur in most circumstances	4

Almost Certain	90% - 66% probability of occurrence – is expected to occur	5
Definite	100% - will occur	6
SEVERITY / MAGNITUDE		
Catastrophic (critical)	Total change in area of direct impact, relocation not an option, death, toxic release off-site with detrimental effects, irreversible loss, huge financial loss	6
Significant (High)	> 70% change in area of direct impact due to loss of significant aspect, extensive injuries, long term loss in capabilities, off-site release to high extent, major financial implications	5
Serious	50 – 70% long term loss, extensive rehabilitation / restoration / treatment required, high financial impact, still restricted in extent	4
Moderate (medium)	20 – 49% change, medium term loss in capabilities, rehabilitation / restoration / treatment required, on-site release with outside assistance, medium financial impact	3
Minor	10 – 19% change, short term impact that can be absorbed, on-site release, immediate containment, low financial implications	2
Insignificant (low)	< 10 % change in the area of impact, no financial implications, localised impact, a small percentage of population	1

[Duration + Extent + Severity] x Probability (P) = Impact Significance (IS)

IMPACT SIGNIFICANCE		
Impact Significance	**IS score range**	**Description**
Low (L)	<15	The impact is minor or insubstantial; it is of little importance to any stakeholder and can easily be rectified.
Moderate Low (ML)	16 - 45	The impact is limited in extent, even if the intensity is major; the probability will only be likely, the impact will not have a significant impact considered in relation to the bigger picture; no major material effect on decisions and will require only small scale management intervention bearing moderate costs.
Moderate high (MH)	46 - 70	The impact is significant to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
High (H)	> 71	The impact could render development options controversial or the entire project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in project decision-making.

5.3 Potential impacts/risks identified

5.3.1 Construction phase

Surface water risk: Quantity: Flooding
Quality: Contamination

Groundwater risk: Quantity: Use of groundwater as water supply source
High abstraction quantities during construction
Lowering of water table due to water harvesting
Sustainability of water use
Water available to surrounding users

Quality: Agriculture (animal manure) – existing & future
Calcrete Borrow Pit
Granite Quarry
Construction materials

5.3.2 Operational phase

Surface water risk: Quantity: Flooding
Quality: Fuel (fuel storage and refuelling)
Sewage (conservancy tanks)
Oils & grease (oil traps & workshop)

Groundwater risk: Quantity: Use of groundwater as water supply source

Quality: Agriculture (animal manure) – existing & future
Building area (including conservancy tank, wash bay, workshop etc.)

5.3.3 Location of potential pollution sources

Table 5-2: Potential pollution sources

Risk:		Coordinates:
Hydrocarbon contamination risk (Fuel - diesel & petrol)	Diesel storage tanks (3 X 20m^3)	28^0 11' 08.26" South 21^0 28' 30.46" East
	Fuel station (4 x 10.25 litre tanks)	28^0 11' 08.70" South 21^0 28' 25.72" East
Waste management (solids, salts)	Hazardous waste collection	28^0 11' 07.64" South 21^0 28' 28.85" East
	Non-hazardous waste collection	28^0 11' 08.74" South 21^0 28' 28.89" East
Wastewater management (nitrates, E.coli, oils)	Conservancy tank	28^0 11' 08.80" South 21^0 28' 29.25" East
	Oil separator	28^0 11' 27.77" South 21^0 28' 25.72" East
Operations (oils, greases, fuels, phosphates from cleaning agents)	Car wash	28^0 11' 09.35" South 21^0 28' 27.17" East
	Workshop	28^0 11' 07.75" South 21^0 28' 28.00" East
Farming activities (nitrate, E.coli)	Livestock excretion	Across the farm

5.4 Surface water environment impact

Wetland: No infrastructure will be established within 500m of the wetland. The wetland has a 500m buffer around it and the closest structure is the oval which is located 850m away from the buffer boundary.

Material sourcing (borrow pit and quarry operations): There would be no need to dewater pits as groundwater level is at least 12m below the bottom of the pit and groundwater will therefore not be intercepted during sourcing of material. Diversion berms around up-gradient areas of pit will minimise rainwater entering pits. Rain water directly into pit can be evaporated due to small quantities.

Storm water: The water tracts are incorporated within the storm water management and drains and culverts will be constructed to ensure the uninterrupted flow of water around the track.

5.5 Groundwater quantity impact

Aquifer classification: Poor aquifer region
Low to moderate aquifer yielding system
Variable water quality

5.5.1 Construction phase

Interception of groundwater during sourcing of material:

Borrow pit depth: 2m
Quarry depth: 10 – 15m
Groundwater depth: 23m

Duration	Extent	Probability	Severity	Significance
3 Construction phase. Sourcing of construction material.	1 Site: Portion 6 of Steenkampspan.	3 12 - 21m difference between depth of groundwater table and depth of pit/quarry. No water in BH 9 drilled to 150m in proximity to quarry.	4 Non-aquifer. Low yielding (BH3 & BH4 close to borrow pit) with limited fracturing in the host rock.	24

Groundwater as water supply source:

Three (3) equipped boreholes exist on the property. Only one (1) located on the northern section of the farm can be considered for use (BH1), the other have low yields. A second borehole (H/BH10) located off the site on the neighbouring farm, Duiker Rand, was therefore also considered for water supply during the construction phase. Four (4) new boreholes were drilled in 2015 of which two (2) proved suitable for possible use (BH5 & 8).

Table 5-3: Potential boreholes for water supply during the construction phase

Borehole number		BH1 (365m from building area)	BH5 (new borehole drilled)	BH 8 (new borehole drilled)	H/BH10
Farm:		Steenkampspan			Duiker Rand
Coordinates:		28.184615º S 21.478047º E	28.200994º S 21.5033247º E	28.1984º S 21.50554º E	28.282260º S 21.519380º E
Depth (metres):		77.3	90	150	70
Static level (metres):		34	25.73	26.5	16.85
Pump test (litres/s for 24 hours):		0.31	0.68	2.14	7.13
Drawdown after 24hrs (metres below static level after 24hrs):		6.39	6.88	5.68	7.88
Use:	Litres/second	0.35	0.6	2.2	5.0
	Hours/day	12	12	12	12
	Litres/day	15 120 15.1m^3/day	25 920 25.9m^3/day	95 040 95m^3/day	216 000 164m^3/day

Note: Boreholes BH2, BH3, BH4 will be used for agricultural purposes (livestock watering)

The groundwater recharge program developed by the Groundwater Institute of the University of the Free State was used to calculate groundwater recharge according to the Chloride, Soil, Vegter, Acru and Harvest potential methods.

Table 5-4: Construction phase water supply calculations

Parameter	Values used	
MAP:	155.4 mm/a	
Recharge (conservative as 1mm/a was achieved):	0.5 mm/a	
Storativity value:	0.000439	
Specific yield:	0.002867	
Farm	**Steenkampspan**	**Duiker Rand**
Surface area of property (ha):	3 732.7185	3 426.1280
Recharge (m^3/a): 0.17mm/a (lower end) and 0.27mm/a (upper end)	6 346 - 10 078	5 824 - 9 250
Recharge (m^3/a) (0.5mm/a)	18 664	17 130.64
Volume of water stored in aquifer (m^3):	9 095 227	8 348 172
Demand for construction (including livestock watering):	142 m^3/day 51 830 m^3/annum	173.6 m^3/day 63 364 m^3/annum (includes H/BH 11, 12 & 13 used for livestock watering)
Total demand for construction period of 22 months (m^3):	93 720	114 576
Percentage of storage required during construction phase:	1.03%	1.4%
Harvest potential:	132 448 m^3/annum 239 495 m^3 for 22 months	121 559 m^3/annum 219 805 m^3 for 22 months
Demand as % of harvest	39.1%	52.1%

potential that will be used		
Average groundwater resource potential (m^3/annum)	63 453 - 67 403	58 244 - 61 842
Recharge as % of demand	12.3 - 19.4%	9.2 – 14.6%
Considering recharge and demand during construction: Time to replenish aquifer after construction phase	5 – 15.5 years	6.7 – 19.7 years
Water demand per annum as % of minimum groundwater potential	81.7%	108%
TOTALS FOR DELINEATED CATCHMENT		
Surface area:	288.6km^2	
Recharge (m^3/a): 0.17mm/a (lower end) and 0.27mm/a (upper end)	49 639 - 80 231	
Recharge as % of demand	39 – 63%	
Recharge as % of demand (for 0.5 mm/annum recharge)	113%	
Volume of water stored in delineated catchment:	70 320 853m^3 (288.6km^2 at 243 662 m^3/km^2)	
Demand for construction:	348.4m^3/d 127 166m^3/annum (includes livestock watering and entire catchment area requirements)	
Total demand for 22 months:	229 944m^3	
Percentage of storage required during construction phase:	0.33%	
Harvest potential (m^3/annum):	1 023 953	
Demand as % of harvest potential that will be used	12.4%	
Average groundwater resource potential (m^3/annum):	490 620 - 520 923	
Water demand per annum as % of minimum groundwater potential	25.9%	
Conclusion:	**The demand of 127 166 m^3/annum is much lower than the average groundwater resource potential and only 25.9% of minimum groundwater potential.**	

- **Duration (4 – life of project):** Though the groundwater abstraction will be limited to the construction phase, a period of 22 months over 5 year period, the impact may remain up to 15 – 20 years after construction has been completed because it will take 15 – 20 years to replenish the aquifer after harvesting groundwater during the construction phase.

- **Extent (2 - local):** Only boreholes on the property and neighbouring properties will be impacted. Boreholes BH1, BH5, BH8 (Portion 6 of Steenkampspan) and H/BH10 (Duiker Rand) will be used. The following boreholes are located within the same catchment area and may be impacted:

Table 5-5: Construction phase impact on other water users

Number of boreholes	Boreholes	Property (farm and portion)	Property owner
8	BH1, 2, 3, 4, 5, 6, 7, 8	Portion 6 of Steenkampspan 419	
1	H/BH 3 (H/BH 1 & 2 not affected due to distance away)	Kenilworth 374	Phillip Coreejes
2	H/BH 4, 5	Remainder of Steenkampspan 419	Siebert Myburg
3	H/BH 11, 12, 13, 14	Duiker Rand 415	Albert Human
2	H/BH 23, 24	Portion 1 of Rooikoppies 416	Fanie le Rouxe
3	H/BH 25, 26, 27	Ceres 373	Gert Fortuin

- **Probability (6 – definite):** Since all the above boreholes are located within the same catchment area and the aquifer from which water will be harvested, it is likely that these boreholes will experience a drawdown. The geohydrology study does not indicate whether sufficient water will be available to these farmers to continue their livestock farming activities or whether they would experience water shortages. If the adjacent farmers should experience water shortages due to a drawdown in their boreholes, MBSA will deliver water to these farmers. MBSA has made financial provision for importing water from Upington during the construction phase for these farmers.

Table 5-6: Total cumulative drawdown at the end of the construction phase (Geologic, 2015)

<table>
<tr><th>Borehole:</th><th>Drawdown (m):</th><th>Owner:</th><th>Farm:</th></tr>
<tr><td>H/BH 3</td><td>0.2</td><td>Phillip Coreejes (attended public meeting and raised concern)</td><td>Kenilworth 374</td></tr>
<tr><td>H/BH 4</td><td>0.4</td><td rowspan="4">Siebert Myburg (attended public meeting and raised concern). H/BH 6 & 7 are outside the delineated catchment but may be affected due to its proximity to BH 1.</td><td rowspan="4">Remainder of Steenkampspan 419</td></tr>
<tr><td>H/BH 5</td><td>0.57</td></tr>
<tr><td>H/BH 6</td><td>0.09</td></tr>
<tr><td>H/BH 7</td><td>0.22</td></tr>
<tr><td>H/BH 12</td><td>0.34</td><td rowspan="3">Albert Human (attended public meeting – will benefit from project)</td><td rowspan="3">Duiker Rand 415</td></tr>
<tr><td>H/BH 13</td><td>0.16</td></tr>
<tr><td>H/BH 14</td><td>0.07</td></tr>
<tr><td>H/BH 23</td><td>0.28</td><td rowspan="2">Fanie le Rouxe</td><td rowspan="2">Portion 1 of Rooikoppies 416</td></tr>
<tr><td>H/BH 24</td><td>0</td></tr>
<tr><td>H/BH 25</td><td>0.15</td><td rowspan="3">Gert Fortuin</td><td rowspan="3">Ceres 373</td></tr>
<tr><td>H/BH 26</td><td>0.15</td></tr>
<tr><td>H/BH 27</td><td>0.15</td></tr>
</table>

- **Severity (5 - significant):** As there are no municipal services in this area nor any alternative water sources, all these farmers are dependent on groundwater for their livelihoods.

- **Significance (66 – Moderate Low)**: Due to the significance of the impact, a WUL is required.

Duration	Extent	Probability	Severity	Significance
4 Life of project. Period required (15 – 20 years) for aquifer to be replenished.	2 Local: site and neighbouring properties as part of the catchment area – see Table 5.4, 5.5 & 5.6.	6 Definite. Normal recharge is insufficient and groundwater will be harvested.	5 Significant. Dependency on groundwater as a water supply source. 0 .0.57m drawdown will result in limited fluctuation in boreholes. Maximum lowering of 2.3% (H/BH5). Drawdown will be gradual and impact will be largest during the last part of the 22 months.	66

Management required: There are no mitigation measure that can reduce the impact as the water quantities are required for the construction phase and there is no alternative water supply source (only groundwater). Alternatives include the import of water from Upington but due to the quantities required, and the associated cost, this would render the project non-feasible. Allow a rest period between Phase I and II of the construction period to allow partial recovery of water levels. Also refer to Section 6. The number of cattle on the site will be reduced from ± 300 head to between 60 and 80 head of cattle, thereby reducing the livestock watering requirements.

5.5.2 Operational phase

- **Duration (4 – life of project):** The impact is anticipated to be for the life of the project (± 20 years).

- **Extent (1 – site specific):** Groundwater for the operational phase of the HSPG will only be abstracted from BH1 which is an existing borehole on the site. BH2, 3 & 4 will be used for livestock watering. These boreholes were previously also used for livestock watering. Livestock watering requirements will reduce to 6m^3/day and the HSPG will require 10 m^3/day water during the operational phase. The total demand (HSPG & livestock watering) therefore is 5 840 m^3/annum which is only 31% of the recharge of 18 664 m^3/annum (0.5 mm/annum) for Steenkampspan. For the catchment, 21 316 m^3/annum is required (water demand during operational phase) which is only 14.8% of the recharge for the catchment (144 300 m^3/annum). Based on the geohydrological study:
  - these abstraction quantities (21 316 m^3/annum) can be provided by the boreholes on site;
  - these quantities can be sustainably abstracted for the life of the project; and
  - these quantities of abstraction will not negatively impact on surrounding groundwater users.

- **Probability (3 – possible):** An impact is possible under certain conditions such as drought that is often experienced in this area.

- **Severity (3 - moderate):** If an impact is experienced it will be of a moderate severity due to the low quantities of water used.

- **Significance (24 – Moderate Low)**: Due to the significance of the impact, a WUL is required.

Duration	Extent	Probability	Severity	Significance
4 Life of project 20 years.	1 Site specific: BH1 on Portion 6 of Steenkampspan for HSPG; BH2, 3, 4 for livestock watering.	3 Possible Drought conditions are prevalent in the area.	3 Moderate. Low water quantities required and used compared to yields determined.	24

Management required: Water in the car wash will be recycled. Potable water for human consumption will be imported from Upington. Also refer to Section 6.

5.6 Groundwater quality impact

5.6.1 General (Geologic, 2015)

Risk levels are based on three factors:

1) Attenuation ability in unconsolidated materials;
2) Contamination load and travel time of degradable pollutants, in aquifer systems; and
3) Vulnerability of the aquifer and behavior of interstitial water regimes.

Aquifer classification: Poor aquifer region
Low to moderate aquifer yielding system
Variable water quality

Aquifer vulnerability: A least tendency or likelihood does exist for contamination to reach a specific position in the groundwater system after introduction at some location above the uppermost aquifer.

Aquifer susceptability: Low
Susceptibility is a qualitative measure of the relative ease with which a groundwater body can be potentially contaminated by anthropogenic activities and includes both aquifer vulnerability and the relative importance of the aquifer in terms of its classification.

Groundwater Quality Management Classification (GQM): 2
Low protection needed

The vulnerability of the underground water sources is related to the distance that the contaminant must flow to reach the water table and the ease with which it can flow through the soil and rock layers above the water table (Geologic, 2015).

5.6.2 Construction phase

Borrow pit (Geologic, 2015)

Duration	Extent	Probability	Severity	Significance
3 Construction phase only to source sand and calcrete to be used as base fill material.	1 Site only - South-east corner of Portion 6 of Steenkampspan .	3 2m deep. Groundwater is 23m deep (BH 3 & 4) 21m difference.	4 BH3 & 4 in area is low yielding – limited fracturing in rock.	24

Quarry (Geologic, 2015)

Duration	Extent	Probability	Severity	Significance
3 Construction phase only to source G1 to G5 material for road construction	1 Site only - Western boundary of Portion 6 of Steenkampspan.	3 10 -15m deep. Water table will be between 12 to 17 metres below the bottom of the pit. No water in BH 9 drilled to 150m.	4 Groundwater movement in this region of the site in the Blaaubosch Granite will be limited due to the un-weathered state of the host rock. Very low yielding aquifer with limited fracturing in the host rock. Non-aquifer.	24

Building area:

Duration	Extent	Probability	Severity	Significance
3 Construction phase - 24 months.	1 Site specific: Portion 6 of Steenkampspan.	2 Unlikely. Host rock layers above the aquifer are thick enough and will sufficiently protect the aquifer below from on surface leaks. Hydraulic conductivities will be altered to be much lower than measured on site due to filling, compaction and elevation. (Geologic, 2015)	2 Minor. **Risk:** Excessive water abstraction from BH 1 may alter the groundwater flow directions near the borehole. (Geologic, 2015)	12

Management required: Abstraction from BH1 to be limited to quantities advised by geohydrologist (15.1 m^3/day). Refer to Section 6.

5.6.3 Operational phase

Building area (Geologic, 2015)

The building area includes the following potential pollution sources:

- Fuel station (mobile with self-containment);
- Workshop;
- Diesel storage (tanks in bunded area);
- Waste storage (hazardous and general) before removal for off-site disposal;
- Conservancy tank for sewage storage before off-site disposal; and
- Oil separator (handling of water from floor cleaning in workshop).

Duration	Extent	Probability	Severity	Significance
4 Life of project – operational phase – 20 years.	1 Site only - western boundary in the central northern part of Portion 6 of Steenkampspan.	3 Building area filled, compacted and elevated. Hydraulic conductivities measured on site will be altered to be much lower than measured on site. Fuel storage above ground. Sewage storage below ground. Water level is expected to be 25 metres below ground level. BH 1 as water supply borehole ±300m east of building. Sanitation conservancy tank will be 21 to 22 metres above the water table if the tank is constructed 3 to 4 metres deep. This means that water migrating to the water table will have a long travel time before reaching the water table.	4 BH 1 used as water supply borehole. Under normal conditions, contamination will migrate to the south and not to the borehole. Excessive water abstraction at borehole BH 1 may alter the groundwater flow directions near the borehole.	27

The location of potential contamination sources, in relation to water resources utilised, is of concern. It is therefore essential that minimum distances between possible contamination sources and the nearest water resource that is in use, be prescribed. The recommended safe distances are based on the acceptable soil's permeability range, in conjunction with the maximum survival times of bacteria, viruses and the breakdown of chemical components. Conservatism has been achieved through the effects of the harsh environmental conditions prevalent in most of Southern Africa, which lowers maximum pathogen survival periods, and by adding a moderate safety factor of 150m to the calculated distances (this ensures a minimum safe distance of 150m at all times).

Production borehole BH1 to be used during the operational phase is located 300 metres from the position of the building site and conservancy tank and therefore a WUL is required (< 500m). Other boreholes are located further away.

The following results in a negligible risk to groundwater (Geologic, 2015):

- Distance between water supply boreholes and potential contamination sources (>150m).
- Groundwater aquifer vulnerability is low risk due to the hydrogeological conditions (Groundwater Protocol document, Version 2, dated March 2003).
- Distance from the surface to the aquifer (water table) is long to very long (17 – 21m).
- Host rock has a medium capacity to absorb contaminants and a medium capacity to create a fair barrier to the movement of biological contaminants.
- The host rock layers above the aquifer is therefore thick enough and will sufficiently protect the aquifer below from on surface leaks.
- A high reduction of bacteria and viruses will be evident in the unsaturated aquifer if a leak in the conservancy tank does happen.
- The top layer will form a good barrier to the movement of biological contaminants but will have little reduction in chemical contaminants (nitrates, phosphates and chlorides).

Table 5-7: Hydraulic conductivity (Geologic, 2015)

	Depth for percolation tests (m)	Hydraulic conductivity rate (m/d)
Aeolian Sand	0.4	6.3 – 6.8
Calcrete	0.6	1.9 – 2.2
Gravel	0.85	2.5
Meta-basalt	2.2	

6 WATER AND WASTE MANAGEMENT

NOTE: All figures/drawings in this section are also provided as an appendix (Appendix E) at a large scale.

6.1 Specialist studies

The following specialist studies have been completed to assist in terms of water and waste management:

- Wetland Delineation and Assessment (Ixhaphozi Enviro Services, 2015);
- Geohydrological and Contamination Risk Assessment Study (Geologic Geohydrological Consultants, 2015);
- Drainage and Geometric Detail Design (WSP, 2015); and
- Water and Wastewater Detail Design (WSP, 2015).

An aquatic health (biomonitoring) study was not conducted as there are no permanent surface water bodies on or in close proximity to the site.

6.2 Potential pollution sources

The following poses a potential threat to the water environment:

- Handling of fuels (petrol & diesel) at fuel station and storage area;
- Handling of hydrocarbon spillages (oils & greases) in workshop area and car wash;
- Improper handling and storage of solid waste;
- Poor storm water management;
- Use of groundwater as a water supply source as there is no alternative water supply and the following were considered: groundwater availability, sustainable water use, other water user requirements (surrounding farm users) etc.; and
- Poor management of wastewater - overflows, spillages and leakages from oil separators, sewage conservancy tank and wastewater containment facilities that can impact on groundwater quality.

6.3 Water supply management

6.3.1 Water source and quantities

Construction phase for project: The construction phase will be conducted in two (2) phases, the first being 14 months and the second being 8 months (total of 22 months). The water demand for the construction phase (to be completed within the first five (5) years will be high at 300 m^3/day.

Operational phase for project: During the operational phase, the water demand will reduce significantly and 10 m^3/day would be adequate.

Potable water for human consumption: Water for human consumption will be bottled water purchased in Upington and brought onto the farm.

Agricultural use: Farming activities (cattle farming) will continue throughout the construction and operational phase and will require 6m^3/day for 80 head of cattle.

Water supply source: Groundwater aquifer

Source for project: For construction phase:
Boreholes BH1, 5 & 8 (Farm Steenkampspan)
Borehole H/BH10 (Farm Duiker Rand)
For operational phase: BH1 only

Source for farming: Boreholes BH2, 3 & 4 (Farm Steenkampspan)

Table 6-1: Water sources

Borehole number	Coordinates	Ground Elevation (mamsl)	Water level (mbgl)	Groundwater Elevation (mamsl)	Use
BH 1	-28.184615° 021.478047°	940	24.72	915	HSPG Construction phase HSPG Operational phase
BH 2	-28.21177° 021.49552°	932	51.40	881	Livestock watering
BH 3	-28.23996° 021.52847°	922	23.15	899	Livestock watering
BH 4	-28.23965° 021.52835°	923	22.90	900	Livestock watering
BH 5	-28.200994° 021.503347°	937	25.73	911	HSPG Construction phase
BH 8	-28.19842° 021.50554°	938	26.5	911	HSPG Construction phase
H/BH 10	-28.28226° 021.51938°	900	16.82	883	HSPG Construction phase

Quantity - construction: Approximately 300 m^3/day
Total of 229 944 m^3 over construction period of 22 months

Quantity – operational: Approximately 5.6 - 6 m^3/day for farming (livestock watering)
Approximately 10 m^3/day for operational phase of HSPG
Approximately 120 - 136 m^3 stored for fire fighting

Periods:
Construction 14 – 22 months (2 phases over 5 years)
Operation Mainly during summer months
Farming 12 months/annum

Table 6-2: Water demand for project

BH number and use	Construction phase	Operational phase
	Water use (m^3/d)	Water use (m^3/d)
BH 1 (HSPG; Steenkampspan)	15.1	10
BH 2, 3 and 4 (Steenkampspan farm use)	6.0	6.0
BH 5 (HSPG; Steenkampspan)	25.9	0.0
BH 8 (HSPG; Steenkampspan)	95	0.0
H/BH 10 (HSPG; Duiker Rand)	164	0.0
Water demand for HSPG	**300**	**10**
Total demand on delineated catchment area in m^3/d	348.4	58.4
Total demand on delineated catchment area in m^3/a	127 166	21 316
Water for HSPG as % of total demand	86.1%	17.1%

A stand-by pump will be available to pump water. Power to the borehole pump will be supplied by solar panels.

Objectives of management of water abstraction:

- Only use required quantities of water from specified boreholes and monitor water quantities used.
- No wastage of water.
- Utilise four (4) boreholes during construction phase to prevent over-utilisation of one borehole.
- Minimise impact on surrounding water users.

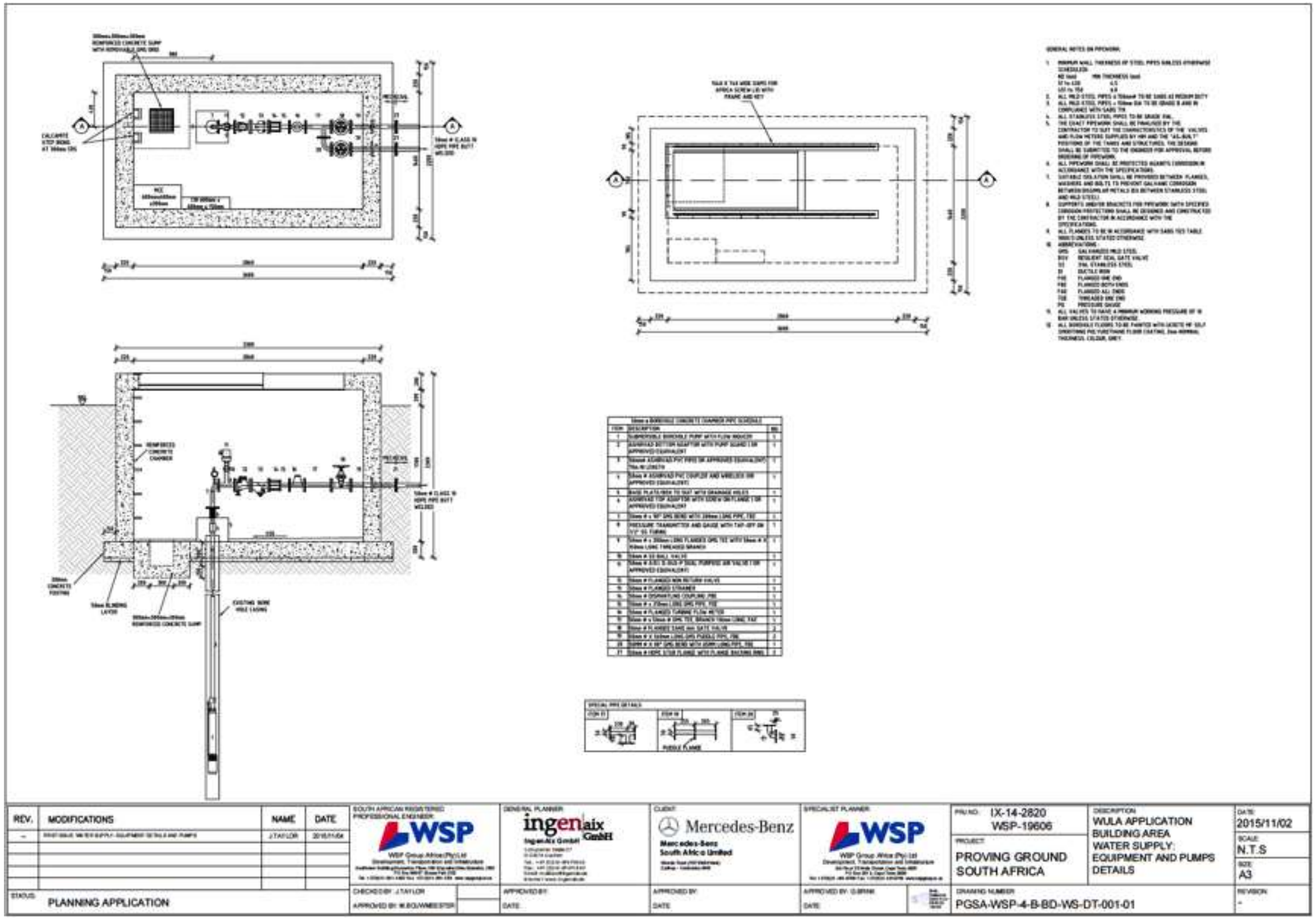


Figure 6-1: Water supply (WSP, 2015)

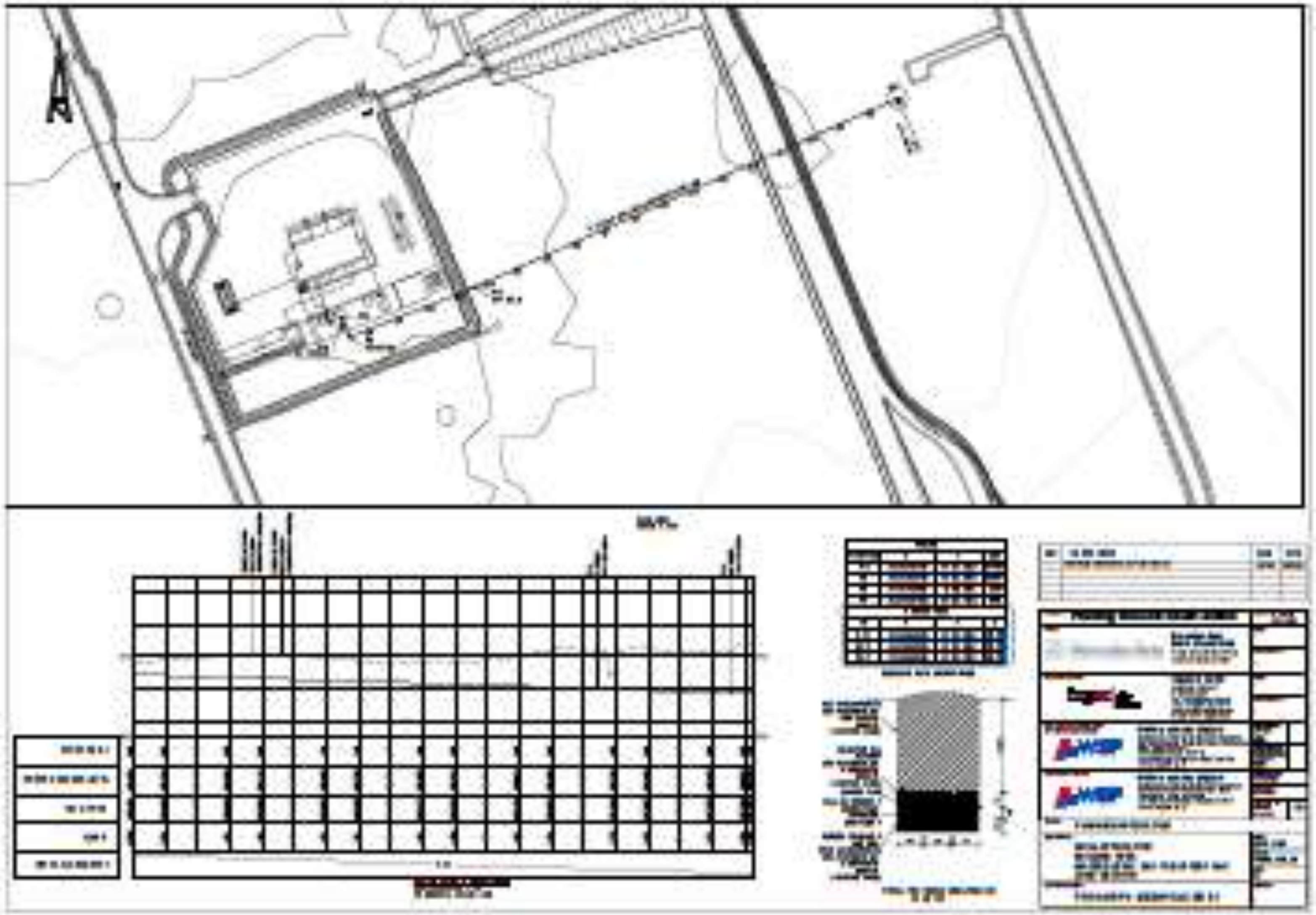


Figure 6-2: BH1 to buffer tank (WSP, 2015)

6.3.2 Water storage and use

Water will be transferred from the boreholes (water source) via a reservoir.

Water will be stored in a 150 m^3 Aquadam to ensure continuous availabiliy and for emergency purposes:

- 5.6 – 6.0 m^3 for livestock watering – drawoff at highest level
- 10 m^3 for project - drawoff at middle level
- 120 -135 m^3 for fire - drawoff at lowest level

Each user has its own take-off pipeline and isolating valve for control and isolation during maintenance.

Construction use:	Construction of pavement layer – major water use Concrete and installation of services foundation Sloping and vegetation Transfer from borehole via water bowser to construction area
Operational use:	Emergencies – fire fighting (hose reel) Sanitary - showers & toilets Kitchen – dish washing Car wash (15 cars/day) – high pressure cleaner
Emergency use:	Fire pumps are sized for 1.5 hour fire duration with a duty of 23.52l/s at 60m

Objective of management of water storage and distribution: Prevent water wastage through prevention of leakage/spillage from storage and conveyances.

6.3.3 Groundwater quantity management

- Abstract water at the recommended rates for each individual borehole only (refer to Table 6-2). The boreholes that are earmarked to be used for abstraction can easily deliver water according to the yields recommended in the specialist report.
- Do not over use one borehole by pumping one specific borehole at all times. None of the boreholes will therefore be individually over pumped. A very conservative approach was taken to calculate the final recommended yields. These recommended yields were further cut from 350 m^3/d to 300 m^3/d. The actual water demand for construction phase 1 is 276m^3/d and for construction phase 2 is 264m^3/d. For calculation purposes and to be conservative, a water demand for both construction phases of 300 m^3/d was used.
- Always use all four boreholes during construction.
- Use water scarcely and do not waste water.
- Monitoring:
  - Measure water levels in stipulated boreholes on a monthly basis (See Section 7). If water levels are declining constantly contact the hydrogeologist.
  - Take water samples at borehole BH 1 on an annual basis.
  - A groundwater monitoring report must be produced on a six monthly basis.

The aquifer can sustain the water abstraction during the construction phase of 22 months spread over 5 years and the project is therefore considered viable (Geologic, 2015).

During the operational phase of the project, the aquifer will have time to recover for the farm to be used as stock farming unit. The water demand during the operational phase will be very low compared to other farming units in the area. The farm Steenkampspan will be an area in which the aquifer can recover to be available in future (Geologic, 2015).

6.4 Management around Waste

Poor solid waste management practices can lead to contamination (soil, groundwater, runoff, air) and unsightly zones (aesthetic issue) as well as pests/vermin and associated health issues.

6.4.1 Construction phase

Waste types: Solid waste during the construction phase will include:

- Excess of spoil due to sloping and levelling – will be used to backfill the sand quarry from which material was mined.
- Vegetation removed due to ground clearance – biodegradable.
- Building rubble.
- Waste generated by workers – general domestic type waste such as paper, plastic, food containers etc.
- Hazardous waste due to spillage of oil and grease from construction vehicles or equipment.

Collection and storage: Construction waste (building rubble) and general domestic type waste (workers) will be collected in suitable containers (drums/skips/bins) on the site. The construction contractor will ensure sufficient containers are available for storage of waste prior to removal off site to prevent overflow and littering on the site and surroundings. No waste will be stored in excess of 30 days. Storage containers will be clearly marked (and/or colour coded) in terms of what waste can be stored in it.

Disposal: Waste will be removed from site for disposal at the Upington landfill/waste management facility (as per communication with Mr Godfrey Kuun at the municipality) by the applicant or its construction contractor on a regular basis (at least weekly or when skip is full). Refer to Appendix C on waste management.

No waste will be stored in excess of 30 days.

Although no special disposal methods are required (non-hazardous waste), non-biodegradable refuse such as glass bottles, plastic bags, etc. must be stored in suitable containers to allow for recycling and emptied on an as-required basis for recycling purposes during the construction and clean-up phase.

Furthermore, the construction contractor will ensure that no litter, refuse, waste, rubble and construction waste generated on the premises is placed, dumped or deposited on the property, or adjacent or surrounding properties during or after construction.

Litter patrols will be organised by the contractor.

The contractor will keep copies of all waste manifests / safe disposal certificates showing responsible handling and disposal by a reputable waste transporter.

Biodegradable waste (vegetation removed) can be sent to a composting facility.

No planned maintenance of vehicles or equipment will be conducted on site. Emergency maintenance will be undertaken using drip trays or absorbent mats. Spill kits will be kept on site in order to clean up any spills. If hydrocarbons are leaked or spilled, immediate clean-up and rehabilitation with a product developed for the purpose is required. Hydrocarbon spillages together with contaminated soil will be classified as hazardous waste and will be collected by EnviroServ for disposal at their registered H:H site in Gauteng (Holfontein). Due to the distance and associated cost, clean-up and rehabilitation kits that are environmentally friendly in that hydrocarbons can be recovered (recycling) and the remains biodegrade (no waste to be disposed) should be considered for small spillages (< 1 litre).

6.4.2 Operational phase

Used tyres are classified as used parts (not waste) and will be taken back to Germany.

Management of operational waste:
- All solid waste will be collected in suitable containers (drums/skips/bins) on site in the building area.
- Sufficient containers will be available for storage of waste prior to removal off site to prevent overflow and littering on the site and surroundings.
- Storage containers will be clearly marked (and/or colour coded) in terms of what waste can be stored in it.
- The separation of waste will be considered to allow for off-site recycling.
- Waste will not be stored on site for longer than 30 days.
- Waste will be removed from site by a contractor for disposal at the Upington waste management facility (general waste) or Holfontein (hazardous waste) on a regular basis (at least weekly or when skip is full).
- No litter, refuse or waste generated on the premises is allowed to be placed, dumped or deposited on this, adjacent or surrounding properties.
- No burning of waste.
- Safe disposal certificates showing responsible handling and disposal by a reputable waste transporter will be kept for five (5) years.

6.4.3 Objectives of waste management

- Collection and storage of waste on site.
- No littering or burning or disposal of waste on site.
- Waste separation to allow recycling and minimise quantities requiring disposal.
- Off-site removal of waste for disposal by registered contractor.
- Disposal to licensed waste disposal facility.

Table 6-3: Operational Waste Management

Waste type	Waste quantity (per month) – approximate volumes	Handling on site	Final destination (refer to Appendix C)
General domestic type waste:			
Paper	1.1 m^3	Collect in drum, skip or bin located in non-hazardous waste storage area in building area 28^0 11' 08.74" South 21^0 28' 28.89" East To allow for recycling waste types should be separated	Contractor (EnviroServ) will transport to "Die Duine" (Upington's waste management facility managed by the municipality) Permit: B33/2/442/1/P68 Class: 2
Foil	0.5 m^3		
Other (Glass; Plastic; Metal)	1.1 m^3		
Biodegradable type waste:			
Food waste from kitchen and apartments	Unknown	Collect in drum, skip or bin located in non-hazardous waste storage area in building area 28^0 11' 08.74" South 21^0 28' 28.89" East	Contractor (EnviroServ) will transport to "Die Duine" (Upington's waste management facility managed by the municipality) Permit: B33/2/442/1/P68 Class: 2
Hazardous type waste:			
Cleaning chemicals and Fluorescent light tubes	Small quantities	Hazardous waste diluted in general waste stream – see general waste	EnviroServ will collect for disposal to Holfontein – see letter from EnviroServ in Appendix C. Permit: B33/2/321/121/P3 Class: H:H
Cooling liquid	50 litres	Collect in labelled containers with lids located in hazardous waste storage area in building area. Containers will be chemical resistant in terms of the waste it needs to contain. 28^0 11' 07.64" South 21^0 28' 28.85" East	
Used oil	50 litres		
Freezing agent	1 kg		
Emulsions	50 litres		
Spray cans (cleaner)	10 kg		
Dirty cleaning towels	0.1 m^3		
Oily sludge from oil separator and absorbent material used for	Small quantities		

hydrocarbon spills			

6.5 Management around Wastewater

6.5.1 Construction phase

- Portable dry chemical toilets will be provided by the construction contractor for workers.
- Chemical toilets will be serviced as required to prevent overflows.
- Construction contractor will ensure that there are an appropriate number of portable dry chemical toilets on site (typically 1 toilet for 20 people).
- Contractor to provide suitable ablution facilities (washing and changing area) for construction workers.
- No builders/workers will be housed on the site.
- Ablutions outside the provided facilities are not to occur under any circumstances.

6.5.2 Operational phase

Table 6-4: Wastewater quantities (WSP, 2015)

Area	Assumption	Oil/Fuel Produced	Total (ml/day)
Car wash	30 Cars washed per day	3 ml/wash/car	90
Workshop	4 Cars serviced per day	2 ml/car/day	8
Fuel Station	30 Cars serviced per day	2 ml/car/day	60
Total			**158**

Table 6-5: Operational wastewater management

Origin (see Table 5.2 for potential pollution sources)	Concern	Handling on-site
Workshop (28^0 11' 07.75" South; 21^0 28' 28.00" East) Car wash (28^0 11' 09.35" South; 21^0 28' 27.17" East) Fuel station of 216m^2 (28^0 11' 08.70" South; 21^0 28' 25.72" East)	Hydrocarbon contamination (fuel – diesel or petrol; oil and grease) resulting from spillages, leakages, floor washing in workshop, car washing, refueling.	Diverted to an oil separator (28^0 11' 27.77" South; 21^0 28' 25.72" East) for separation of oil (overflow) and water (underflow). Overflow to solid waste stream (see Table 6.3). Underflow to conservancy tank (see below).
Wastewater produced as a result of water consumption • Sewage from toilets • Wastewater from showers	Nitrogen compounds (nitrite, nitrate, ammonia) Bacteriological (E.coli)	Captured and contained in a conservancy tank of 70m^3 located at the building area (28^0 11' 08.80" South; 21^0 28' 29.25" East). Emptied every 10 – 14 days by honey sucker for off-site disposal at the municipal wastewater treatment works (WWTW) – see Appendix C.

Oil separator:

The following areas due to their potential hydrocarbon contamination risk will drain to the oil separator:

- Car wash (28^0 11’ 09.35” South; 21^0 28’ 27.17” East)
- Workshop (28^0 11’ 07.75” South; 21^0 28’ 28.00” East)

Location: 28^0 11’ 27.77” South
21^0 28’ 25.72” East

Capacity: 0.0705 m^3 for 158 ml/day @ 1.5litres/second

The oil from the oil separator will be emptied every 10 days and waste hydrocarbons will be removed off site for recycling or disposal to Holfontein by EnviroServ (see hazardous waste management in Table 6.3)

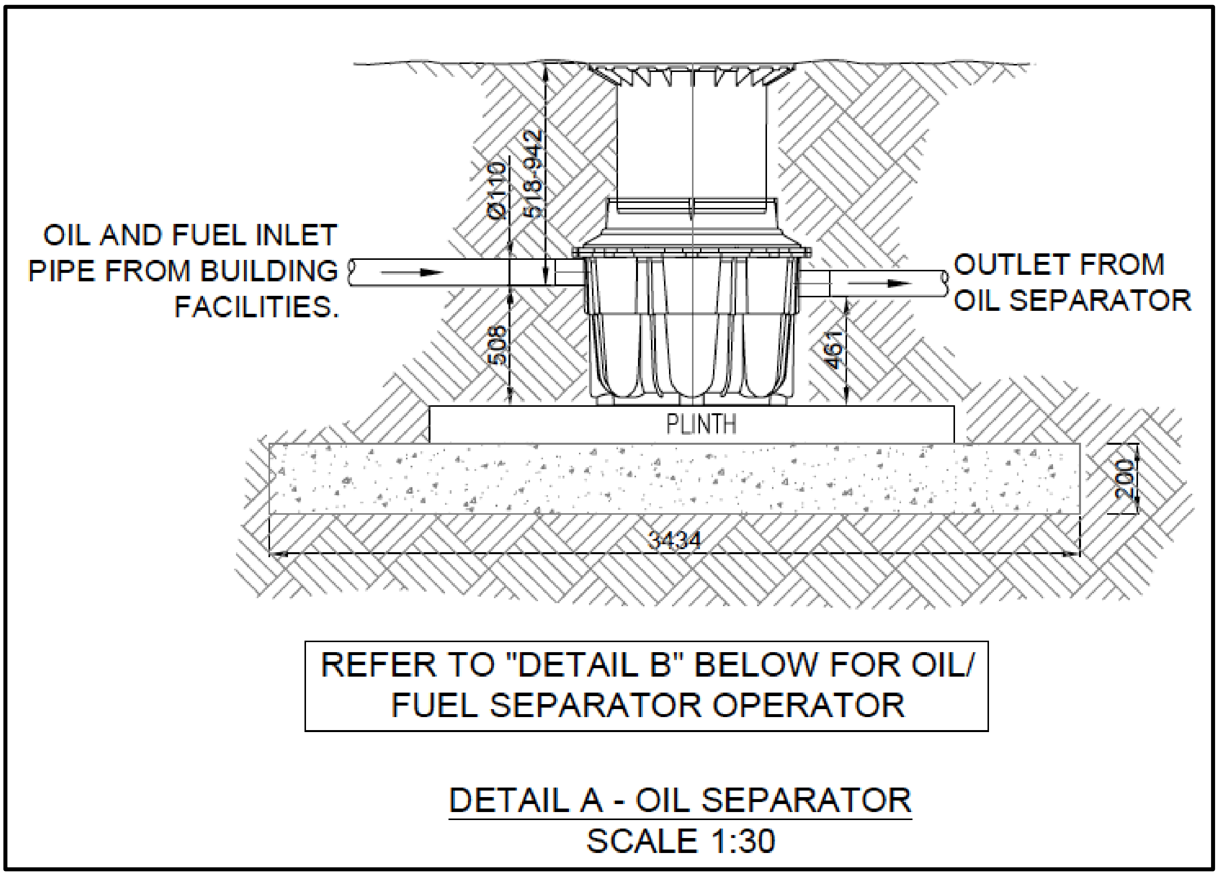
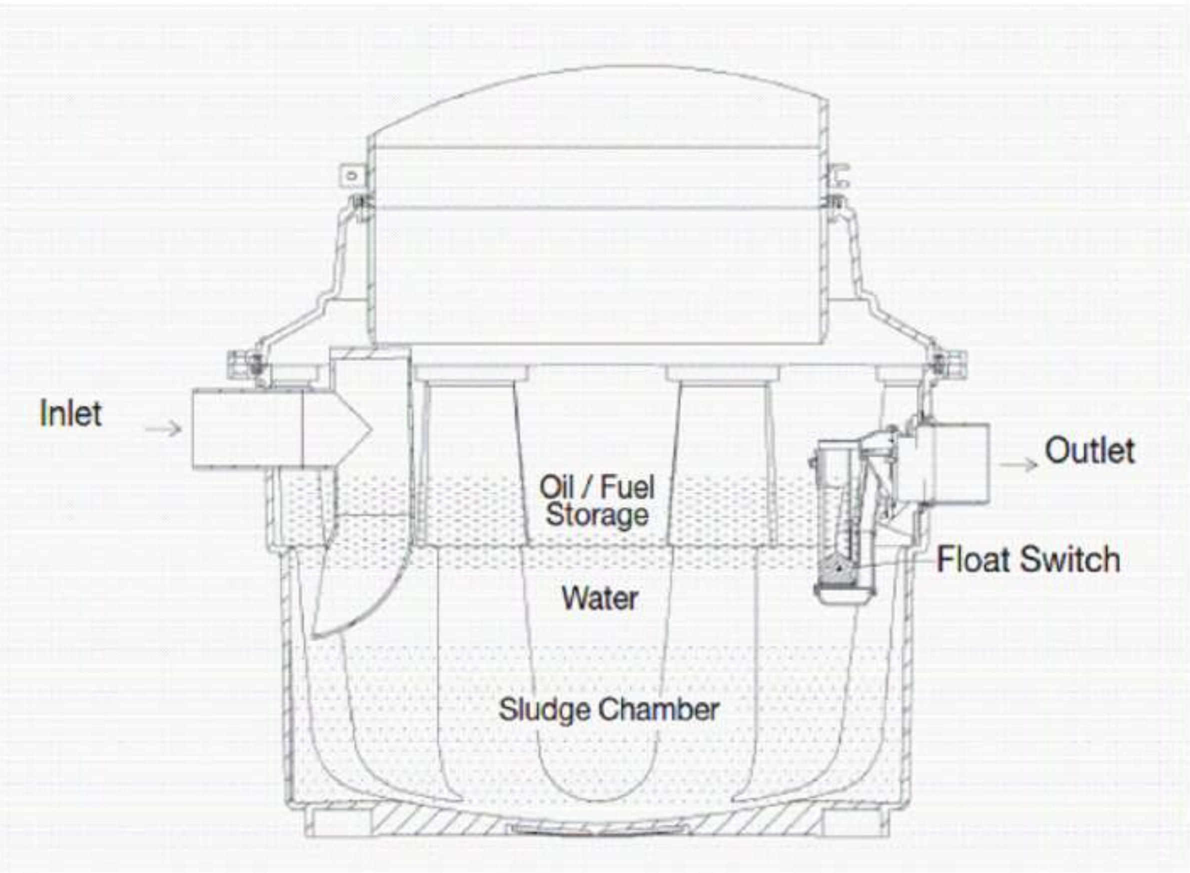


Figure 6-3: Oil separator – detail A (WSP, 2015)



DETAIL B - DIAGRAMMATIC ILLUSTRATION OF OIL/ FUEL SEPARATOR OPERATIONAL PHILOSOPHY
N.T.S

Figure 6-4: Oil separator – detail B (WSP, 2015)

Conservancy tank:

Sewage at entrance:	Guard house Dry chemical toilet Emptied every 2 – 3 weeks

Wastewater from the buildings will be handled in a conservancy tank.

Location:	28^0 11’ 08.80” South 21^0 28’ 29.25” East Underground (3m below ground level)
Capacity:	70 m^3
Dimensions:	7 m X 3 m X 1.7 m (two duplicate tanks to allow for maintenance)

Design was based on:

- SANS 10160-2:2011 - Basis of structural design and actions for building and industrial structures - Part 2: Self-weight and imposed loads.
- SABS 0100-1:2000 - Structural use of concrete - Part 1: Design

The following will drain into the conservancy tank:

- Underflow from oil separator (conservancy tank allows for 3 m^3 water from oil separator);
- Kitchen wastewater;
- Shower wastewater; and
- Toilets.

Prior to the conservancy tank, there will be an interconnecting manhole along with sluice gates for control of inflow to the conservancy tank. The conservancy tank will be constructed with in-situ concrete and consist of two (2) separate sections which will aid maintenance. On each tank two (2) access manhole shafts are proposed. The size of the sections is 3 m x 10 m while the depth is 1.9 m. There will be a 150mm wide overflow weir between the two sections.

The conservancy tank will be emptied by honeysucker (from drawoff valve) every 10 – 14 days for off-site disposal to Upington Wastewater Treatment Plant (WWTP) - Mr Boetie van Tonder 076 967 7171. See communication in Appendix C.

One side can be closed off to allow cleaning and/or maintenance.

6.5.3 Objectives of wastewater management

- Capturing and containment of wastewater not suitable for release to the environment to prevent environmental impacts.
- Structural integrity of containment structures to prevent overflows, leakages and spillages.
- Off-site recycling or disposal of wastewaters that pose an environmental risk.

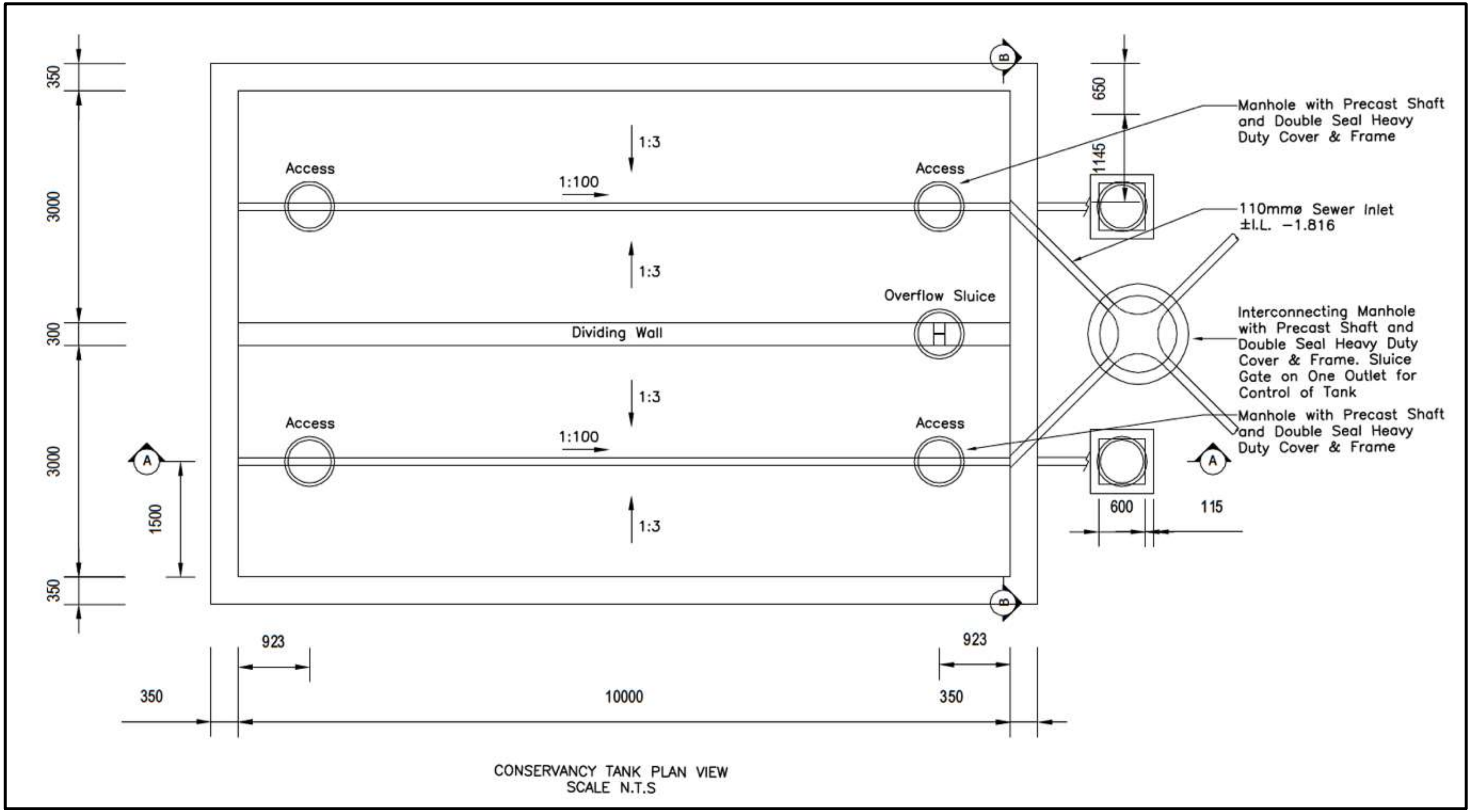


Figure 6-5: Conservancy tank – plan view (WSP, 2015)

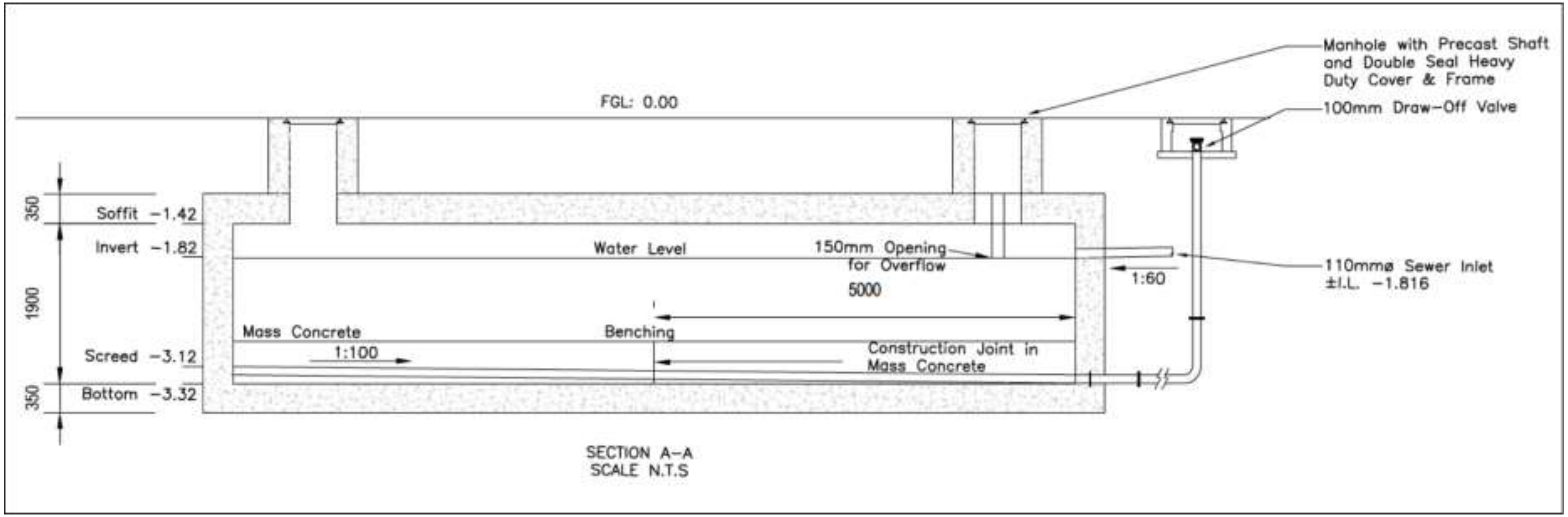


Figure 6-6: Conservancy tank – Section A-A (WSP, 2015)

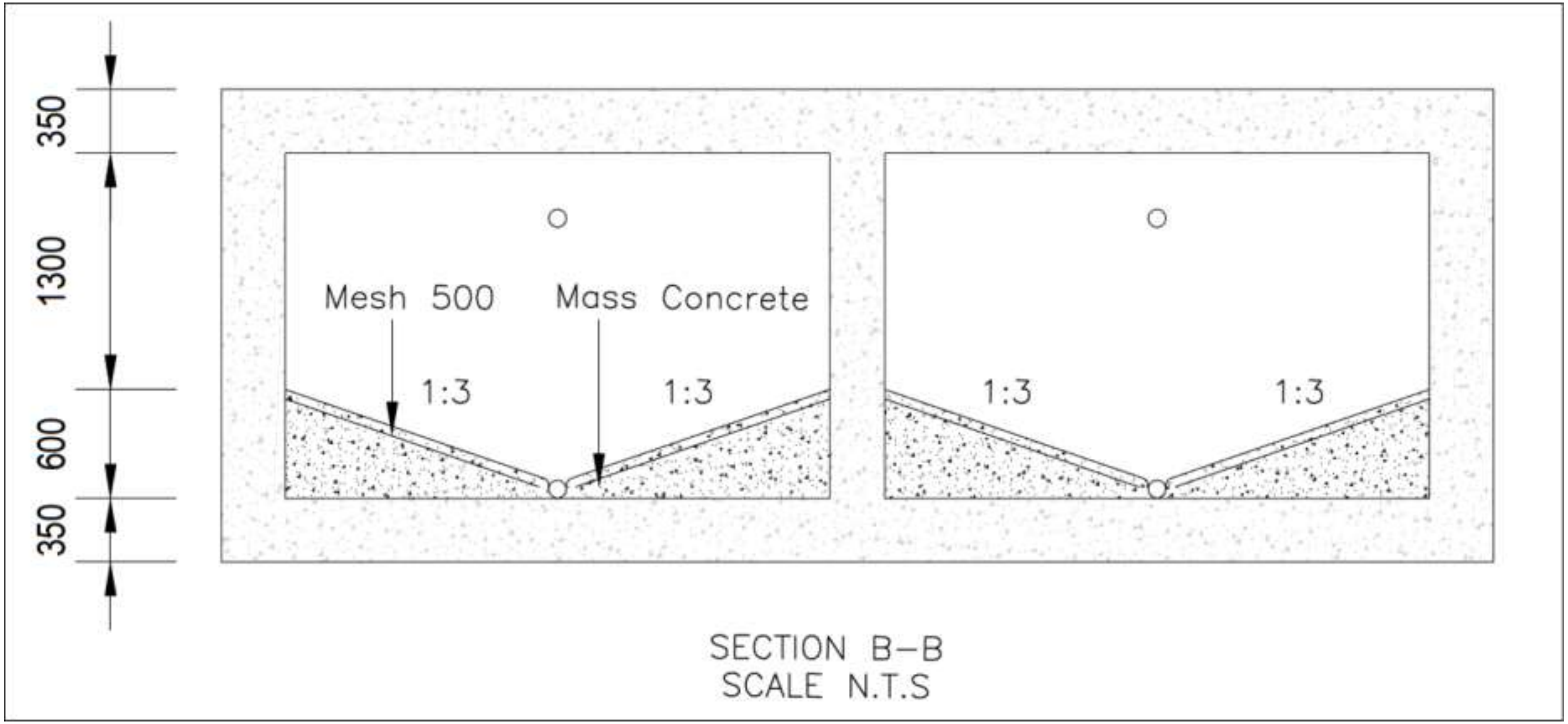


Figure 6-7: Conservancy tank – Section B-B (WSP, 2015)

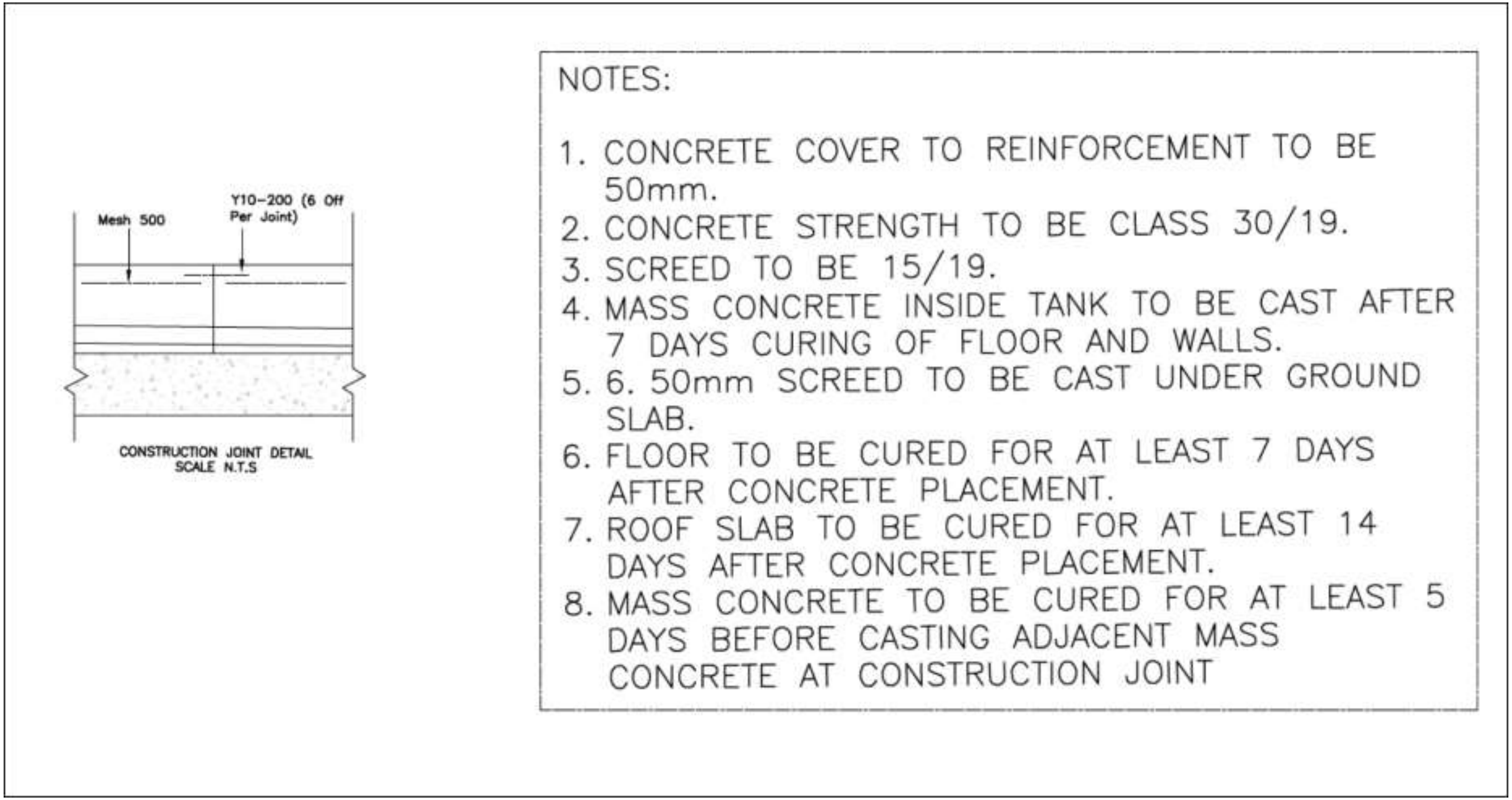


Figure 6-8: Conservancy tank – Connection details (WSP, 2015)

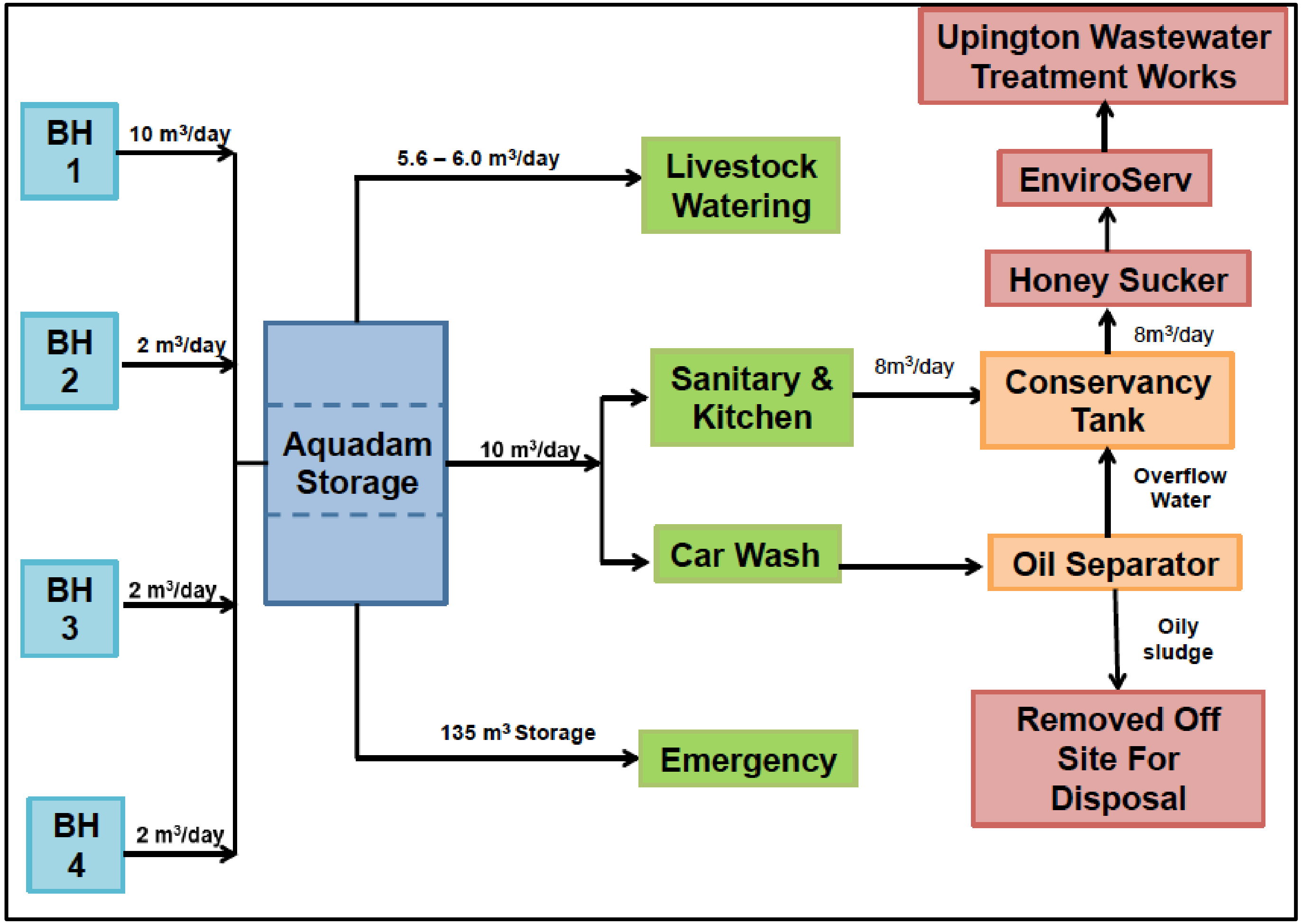


Figure 6-9: Water balance schematic

6.6 Management around Fuel Station

Location: 28^0 11’ 08.70” South
21^0 28’ 25.72” East

The design of the Transtank unit includes ‘self-bunding’ and therefore no external bund needs to be constructed. This allows the Transtank unit to be easily relocated and stored (security) when the facilities are not used. Also refer to Appendix D on installation, operation and maintenance for T10 Transtank.

The fuel station has 4 x 10.25 litre tanks.

The transtank system has the following characteristics:

- Construction material:
  - COR-TEN® (350mpa) steel - corrosion resistant
  - Marine grade polyurethane paint - white
- Dimensions: 5.743 m (length) X 2.262 m (width) X 1.256 m (height)
- Tare weight: 4.4 ton
- Air breather vents and fitting with dust filter
- Design and manufacture standards: Australian AS1940 & AS1692
- Filling and monitoring:
  - Inspection Plate
  - Safe fill level: 10.35 m^3
  - Fill point: 80 mm diameter
  - Fluid level dipstick
- Safety and movement
  - Forklift pocket
  - Front lockable pump cabinet
  - Crane lifting lugs
  - Statutory signage
- Management measures to prevent overflow/spillages:
  - Self-contained (bunded or double wall) design
  - Containment compartment (internal bunding) with pressure vent
  - Top mounted lockable spill containment box with tank fill / dipstick point and interstitial space dip point
  - Fill point spill catchment trough

Figure 6-10: Transtank (http://www.transtank.com/product/transtak-t10)

Figure 6-11: Transtank example of application in South Africa (Toyota)

6.7 Management around Fuel Storage

Diesel storage: 3 tanks of 20 m^3 each
Total of 60 m^3
Bunded area
Location: 28^0 11' 08.26" South; 21^0 28' 30.46" East

Petrol storage: 4 tanks of 10.35 litre each
Total 41.4 litres
See fuel station

All fuel storage (for generator and fuel station) would be above ground. This way spillages, leaks, overflows would be highly visible to allow for fast action and clean-up. Fuel storage containers will be double-walled to prevent leakages.

6.8 Material sourcing areas

Two (2) areas will be used to source material, the borrow pit and quarry.

Name	Material sourced	Coordinates
Borrow pit	Calcrete	28^0 13' 22.8505" South
		21^0 29' 27.5772" East
Quarry	Granite	28^0 11' 29.1741" South
		21^0 28' 45.6157" East

Due to the depth of sourcing versus the groundwater depth, there is no risk for groundwater contamination and therefore no mitigation measures have been included.

6.9 Storm water management

6.9.1 Objectives

The key objectives of the storm water management plan (SWMP) are to define infrastructure and management measures to:

- Ensure compatibility of the site with relevant legislation from a surface water perspective.
- Manage the increase (0.55m^3/s) in concentrated flows to prevent downstream erosion. Gabion mattresses will be applied along the toe line of the road fill embankments at localised areas and on the outlet side of drainage structures for erosion protection.
- Delineate the pre-development and post development catchment areas affecting the site.

6.9.2 Legislation

The surface water management for the project, and related infrastructure, falls under legislation contained in, amongst other, the NWA. Section 4 of the NWA deals with the prevention of contamination and it states "the person who controls, occupies or uses the land in question is responsible for taking measures to prevent pollution of water resources."

This can be broadly summarised as follows:

- Separation of "clean" and "dirty" water;
- Water contaminated by activities / infrastructure may not be discharged to surface or groundwater resources; and
- Prevention of erosion.

"**Clean**": Catchment designated as "clean" imply that any runoff from this area can be discharged to the natural environment.

"**Dirty**": Implies any area or activity which causes, has caused, or is likely to cause pollution of a water resource.

6.9.3 Summary

The SWMP is discussed in the WSP Parsons Brinckerhoff report titled Drainage and Geometyric Detail Design. Report number 19606-01 of November 2015. The report covers the detail design of the stormwater drainage requirements of the HSPG facility, primarily the "outer system" of the HSPG. Outer system refers to water run-off that enters from catchment areas outside the facility. The water follows the natural topography and is managed through crossing culverts or in channels alongside the new constructions. This drainage system also caters for the Inner System (run-off from all the internal hard surface) provided by IngenAix.

Based on the WSP Drainage and Geometyric Detail Design Report, the following should be noted:

- Clean and natural runoff from upgradient catchment areas flowing towards the HSPG is diverted around structures to prevent any possible contamination. Flows deviated around the activities (HSPG) will return to its natural flow path further down gradient.
- For the purposes of the project, the potential "dirty water" is defined as water that might be contaminated in the case of an accidental spillage/leakage from the Building Area, and measures have been put in place to be able to handle water. No dirty runoff is anticipated because rain will not be in contact with potential pollution sources due to the following:
  - Fuel station where fuel may be spilled is roofed and bunded.
  - Diesel storage area where diesel may be spilled is bunded and therefore any rain water falling onto this area will be contained within the bund and evaporate.
  - Waste areas, car wash and workshop are all within buildings or roofed.
  - Fuel barrels will be stored in the oil storage room in bunded area attached to the workshop in the building area.
- The dirty water circuit therefore only includes:
  - Water from the workshop due to hydrocarbon spillages and floor washing. Water from the car wash due to the use of water and detergents for washing cars. The water from these areas will be captured and diverted through an oil separator before entering the conservancy tank (capture and contain).
  - Water from the showers and toilets that will be captured in the conservancy tank for off-site disposal to the Upington WWTW.
- Hydrology calculations do not take into consideration the permeability between different materials at various depths. Less permeability and increased percentages were included to reflect hardstand runoff and possible exposed calcrete sections. Therefore an increase in runoff, post-development was found to be 0.55m^3/s.
- All soil structures are going to be earth structures (mixture of sand and calcrete) which will minimise the movement of structures. Maintenance has also been provided for.
- A storm water management system should be designed for a specific flood event, commonly referred to as the "Design flood" (QD). The minimum design life of the structure is determined by the choice of QD. For this project, a 50 year return period was specified to cater for a longer design life and reduced risk of possible damage and impact and disruption of natural watercourses. Run-off and peak flow rates were calculated according to the selected return period and outflow points. The 1:50 recurrence intervals were therefore used for the major system design.

- The Rational method was used to determine the storm peak flows (in use in South Africa for at least 60 years). This method meets the requirements of consistency and robustness, and there is little justification for the development of competitive methods other than special applications.
- Flood peaks for this method was calculated using the University of Pretoria's Utility Drainage Program version 1.1.0 Software. This computer version has been successfully used in South Africa for more than a decade.
- **Construction:** Embankments and/or diversion drains will be established around excavation areas and stockpiles to divert surface runoff away from these areas to avoid water pollution. Stagnant water must not be allowed in the borrow pit or quarry area during the construction phase. Contaminated water must be pumped out and treated before re-used for construction purposes.

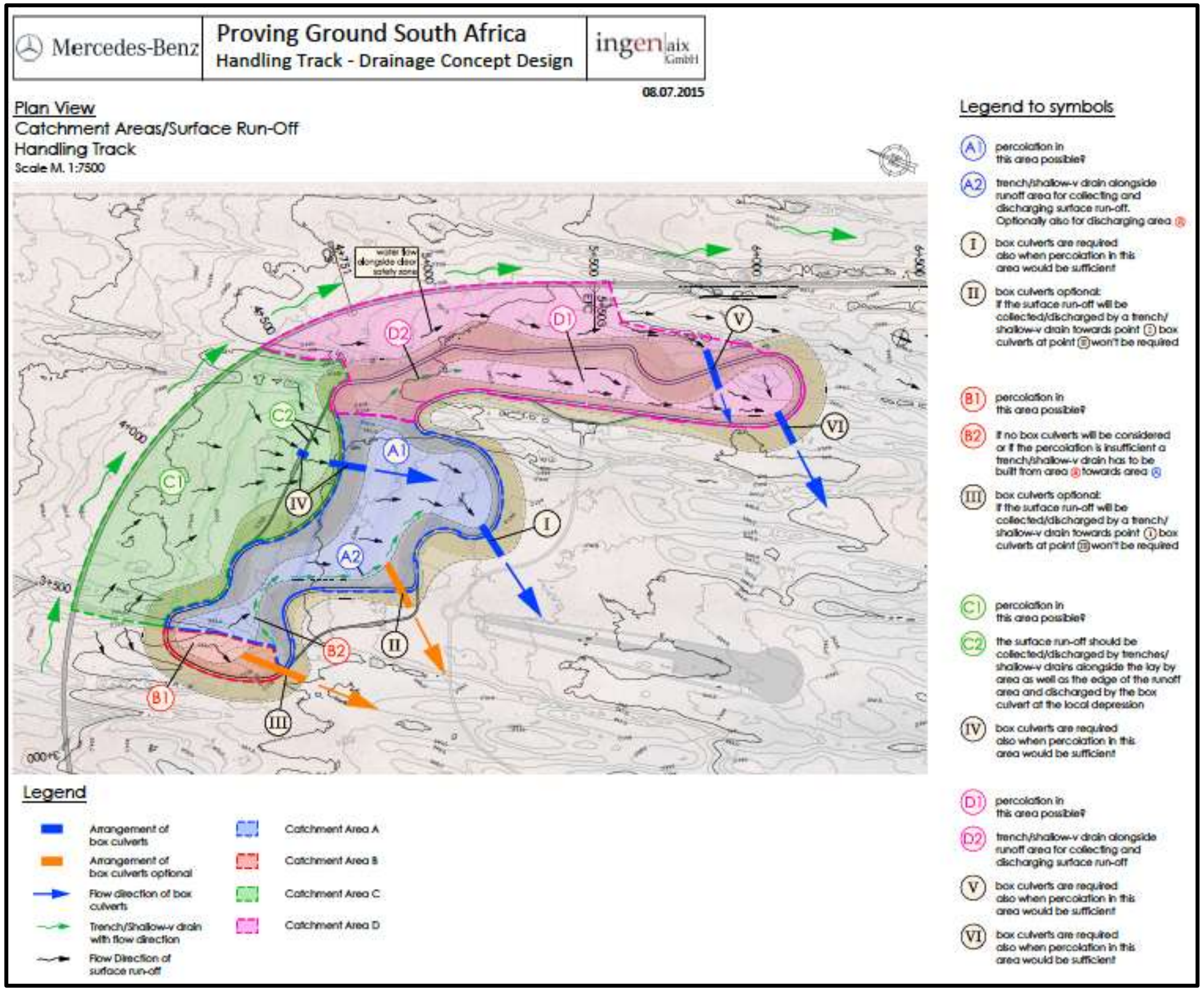


Figure 6-12: Handling track – catchment areas and surface runoff drainage (IngenAix, 2015)

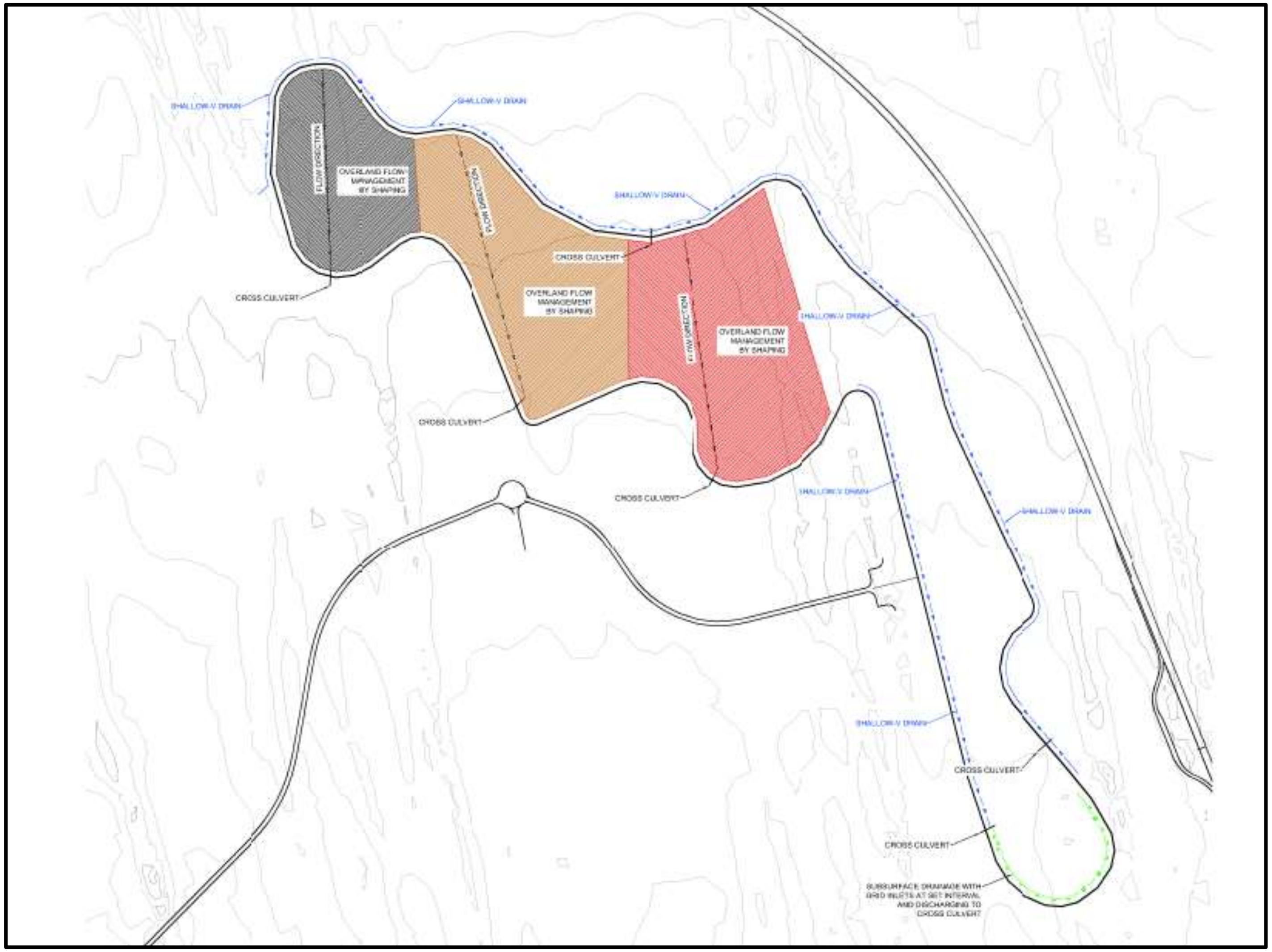


Figure 6-13: Handling track – drainage concept (WSP, 2015)

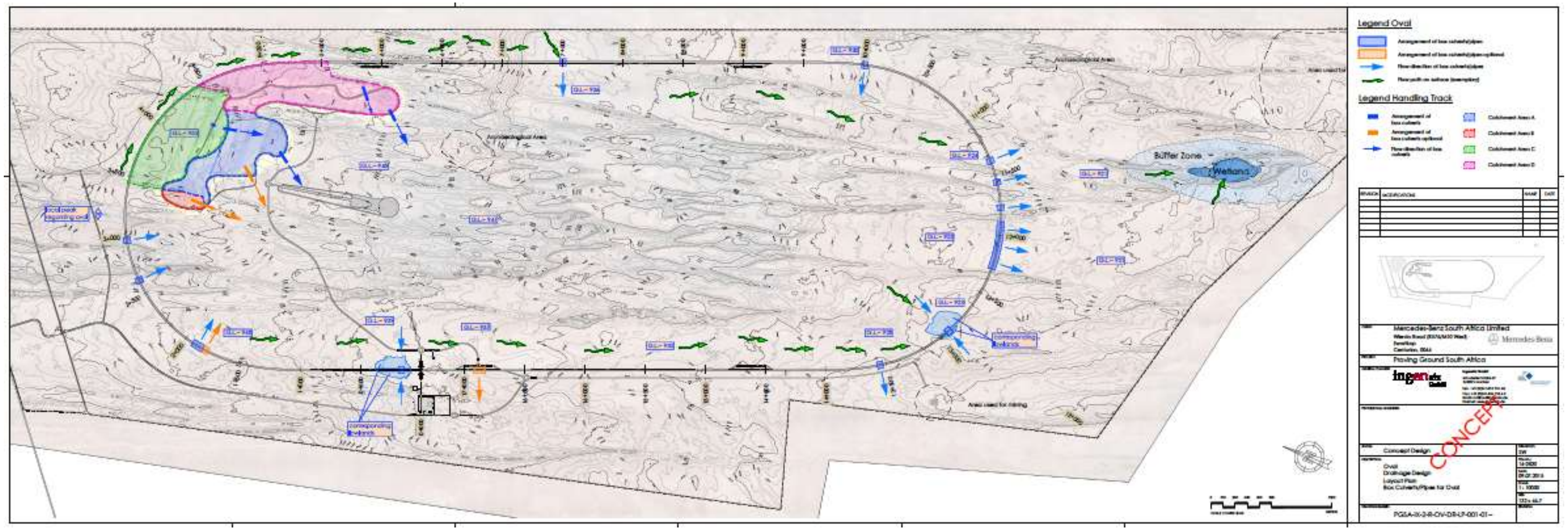


Figure 6-14: Oval drainage (IngenAix, 2015)

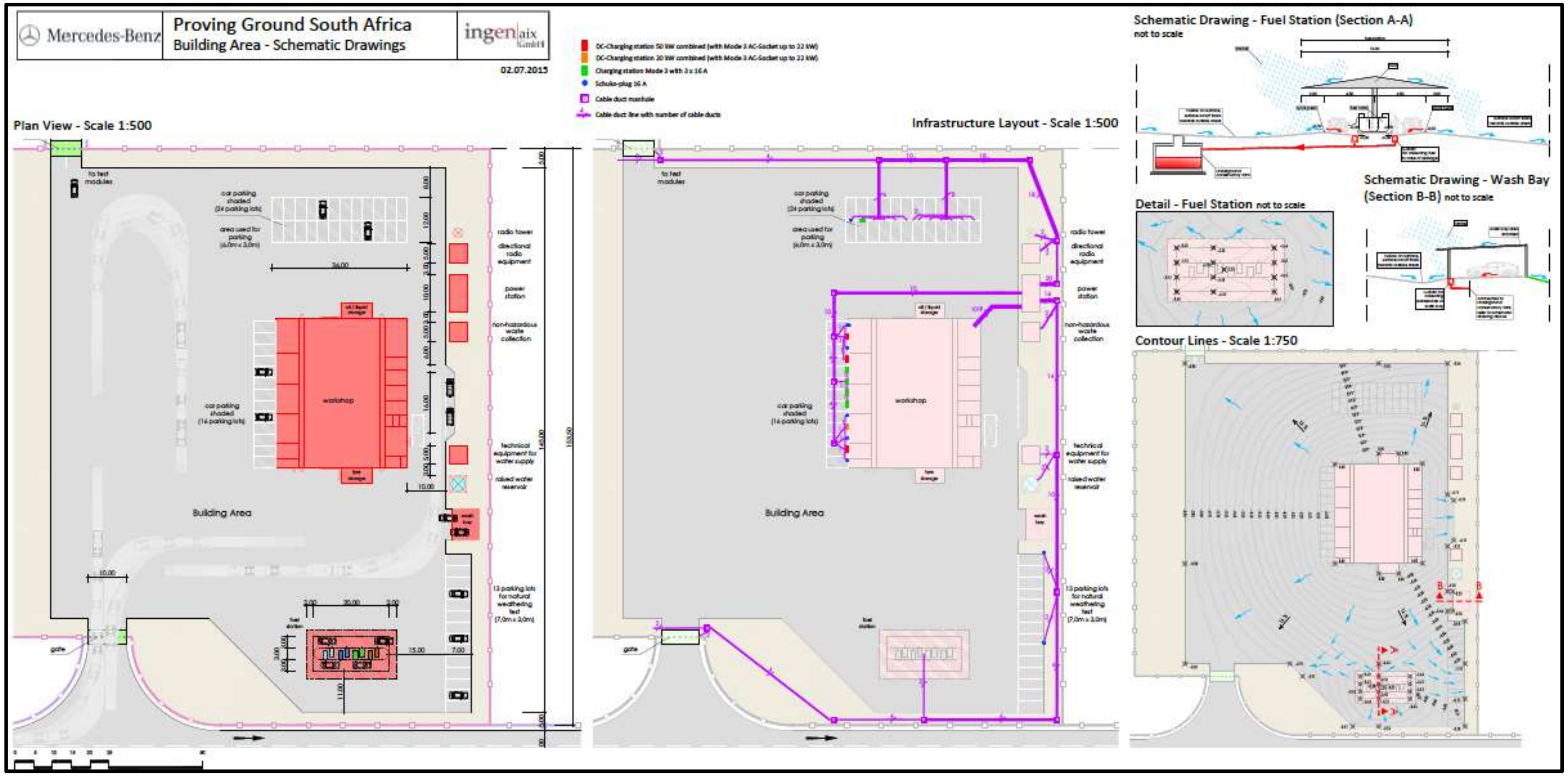


Figure 6-15: Building area drainage (IngenAix, 2015)

6.9.4 Storm water quantities

Pre-development discharge: 122.97 m^3/s
Post development discharge: 123.52 m^3/s

The following information was used in the modelling of storm water volumes:

- Area: Rural
- Slope: 100% Flat
- Permeability: 95% permeable
- Cover: 95% Bare & 5% light bush
- Rainfall: 176mm

Table 6-6 indicates the results from the modelling (rationale method).

Table 6-6: Storm water quantities used for design (WSP results summarised)

Catchment:	Area (km^2):	Longest course (km):	Height difference (m)	Peakflow (m^3/s) for 1:50 year event
Pre-development				
1	47.19	19.61	90	59.31
2	41.552	12.68	88	73.19
3	9.966	5.42	22	20.01
4	98.703	19.61	90	122.97
Post development				
1	11.4	9.89	74.6	20.58
2	0.2	1.35	7.1	0.678
3	36.2	13.81	60.2	51.53
4	21.68	13.08	88	34.29
5	9.97	5.42	22	20.02
6	18.36	8.48	45	32.98
7	79.38	22.51	90	98.35
8	97	22.51	90	120.84
9	1.95	4.08	29	2.678
Oval & buildings				
1	0.992	3.7	30	2.769
2	1.015	4.08	29	2.678
3	0.023	0.31	2	0.131
4	13.4	6.7	35	25.99
5	9.3	4.59	35.3	22.17
6	8	5.95	63.8	20.40
7	11.4	9.89	74.6	20.58
8	0.2	1.35	7.1	0.678
9	36.2	13.81	60.2	51.53
10	0.201	0.79	7.2	0.961
Access roads				
1	0.084	0.6	9.8	0.426
2	0.009	0.2	3.5	0.060
3	0.028	0.2	2.2	0.189
4	0.305	1.3	9.8	1.185
5	0.029	0.3	5.6	0.177
6	0.004	0.1	3.7	0.032
7	0.009	0.1	2.1	0.069

Catchment:	Area (km^2):	Longest course (km):	Height difference (m)	Peakflow (m^3/s) for 1:50 year event
8	0.003	0.08	3.4	0.025
9	0.778	1.83	11.2	2.703
Handling track				
1	0.064	0.51	6.3	0.360
2	0.309	0.95	7.7	1.376
3	0.039	0.32	2.6	0.234
4	0.348	1.07	8.1	1.480
5	0.083	0.84	6.6	0.382
6	0.05	0.37	3.0	0.289
7	0.132	1.1	7.8	0.551
8	0.27	1.11	8.5	1.138
9	0.618	1.6	10.6	2.271
10	0.035	0.37	1.3	0.181
11	0.018	0.35	1.5	0.097
12	0.107	0.61	5.7	0.552
13	0.029	0.42	4.0	0.166
14	0.223	1.3	6.2	0.831
15	0.04	0.21	2.5	0.278
16	0.229	1.0	4.8	0.928
17	0.269	1.0	4.8	1.090
18	0.044	5.1	5.1	0.212

6.9.5 Channel detail (WSP, 2015)

The project will lead to an increase in impermeable surfaces, i.e. buildings, roofs, roads etc. An increase in such impermeable surfaces minimises the surface area available for infiltration and prevents the effective infiltration of precipitation into the soils and therefore leads to an increase in surface water flow volumes to be managed as well as the velocity at which it flows.

Side channels are specified in catchment areas for two scenarios:
- Along the roadway when in cut; and
- To redirect natural water flow away from the toe line of the pavement structure to the nearest culvert.

Earth lined trapezoid channels are specified for this project area to limit the amount of disturbance to the natural environment. As velocities are extremely low, the channels will not be susceptible to erosion. However, due to the loose sand and rolling dunes, regular maintenance will be required to keep the channels clear of vegetation. Energy dissipaters will be considered where necessary and where high velocity is anticipated.

HSPG: The high-speed oval, handling track and MFA will be constructed with one-sided inclination to allow drainage from the road surface.

Bad road: Will be a dirt road allowing rain water infiltration.

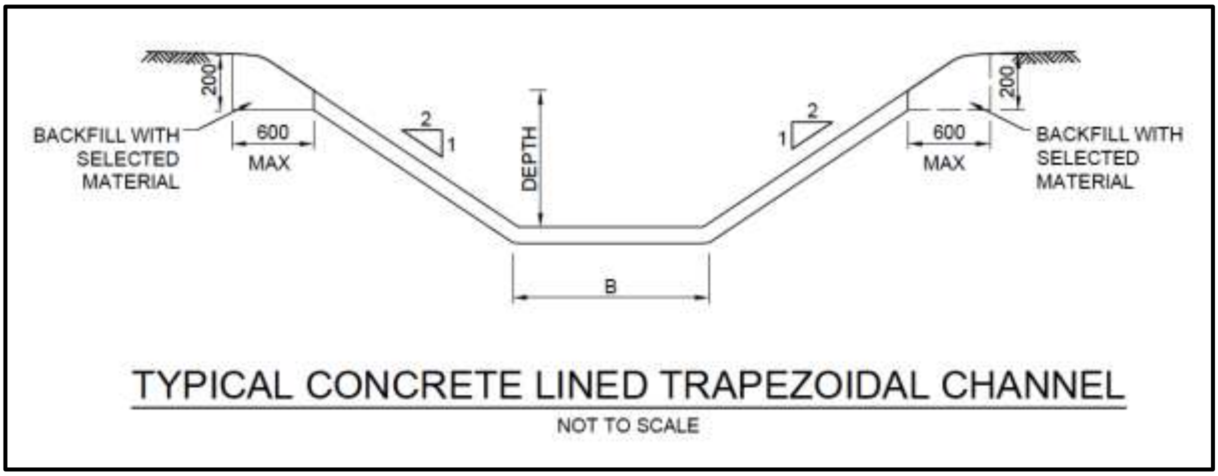


Figure 6-16: Typical concrete trapezoidal channel (WSP, 2015)

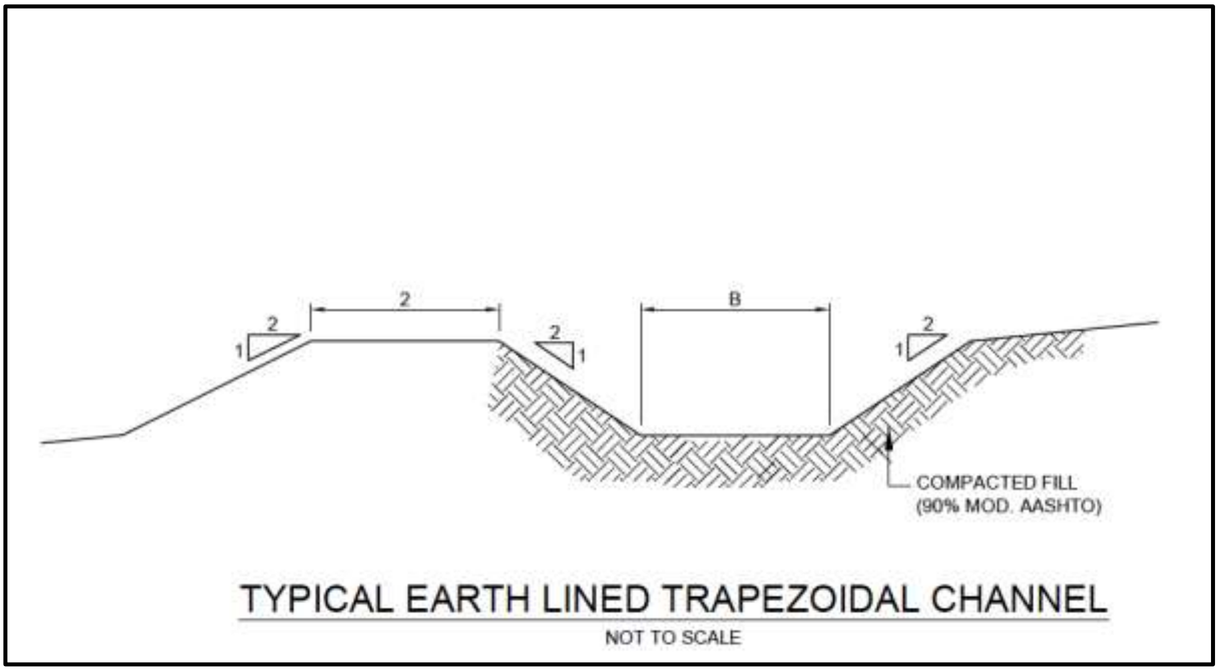


Figure 6-17: Typical earth-lined trapeziodal channel (WSP, 2015)

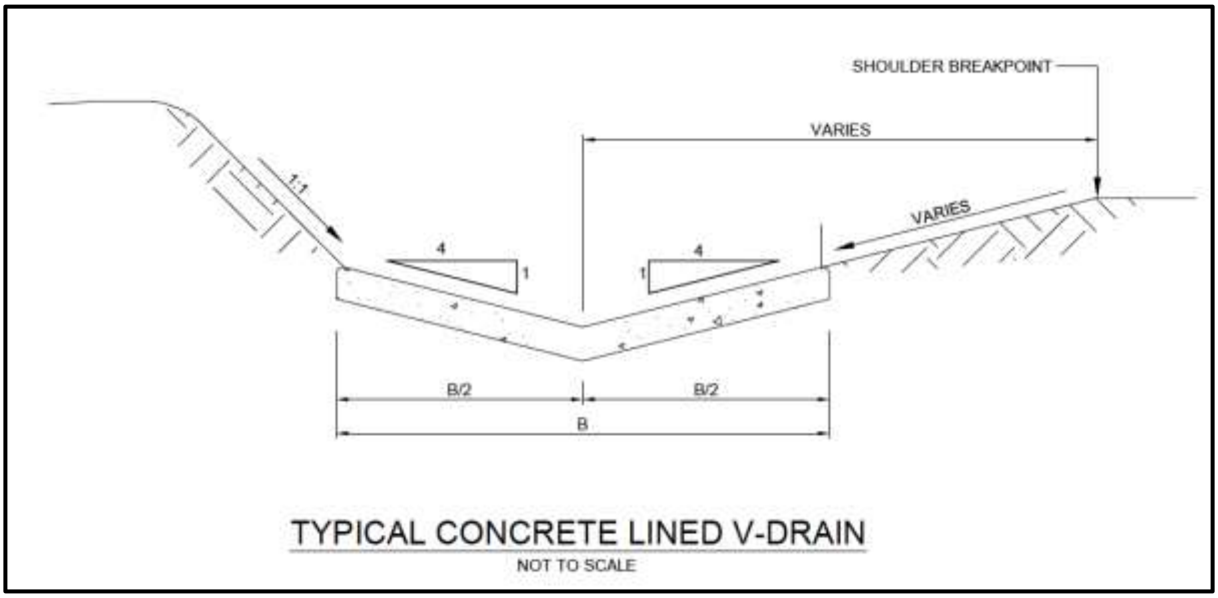


Figure 6-18: Typical concrete lined V-drain (WSP, 2015)

Table 6-7: Channel detail (WSP information summarised)

OVAL CHANNELS						
OV-CHANNEL	GPS POINT		LENGTH (m)	TOP WIDTH (m)	HEIGHT (m)	FLOW RATE CAPACITY (m^3/s)
	Start	End				
OV-CH-01	S28° 10' 13.18" E21° 28' 16.83"	S28° 11' 04.32" E21° 28' 28.72"	1617,6	7,0	1,0	30,2
OV-CH-02	S28° 10' 11.19" E21° 28' 17.63"	S28° 10' 31.33" E21° 28' 22.82"	639,5	7,0	1,0	28,7
OV-CH-03	S28° 09' 29.26" E21° 29' 05.32"	S28° 09' 42.07" E21° 28' 29.55"	1085,4	7,0	1,0	23,8
OV-CH-04	S28° 09' 30.00" E21° 29' 02.79"	S28° 09' 42.62" E21° 28' 30.16"	997,3	7,0	1,0	21,9
OV-CH-05	S28° 09' 30.00" E21° 29' 02.79"	S28° 10' 56.58" E21° 30' 14.35"	3551,9	7,0	1,0	27,1
OV-CH-06	S28° 09' 31.91" E21° 29' 19.86"	S28° 09' 36.57" E21° 29' 29.85"	308,9	7,0	1,0	18,1
OV-CH-07	S28° 09' 50.36" E21° 29' 44.14"	S28° 10' 55.98" E21° 30' 15.13"	2190,6	7,0	1,0	29,4
OV-CH-08	S28° 11' 34.14" E21° 30' 31.63"	S28° 12' 25.60" E21° 30' 53.56"	1710,6	7,0	1,0	22,9
OV-CH-09	S28° 11' 34.21" E21° 30' 32.42"	S28° 11' 50.64" E21° 30' 39.92"	545,6	7,0	1,0	22,9
OV-CH-10	S28° 12' 11.49" E21° 30' 49.42"	S28° 12' 19.14" E21° 30' 52.46"	249,6	7,0	1,0	18,1
OV-CH-11	S28° 12' 46.82" E21° 30' 51.91"	S28° 12' 48.55" E21° 30' 51.19"	56,6	7,0	1,0	22,9
OV-CH-12	S28° 12' 53.32" E21° 30' 48.61"	S28° 12' 53.97" E21° 30' 48.19"	23,0	7,0	1,0	21,5
OV-CH-13	S28° 13' 04.45" E21° 30' 38.24"	S28° 13' 05.14" E21° 30' 37.29"	33,6	7,0	1,0	18,1
OV-CH-14	S28° 13' 07.68" E21° 30' 33.29"	S28° 13' 09.26" E21° 30' 30.25"	96,0	7,0	1,0	15,9
OV-CH-15	S28° 13' 11.26" E21° 30' 25.31"	S28° 13' 10.87" E21° 30' 26.40"	32,0	7,0	1,0	13,9

OV-CH-16	S28° 13' 11.82" E21° 30' 25.64"	S28° 13' 11.51" E21° 30' 26.52"	25,7	7,0	1,0	20,5
OV-CH-17	S28° 12' 58.43" E21° 29' 32.65"	S28° 13' 14.03" E21° 30' 09.22"	1146,6	7,0	1,0	15,0
OV-CH-18	S28° 13' 14.63" E21° 30' 07.30"	S28° 13' 14.65" E21° 30' 09.13"	49,9	7,0	1,0	12,8
OV-CH-19	S28° 12' 08.52" E21° 29' 07.21"	S28° 12' 37.73" E21° 29' 20.56"	985,7	7,0	1,0	22,5
OV-CH-20	S28° 12' 20.18" E21° 29' 11.76"	S28° 12' 27.26" E21° 29' 15.00"	235,2	7,0	1,0	22,9
OV-CH-21	S28° 11' 17.20" E21° 28' 46.64"	S28° 11' 37.06" E21° 28' 52.82"	666,1	7,0	1,0	21,9
OV-CH-22	S28° 11' 18.73" E21° 28' 43.69"	S28° 11' 36.68" E21° 28' 51.89"	596,2	7,0	1,0	25,9
OV-CH-23	S28° 11' 02.36" E21° 28' 36.97"	S28° 11' 13.65" E21° 28' 43.60"	398,0	7,0	1,0	29,4
OV-CH-24	S28° 11' 02.64" E21° 28' 36.32"	S28° 11' 10.68" E21° 28' 39.99"	266,8	7,0	1,0	28,7

HANDLING TRACK CHANNELS						
HT-CHANNEL	**GPS POINTS**		**LENGTH (m)**	**TOP WIDTH (m)**	**HEIGHT (m)**	**FLOW RATE CAPACITY (m^3/s)**
	Start	**End**				
HT-CH-01	S28° 09' 55.68" E21° 29' 30.61"	S28° 10' 25.04" E21° 29' 40.65"	975,4	3,75	1,0	11,0
HT-CH-02	S28° 09' 52.97" E21° 29' 28.76"	S28° 10' 23.98" E21° 29' 44.00"	1169,4	3,75	1,0	9,9
HT-CH-03	S28° 09' 55.68" E21° 29' 30.61"	S28° 10' 11.42" E21° 29' 21.36"	612,0	3,75	1,0	12,8
HT-CH-04	S28° 09' 52.97" E21° 29' 28.76"	S28° 10' 04.80" E21° 29' 24.96"	433,8	3,75	1,0	11,5
HT-CH-05	S28° 09' 51.96" E21° 29' 23.06"	S28° 10' 04.78" E21° 29' 24.96"	398,1	3,75	1,0	10,2
HT-CH-06	S28° 10' 04.80" E21° 29' 24.96"	S28° 09' 40.52" E21° 28' 57.92"	1347,7	3,75	1,0	8,2
HT-CH-07	S28° 10' 02.04" E21° 29' 11.32"	S28° 10' 08.81" E21° 29' 21.48"	373,6	3,75	1,0	8,2
HT-CH-08	S28° 09' 37.29" E21° 28' 57.33"	S28° 09' 45.36" E21° 28' 52.55"	311,0	3,75	1,0	11,9
HT-CH-09	S28° 09' 40.42" E21° 28' 57.95"	S28° 09' 51.50" E21° 29' 13.87"	580,0	3,75	1,0	8,2
HT-CH-10	S28° 09' 37.29" E21° 28' 57.33"	S28° 09' 45.38" E21° 29' 21.68"	774,9	3,75	1,0	11,0
HT-CH-11	S28° 09' 45.46" E21° 29' 14.75"	S28° 09' 48.59" E21° 29' 22.14"	260,1	3,75	1,0	9,5
HT-CH-12	S28° 09' 46.04" E21° 29' 21.67"	S28° 09' 48.58" E21° 29' 22.16"	79,2	3,75	1,0	11,3
HT-CH-13	S28° 09' 46.23" E21° 29' 26.80"	S28° 09' 48.59" E21° 29' 22.14"	148,7	3,75	1,0	18,6
HT-CH-14	S28° 09' 45.75" E21° 29' 27.38"	S28° 09' 45.38" E21° 29' 21.68"	155,7	3,75	1,0	12,7
HT-CH-15	S28° 09' 45.75" E21° 29' 27.38"	S28° 10' 16.60" E21° 29' 52.56"	1308,9	3,75	1,0	8,2
HT-CH-16	S28° 09' 54.65" E21° 29' 36.01"	S28° 10' 16.89" E21° 29' 42.49"	781,4	3,75	1,0	9,6
HT-CH-17	S28° 10' 15.10" E21° 29' 50.99"	S28° 10' 19.28" E21° 29' 48.28"	204,7	3,75	1,0	9,3
HT-CH-18	S28° 10' 23.40" E21° 29' 52.14"	S28° 10' 19.28" E21° 29' 48.28"	166,2	3,75	1,0	6,6

HT-CH-19	S28° 10' 23.14" E21° 29' 48.97"	S28° 10' 21.18" E21° 29' 45.40"	114,6	3,75	1,0	6,7
HT-CH-20	S28° 10' 23.43" E21° 29' 52.17"	S28° 10' 27.22" E21° 29' 41.01"	655,8	3,75	1,0	8,7
HT-CH-21	S28° 10' 23.14" E21° 29' 48.97"	S28° 10' 23.98" E21° 29' 44.00"	435,9	3,75	1,0	6,2
HT-CH-22	S28° 09' 49.09" E21° 29' 29.43"	S28° 09' 51.94" E21° 29' 32.78"	156,5	3,75	1,0	14,0
HT-CH-23	S28° 09' 49.09" E21° 29' 29.43"	S28° 09' 51.98" E21° 29' 22.87"	201,6	3,75	1,0	12,5

ACCESS ROAD CHANNELS						
AC - CHANNEL	**GPS POINT**		**LENGTH (m)**	**TOP WIDTH (m)**	**HEIGHT (m)**	**FLOW RATE CAPACITY (m^3/s)**
	Start	**End**				
AC-CH-01	S28° 09' 13.05" E21° 27' 59.60"	S28° 09' 13.52" E21° 28' 00.03"	18,5	3,75	1,0	21,7
AC-CH-02	S28° 09' 27.01" E21° 28' 04.15"	S28° 09' 27.56" E21° 28' 04.66"	21,7	3,75	1,0	22,9
AC-CH-03	S28° 09' 44.64" E21° 28' 11.64"	S28° 10' 03.20" E21° 28' 05.47"	606,1	3,75	1,0	6,7
AC-CH-04	S28° 10' 05.50" E21° 28' 06.15"	S28° 10' 06.25" E21° 28' 06.23"	23,3	3,75	1,0	4,8
AC-CH-05	S28° 10' 14.71" E21° 28' 07.64"	S28° 10' 21.00" E21° 28' 09.42"	199,5	3,75	1,0	8,2
AC-CH-06	S28° 10' 16.64" E21° 28' 08.76"	S28° 10' 20.66" E21° 28' 09.88"	127,5	3,75	1,0	8,2
AC-CH-07	S28° 10' 25.33" E21° 28' 10.61"	S28° 10' 52.17" E21° 28' 18.08"	853,0	3,75	1,0	10,6
AC-CH-08	S28° 10' 26.98" E21° 28' 11.65"	S28° 10' 33.19" E21° 28' 13.38"	196,9	3,75	1,0	9,5
AC-CH-09	S28° 11' 01.03" E21° 28' 21.22"	S28° 11' 03.32" E21° 28' 22.15"	134,9	3,75	1,0	16,5
AC-CH-10	S28° 11' 16.33" E21° 28' 28.20"	S28° 11' 26.89" E21° 28' 36.92"	415,9	3,75	1,0	11,3
AC-CH-11	S28° 11' 17.07" E21° 28' 27.84"	S28° 11' 27.96" E21° 28' 38.40"	460,2	3,75	1,0	10,9
AC-CH-12	S28° 11' 27.18" E21° 28' 46.02"	S28° 11' 23.98" E21° 28' 45.75"	98,6	3,75	1,0	7,5
AC-CH-13	S28° 11' 27.74" E21° 28' 46.60"	S28° 11' 25.12" E21° 28' 46.38"	80,8	3,75	1,0	7,5
AC-CH-14	S28° 10' 36.69" E21° 28' 44.28"	S28° 10' 43.54" E21° 28' 41.94"	220,4	3,75	1,0	17,2
AC-CH-15	S28° 10' 36.80" E21° 28' 43.66"	S28° 10' 40.73" E21° 28' 42.28"	126,8	3,75	1,0	18,3
AC-CH-16	S28° 10' 30.32" E21° 28' 49.21"	S28° 10' 34.58" E21° 28' 45.47"	166,6	3,75	1,0	14,8
AC-CH-17	S28° 10' 29.78" E21° 28' 49.07"	S28° 10' 33.72" E21° 28' 45.43"	157,2	3,75	1,0	13,1
AC-CH-18	S28° 10' 21.23" E21° 28' 56.76"	S28° 10' 25.26" E21° 28' 54.00"	145,7	3,75	1,0	13,2
AC-CH-19	S28° 10' 21.98" E21° 28' 56.95"	S28° 10' 25.55" E21° 28' 54.41"	130,0	3,75	1,0	13,2
AC-CH-20	S28° 10' 15.05" E21° 28' 59.66"	S28° 10' 16.34" E21° 28' 59.21"	41,5	3,75	1,0	9,5
AC-CH-21	S28° 10' 14.54" E21° 28' 59.29"	S28° 10' 15.39" E21° 28' 58.99"	27,5	3,75	1,0	9,5
AC-CH-22	S28° 10' 10.71" E21° 29' 01.19"	S28° 10' 11.88" E21° 29' 00.78"	37,5	3,75	1,0	8,2
AC-CH-23	S28° 10' 10.45" E21° 29' 00.73"	S28° 10' 11.80" E21° 29' 00.25"	43,6	3,75	1,0	8,2
AC-CH-24	S28° 10' 07.17" E21° 29' 03.19"	S28° 10' 08.06" E21° 29' 02.45"	34,3	3,75	1,0	8,2

AC-CH-25	S28° 10' 06.91" E21° 29' 02.75"	S28° 10' 07.31" E21° 29' 02.38"	16,0	3,75	1,0	8,2
AC-CH-26	S28° 10' 06.04" E21° 29' 04.70"	S28° 10' 06.89" E21° 29' 03.50"	16,0	3,75	1,0	6,7
AC-CH-27	S28° 10' 05.71" E21° 29' 04.28"	S28° 10' 06.06" E21° 29' 03.75"	18,1	3,75	1,0	6,7
AC-CH-28	S28° 10' 10.79" E21° 29' 34.50"	S28° 10' 11.36" E21° 29' 21.44"	371,5	3,75	1,0	8,2
AC-CH-29	S28° 10' 11.29" E21° 29' 34.42"	S28° 10' 12.19" E21° 29' 30.38"	113,5	3,75	1,0	8,2

BUILDING AREA CHANNELS						
BD - CHANNEL	**GPS POINT**		**LENGTH (m)**	**TOP WIDTH (m)**	**HEIGHT (m)**	**FLOW RATE CAPACITY (m^3/s)**
	Start	**End**				
BD-CH-01	S28° 11' 04.32" E21° 28' 28.72"	S28° 11' 06.56" E21° 28' 24.40"	148,9	3,75	1,0	10,3
BD-CH-02	S28° 11' 05.00" E21° 28' 29.30"	S28° 11' 11.31" E21° 28' 25.87"	305,7	3,75	1,0	10,3
BD-CH-03	S28° 11' 07.11" E21° 28' 24.64"	S28° 11' 11.29" E21° 28' 25.91"	138,3	3,75	1,0	8,1
BD-CH-04	S28° 11' 09.62" E21° 28' 27.40"	S28° 11' 10.31" E21° 28' 25.48"	56,4	3,75	1,0	23,9

MULTIFUNCTIONAL AREA CHANNELS						
MA - CHANNEL	**GPS POINT**		**LENGTH (m)**	**TOP WIDTH (m)**	**HEIGHT (m)**	**FLOW RATE CAPACITY (m^3/s)**
	Start	**End**				
MA-CH-1	S28° 10' 06.44" E21° 29' 11.47"	S28° 10' 14.57" E21° 29' 11.43"	275,3	3,75	1,0	10,5
MA-CH-2	S28° 10' 08.31" E21° 29' 11.86"	S28° 10' 14.53" E21° 29' 12.11"	208,6	3,75	1,0	11,5
MA-CH-3	S28° 10' 08.36" E21° 29' 11.90"	S28° 10' 11.56" E21° 29' 12.35"	100,7	3,75	1,0	8,8
MA-CH-4	S28° 10' 10.40" E21° 29' 13.69"	S28° 10' 40.49" E21° 29' 19.29"	1000,8	3,75	1,0	10,0
MA-CH-5	S28° 10' 21.13" E21° 29' 12.55"	S28° 10' 41.53" E21° 29' 19.50"	704,7	3,75	1,0	10,0

6.9.6 Culvert detail (WSP, 2015)

Erosion may occur in areas where previous overland flow is converted into concentrated discharge points. The erosion potential will be applicable to all channel and culvert inlet and outlets. The mitigation measure would normally consist of concrete aprons at invert of culverts with energy dissipaters, and gabion mattresses at the end of the apron. This would decrease the runoff flows and decrease velocities. The site however, is extremely flat and the possibility of erosion is limited.

Construction of culverts will entail the following:

- General terrain shaping/channelling from the culvert outlet to the relevant low point to ensure the flow of the natural watercourse.
- Shaping of culvert outlet will be needed in some instances to daylight the culvert to relevant low points.
- 150mm calcrete layer will be used as initial layer of cover for all rectangular box culverts.
- Erosion protection in the form of Gabion baskets to be constructed at all storm water discharge points.

- All surface water management infrastructure constructed from soil should be inspected on a regular basis, with more frequent inspections during rainfall periods. Maintenance will be required to prevent siltation.
- All stormwater diversion berms are kept clean and vegetation cover adequately maintained.
- Drains should be cleaned and maintained annually, or as necessary.

Culvert positions and peak flows were determined from the delineated catchment areas. This information has been applied to the sizing of the culverts. The SANRAL Drainage Manual was used to determine the optimum size of the culverts for each respective catchment.

The following criteria had to be taken into consideration:
- Limited headwater depth due to vertical alignment being close to natural ground.
- Culvert crossing would be placed at minimum grade due to very flat terrain.
- Culverts to be placed at low points for drainage purposes and to prevent disturbance of the natural watercourses.

With the above criteria taken into consideration, rectangular portal culverts have been chosen for the following reasons:
- **Wide flow with low head:** Box culverts are ideal for flow where hydraulic head is limited. For an equivalent waterway area to circular pipes, box culverts can be configured to have less impact on upstream water levels and downstream flow velocities than equivalent pipe structures.
- **Difficult site conditions:** When site conditions are difficult, installation of a box culvert requires reduced compaction and backfill.

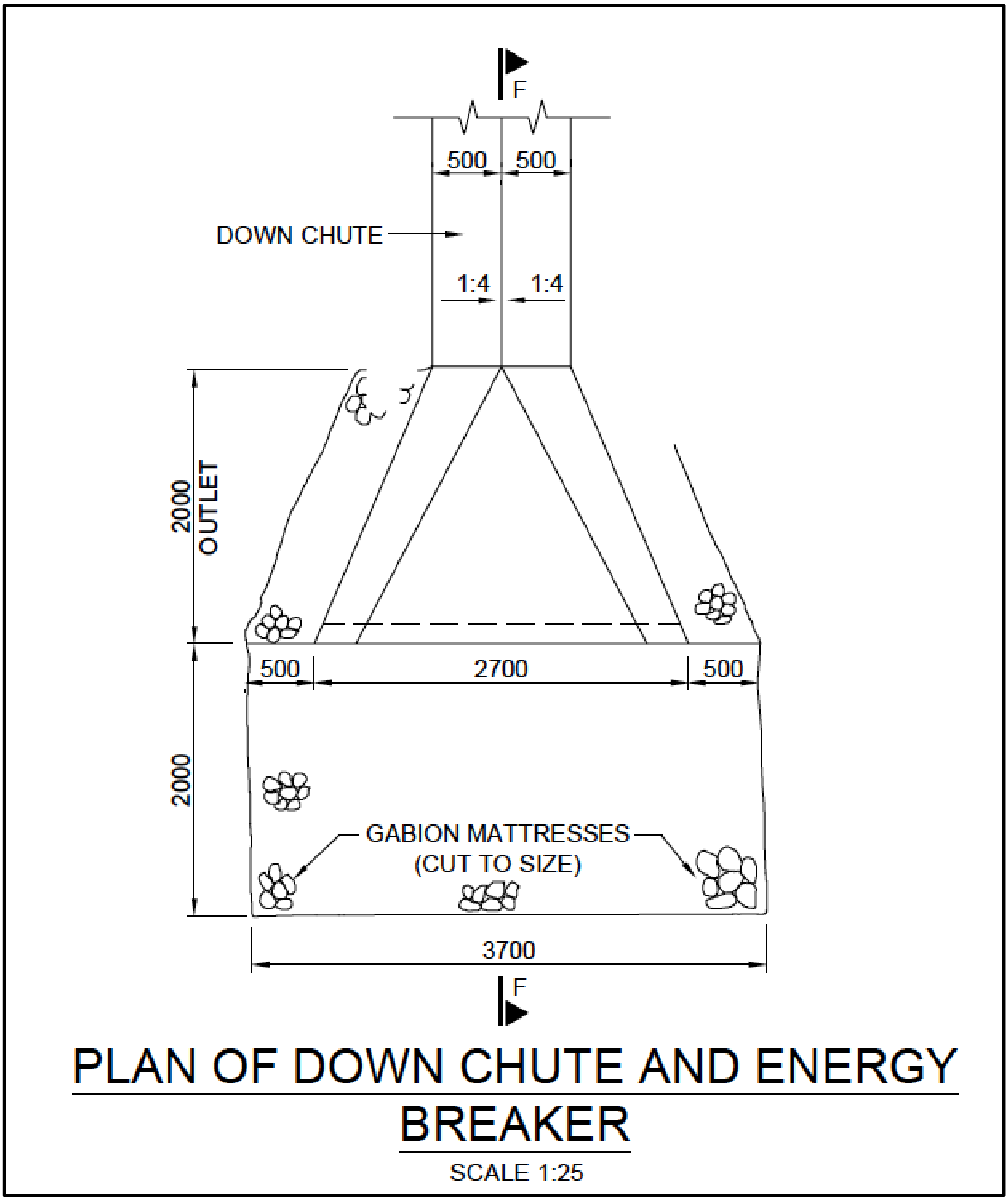


Figure 6-19: Down chute and energy breaker (WSP, 2015)

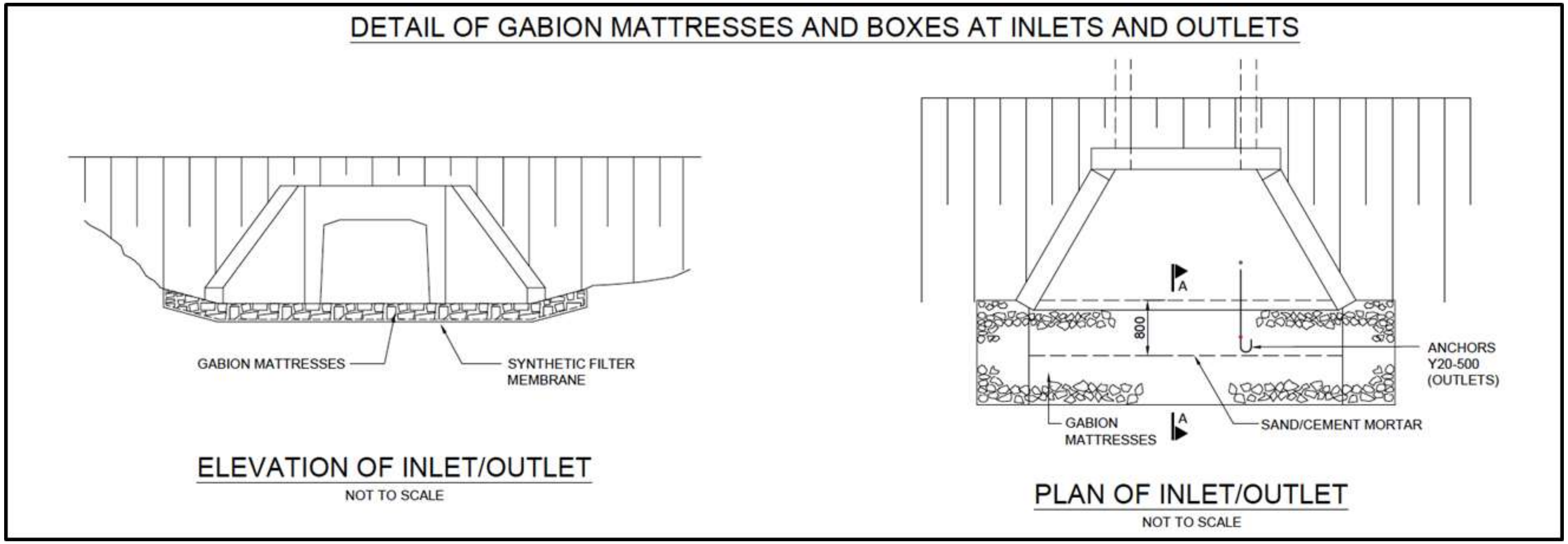


Figure 6-20: Gabion matresses and box culverts (WSP, 2015)

RECTANGULAR CULVERTS
D – height (inside) (m) B – width (inside) (m)
For: **0 < H_1/D ≤ 1,2** $Q=\frac{2}{3}C_B BH_1\sqrt{\frac{2}{3}gH_1}$ Where: C_B = 1,0 for rounded inlets (r > 0,1B) C_B = 0,9 for square inlets
And for: **H_1/D > 1,2** $Q=C_h BD\sqrt{2g(H_1-C_h D)}$ Where: C_h = 0,8 for rounded inlets C_h = 0,6 for square inlets

Figure 6-21: Rectangular culvert design (WSP, 2015)

Table 6-8: Culvert detail (WSP information summarised)

HIGH SPEED OVAL						
OV-CULVERT	GPS POINTS		LENGTH	WIDTH	HEIGHT	FLOW RATE
	Start	End				
OV-C1-02	28° 09' 42.12" S 21° 28' 29.59" E	28° 09' 42.65" S 21° 28' 30.20" E	23.18	6	9	8.87
OV-C1-04	28° 09' 42.22" S 21° 28' 29.48" E	28° 09' 42.74" S 21° 28' 30.09" E	23.18	6	9	8.87
OV-C1-06	28° 09' 42.31" S 21° 28' 29.38" E	28° 09' 42.84" S 21° 28' 29.99" E	23.18	6	9	8.87
OV-C2-02	28° 10' 06.72" S 21° 28' 17.03" E	28° 10' 06.79" S 21° 28' 17.87" E	23.18	6	9	8.87
OV-C2-04	28° 10' 06.59" S 21° 28' 17.04" E	28° 10' 06.66" S 21° 28' 17.89" E	23.18	6	9	8.87
OV-C2-06	28° 10' 06.46" S 21° 28' 17.06" E	28° 10' 06.53" S 21° 28' 17.90" E	23.18	6	9	8.87
OV-C3-02	28° 11' 06.32" S 21° 30' 19.74" E	28° 11' 06.60" S 21° 30' 18.96" E	23.18	6	9	8.87
OV-C3-04	28° 11' 06.20" S 21° 30' 19.69" E	28° 11' 06.48" S 21° 30' 18.90" E	23.18	6	9	8.87
OV-C3-06	28° 11' 06.08" S 21° 30' 19.63" E	28° 11' 06.36" S 21° 30' 18.84" E	23.18	6	9	8.87
OV-C4-02	28° 13' 10.10" S 21° 30' 28.23" E	28° 13' 10.85" S 21° 30' 28.62" E	25.62	6	9	8.87
OV-C4-04	28° 13' 10.15" S 21° 30' 28.10" E	28° 13' 10.91" S 21° 30' 28.49" E	25.62	6	9	8.87
OV-C4-06	28° 13' 10.21" S 21° 30' 27.96" E	28° 13' 10.96" S 21° 30' 28.35" E	25.62	6	9	8.87
OV-C5-02	28° 13' 12.13" S 21° 30' 22.40" E	28° 13' 12.88" S 21° 30' 22.67" E	24.40	9	9	2.22
OV-C6-02	28° 13' 13.95" S 21° 30' 11.49" E	28° 13' 14.70" S 21° 30' 11.54" E	23.18	6	9	8.87
OV-C6-04	28° 13' 13.96" S 21° 30' 11.34" E	28° 13' 14.71" S 21° 30' 11.40" E	23.18	6	9	8.87
OV-C6-06	28° 13' 13.97" S 21° 30' 11.19" E	28° 13' 14.72" S 21° 30' 11.25" E	23.18	6	9	8.87
OV-C6-08	28° 13' 13.98" S 21° 30' 11.05" E	28° 13' 14.73" S 21° 30' 11.10" E	23.18	6	9	8.87
OV-C6-10	28° 13' 13.98" S 21° 30' 10.90" E	28° 13' 14.73" S 21° 30' 10.95" E	23.18	6	9	8.87
OV-C6-12	28° 13' 13.99" S 21° 30' 10.75" E	28° 13' 14.74" S 21° 30' 10.80" E	23.18	6	9	8.87

HANDLING TRACK						
HT-CULVERT	GPS POINT Start	GPS POINT End	LENGTH	WIDTH (m)	HEIGHT	FLOW RATE
HT-C1-02	28° 09' 45.40" S 21° 29' 21.74" E	28° 09' 46.04" S 21° 29' 21.70" E	19.52	9	4.5	0.66
HT-C1-04	28° 09' 45.40" S 21° 29' 21.68" E	28° 09' 46.03" S 21° 29' 21.65" E	19.52	9	4.5	0.66
HT-C1-06	28° 09' 45.40" S 21° 29' 21.63" E	28° 09' 46.03" S 21° 29' 21.60" E	19.52	9	4.5	0.66
HT-C2-02	28° 09' 48.59" S 21° 29' 22.20" E	28° 09' 51.95" S 21° 29' 23.10" E	106.13	9	4.5	0.66
HT-C2-04	28° 09' 48.60" S 21° 29' 22.15" E	28° 09' 51.96" S 21° 29' 23.04" E	106.13	9	4.5	0.66
HT-C2-06	28° 09' 48.61" S 21° 29' 22.10" E	28° 09' 51.97" S 21° 29' 22.99" E	106.20	9	4.5	0.66
HT-C3-02	28° 09' 54.47" S 21° 29' 10.48" E	28° 09' 55.14" S 21° 29' 08.57" E	56.12	9	4.5	0.66
HT-C4-02	28° 10' 01.61" S 21° 29' 09.75" E	28° 10' 02.03" S 21° 29' 09.50" E	14.64	9	4.5	0.66
HT-C5-02	28° 10' 04.80" S 21° 29' 24.98" E	28° 10' 07.91" S 21° 29' 26.20" E	101.31	12	4.5	1.11
HT-C5-04	28° 10' 04.81" S 21° 29' 24.94" E	28° 10' 07.92" S 21° 29' 26.16" E	101.26	12	4.5	1.11
HT-C5-06	28° 10' 04.82" S 21° 29' 24.91" E	28° 10' 07.93" S 21° 29' 26.13" E	101.35	12	4.5	1.11
HT-C6-02	28° 10' 19.29" S 21° 29' 48.26" E	28° 10' 21.29" S 21° 29' 45.60" E	95.16	9	4.5	0.66
HT-C7-02	28° 10' 24.05" S 21° 29' 44.01" E	28° 10' 25.02" S 21° 29' 40.74" E	93.94	15	4.5	1.11
HT-C7-04	28° 10' 23.99" S 21° 29' 43.99" E	28° 10' 24.96" S 21° 29' 40.72" E	93.94	15	4.5	1.11
HT-C8-02	28° 10' 06.01" S 21° 29' 36.63" E	28° 10' 06.97" S 21° 29' 36.90" E	30.50	4.5	4.5	0.33
HT-C9-02	28° 10' 13.64" S 21° 29' 38.80" E	28° 10' 14.52" S 21° 29' 39.05" E	28.06	4.5	4.5	0.33

ACCESS ROAD						
AC - CULVERT	GPS POINT Start	GPS POINT End	LENGTH	WIDTH	HEIGHT	FLOW RATE
AC-C1-02	28° 09' 56.51" S 21° 28' 06.20" E	28° 09' 56.61" S 21° 28' 06.77" E	20.86	9	4.5	0.92
AC-C2-02	28° 10' 35.80" S 21° 28' 13.54" E	28° 10' 35.67" S 21° 28' 14.10" E	20.86	4.5	4.5	0.46
AC-C3-02	28° 11' 28.18" S 21° 28' 42.25" E	28° 11' 28.84" S 21° 28' 42.11" E	20.74	4.5	4.5	0.46
AC-C4-02	28° 10' 49.06" S 21° 28' 39.55" E	28° 10' 49.22" S 21° 28' 40.20" E	18.30	9	4.5	0.92
AC-C4-04	28° 10' 49.10" S 21° 28' 39.54" E	28° 10' 49.26" S 21° 28' 40.19" E	18.30	9	4.5	0.92
AC-C5-02	28° 10' 28.36" S 21° 28' 50.47" E	28° 10' 28.89" S 21° 28' 51.07" E	23.18	4.5	4.5	0.46
AC-C6-02	28° 10' 20.01" S 21° 28' 57.22" E	28° 10' 20.26" S 21° 28' 57.97" E	21.96	4.5	4.5	0.46
AC-C7-02	28° 10' 08.65" S 21° 29' 01.33" E	28° 10' 08.92" S 21° 29' 02.01" E	20.20	4.5	4.5	0.46
AC-C8-02	28° 10' 04.66" S 21° 29' 06.70" E	28° 10' 05.28" S 21° 29' 06.87" E	19.72	4.5	4.5	0.46
AC-C9-02	28° 10' 11.40" S 21° 29' 21.43" E	28° 10' 11.95" S 21° 29' 20.99" E	20.74	9	4.5	0.92
AC-C9-04	28° 10' 11.38" S 21° 29' 21.39" E	28° 10' 11.93" S 21° 29' 20.95" E	20.74	9	4.5	0.92
AC-C9-06	28° 10' 11.36" S 21° 29' 21.36" E	28° 10' 11.91" S 21° 29' 20.92" E	20.74	9	4.5	0.92

SH - CULVERT	GPS POINT Start	GPS POINT End	LENGTH	WIDTH	HEIGHT	FLOW RATE
SH-C1-02	28° 10' 57.24" S 21° 28' 45.76" E	28° 10' 57.61" S 21° 28' 46.09" E	14.64	12	4.5	1.23

BUILDING AREA						
BD - CULVERT	**GPS POINT**		**LENGTH**	**WIDTH**	**HEIGHT**	**FLOW RATE**
	Start	**End**				
BD-C1-02	28° 11' 06.57" S 21° 28' 24.40" E	28° 11' 07.09" S 21° 28' 24.63" E	17.08	15	6	2.55
BD-C2-02	28° 11' 11.33" S 21° 28' 25.81" E	28° 11' 11.50" S 21° 28' 25.31" E	14.64	15	6	2.55

6.10 Wetland management

The following management measures were considered and will be implemented for the wetland area:

- The interdune wetland is locally important in terms of biodiversity and should therefore be conserved. This interdune wetland (pan) will therefore not be degraded due to the HSPG project.
- A buffer zone will be established to ensure the pan receives adequate water from its catchment. The catchment of the pan will be the minimum boundary of the buffer zone.
- The pan and related buffer zone will form a corridor linking the inner track area with the outer undeveloped (natural area) to ensure that fauna and flora movement are not totally disrupted by the material sourcing and track development.
- Restrict the track development and material sourcing to outside the wetland buffer.
- The water tract (along SP3) will be defined as part of the stormwater management plan and mitigation defined accordingly. See Section 6.9.

6.11 Additional management measures

The following management measures will also be implemented to prevent pollution or minimise contamination where prevention is not possible:

- Construction – risk of soil, groundwater and runoff contamination due to building activities, building material, sanitary practices, waste management:
    - Prevent spillage of construction material (concrete, bitumen etc.).
    - Construction contractor will ensure that all building materials / chemicals are effectively stored and managed.
    - In the unlikely event of a spillage, an incident will be registered and sufficient clean-up procedures will be carried out immediately.
    - All reagents, reagent storage tanks and mixing units will be supplied with a concrete bunded area built to contain 110% of the total capacity of the facility in order to contain and return any spilled material back into the system. The system will be maintained in a state of good repair and standby pumps will be provided for liquids.
    - Any hazardous substances will be handled according to the relevant legislation relating to transport, storage and use of the substance (Safety Datasheets).
    - All construction vehicles will be maintained/serviced off the site to prevent any leakages or spillages of hydrocarbons.
    - If emergency maintenance is required on site, drip trays and/or absorbent mats will be placed underneath the vehicles/equipment where maintenance work is conducted.

- All areas where hydrocarbons are handled and contamination is possible (workshop, car wash and oil storage) will have oil and wear resistant impermeable concrete floors surrounded by bund walls. In case of a spillage / leak:
    - Stop source of leak or release.
    - Ventilate area.
    - Contain and recover spilled material using sand or another suitable inert absorbent material.
    - Cover spill with generous amounts of inert absorbent and mix thoroughly.
    - Sweep up and place in disposable container – hazardous waste. Keep certificates for safe disposal.
    - Scrub area with detergent and water.
    - Collect liquid with additional absorbent and place in disposal container – hazardous waste. Keep certificates for safe disposal. Or leakages and spillages will flow into the sumps that lead to the oil-water separator.

- Prevent access to the area (slippery).
- Spill clean-up kits will be readily available throughout the site. Some rehabilitation kits produced are environmentally friendly in that hydrocarbons can be recovered (recycling) and the remains biodegrade (no waste to be disposed).
- Use appropriate Personal Protective Equipment (PPE) – respirator & protective clothing, when cleaning spills.

7 WATER MONITORING

7.1 General

In general, water monitoring is conducted for the following reasons:

- It is a legal requirement;
- It generates reliable baseline and background data that can be used as management objectives;
- It identifies pollution sources and allows the early detection of changes in water quality for the further implementation of management measures;
- It determines the extent of pollution and pollution plumes;
- It monitors water usage (cost control for water charges);
- It can be used to calibrate and verify prediction and assessment models (refine conceptual and numerical models);
- It helps with identification of water reuse opportunities;
- It can assist with identification of appropriate water treatment technology;
- It determines and evaluates the success of implemented management measures and redirect or refocus the management plan; and
- It assesses compliance (with licenses, authorisations, standards and legislation) and the impact on the receiving water environment.

To ensure that the data collected through the water monitoring system is reliable and appropriate, the following is required:

- Consultation with Interested and Affected Parties (I&APs) to address their concerns, specifically downstream users to assess the risk of water pollution and its associated impact as well as impacts on water availability.
- Clear definition of objectives of management actions that drive the monitoring programme.
- A detailed design of a water monitoring system, which specifies location of monitoring points (map), data to be collected (flow/water level, constituents, frequency), data collection procedure (sampling protocol and analytical techniques), management (database, storage, assessment) and reporting.
- Audit to ensure implementation is according to detailed design and that the objectives are achieved.
- Data that represents the actual situation by covering the area in sufficient detail and using procedures that will provide representative data.
- An operating and maintenance programme to ensure the water monitoring system functions properly.
- A data management system, which is accessible to all relevant users and ensures that data is used optimally.
- Quality control and assurance measures to ensure reliable and verifiable data. This may include blanks, standards, duplicates, cation-anion balances etc.

Groundwater: Monitoring is required to monitor potential impacts on specifically the groundwater environment and other groundwater users such as groundwater level depth changes/fluctuation due to the abstraction and use of groundwater by the project (especially during the construction phase when high volumes are used) and groundwater quality changes due to the surface activities and potential pollution sources (fuel storage, oil separators, conservancy tank).

Surface water: No surface water bodies exist on the site (streams, rivers, dams) and no surface water will be used for this development and no impact on surface water is anticipated due to the type of development. Surface water monitoring is therefore not included as the risk to surface water is negligible. A storm water management plan has been developed to manage runoff and drainage.

Wetland: All activities are located outside the identified wetland area and beyond 500 m from it. Therefore no impact on the wetland is anticipated and no monitoring has been included.

7.2 Groundwater monitoring

7.2.1 Groundwater monitoring positions

Refer to Figure 7-1 and Table 7-1.

Recommendation: Place a groundwater monitoring borehole at the southern side of the building site to confirm no water quality impact.

Table 7-1: Groundwater monitoring positions

Borehole number	Farm	Coordinates
BH 1	Steenkampspan, Portion 6	-28.184615^{0} S 21.478047^{0} E
BH 2		-28.21177^{o} 021.49552^{o}
BH 3		-28.23996^{o} 021.52847^{o}
BH 5		-28.200994^{0} S 21.5033247^{0} E
BH 8		-28.1984^{0} S 21.50554^{0} E
H/BH 10	Duiker Rand	-28.282260^{0} S 21.519380^{0} E
H/BH 14		-28.23936^{o} 021.50644^{o}
H/BH 15	Steenkamspan, Portion 3	-28.15137^{o} 021.43464^{o}

7.2.2 Groundwater monitoring frequency

Table 7-2: Groundwater monitoring frequency

Site Name	Chemistry sampling	Water level measurements
Construction Phase		
Production boreholes: BH 1, BH 5, BH 8 and H/BH 10 and new monitoring borehole south of building area	Annually	Monthly
Livestock watering boreholes: BH2, BH 3, BH 4, H/BH14	-	Monthly
Operational Phase		
BH1 and new monitoring borehole south of building area	Annually	Quarterly
BH5, BH8 & H/BH10	-	Quarterly to monitor recovery

7.2.3 Groundwater monitoring parameters

A SANAS accredited laboratory, with the necessary quality control and assurance measures in place will conduct analyses.

Quantity: Water level depth

Quality:

Physical	pH at 25^{0}C Electrical Conductivity (EC) Total Dissolved Solids (TDS) Total Hardness
Major cations:	Calcium (Ca) Magnesium (Mg) Sodium (Na) Potassium (K) Ammonia (NH_3) as N
Major anions:	Sulphate (SO_4) Chloride (Cl) Fluoride (F) o-Phosphate (o-PO_4) Nitrate (NO_3) as N
Metals:	Iron (Fe) Manganese (Mn) Aluminium (Al)
Bacteriological:	E. Coli Total Coliforms
Other:	Chemical Oxygen Demand (COD) Soaps, oils & greases (SOP)

Figure 7-1: Proposed water monitoring points

7.3 Data management and reporting

7.3.1 Data collection

Groundwater samples should be collected as per the documented sampling protocol (prepared based on Weaver, 1992) at monitoring points and frequencies indicated and in suitable clean sampling bottles obtained from the laboratory. Clearly marked samples should be submitted to a SANAS accredited laboratory within 24 hours for analyses indicated.

7.3.2 Data storage

Analytical results received from the laboratory should be entered into a database for storage and access. Any concern with data should be queried with the laboratory within a month from receiving analyses.

The database will contain the following information:

- Company name and site (MBSA - Steenkampspan, Upington)
- Name of monitoring point (borehole number)
- Location (coordinates) of monitoring point
- Frequency of monitoring (date of sampling)
- Parameters determined
- Units parameters are measured in
- Water quality objectives or reserve objectives

7.4 Waste monitoring and reporting

No waste treatment, burning or disposal will take place on the site, only storage. Storage of waste will comply with GNR 926 (29 November 2013). Storage will be conducted in such a way to prevent cross-contamination and allow for recycling (separation of waste). Safe disposal certificates will be obtained for all waste collected from the site and disposed off site.

The safe disposal certificates should at least indicate the:

- Quantity of waste;
- Waste type; and
- Destination.

7.5 Recording of incidents and impacts

7.5.1 Incident investigation reports

All incidents (injuries, spillages etc.) will be recorded as per defined Safety, Health, Environment and Quality (SHEQ) standards. A standard format (incident investigation report) will be completed for each incident to allow further investigation into the matter (Table 7-3). The incident investigation report should contain the following information:

- Particulars of incident – date, time, shift, day of week, section
- Details of injured/affected person – name & surname, occupation, length of service/employment
- Details of injury - nature of injury, part of body affected, expected period of disablement.

- Description of incident – injury, damage/theft to property, losses, pollution, location (where), occupational disease etc.
- Reporting to authority – compensation commissioner, DWS, NC DENC.
- Investigation – investigator/investigation panel, date
- Root/Basic cause of incident
- Evidence – Witness and Insured's statements, photographs, sketches etc.
- Corrective and preventative measures to prevent incident from recurring; and
- Risk assessments carried out for the tasks performed.

A record of spillages must be maintained with details on the date of the spill, location of the spill, substance or chemical, volumes lost, the medium to long-term significance of the impact, clean-up measures and further action required.

7.5.2 Emergency and contingency measures

An emergency preparedness plan provides a documented procedure on the identification and assessment of potential emergencies. Emergency and contingency plans should be in place together with the necessary equipment (fire-fighting equipment; a helicopter may be required for transport of injured due to distance to closest medical facilities) and personnel on stand-by (first-aider) to manage such situations as and when necessary. A plan must include contact details of relevant emergency response departments such as the fire station, ambulance and police (Table 7-4).

Emergencies may include:

- Fire - the fire pumps are sized for a 1.5 hour fire duration with a duty of 23.52l/s at 60 m
- Flooding
- Bomb threat
- Explosion

Table 7-3: Example of Emergency Contact Details

NETCARE	082 911
UPINGTON MEDI-CLINIC (for injuries and snake and scorpion bites)	054 338 8900 Du Toit Street, Upington
POLICE	10111
POLICE STATION (UPINGTON)	054 337 3433 Schroder Street, Upington
FIRE/AMBULANCE	10177
FIRE STATION (UPINGTON)	054 338 7400 Corner of Swartmodder and Dakota Roads, Upington

All the necessary safety regulations must be abided by including Occupational Health and Safety Act (OHSA), 1993 (Act 85 of 1993), building codes and fire practice requirements. Should an evacuation be necessary, workers should be aware of the assembly points and evacuation exit routes from the property. Fire extinguishers must be inspected, maintained and located in a clearly marked area.

Plate 3: Example of emergency assembly point signage

Plate 4: Fire fighting equipment examples and notices

7.5.3 Registers

Records of all the accident/incident investigations should be retained in an environmental impact register at the management offices for a period of five (5) years.

A complaints register should also be kept at the management offices to record any public complaints received and the action taken to address the complaint.

Table 7-4: Example of Incident and Environmental Reporting Sheet

<table>
<tr><th colspan="19">INCIDENT AND ENVIRONMENTAL LOG SHEET</th></tr>
<tr><td>Date:</td><td>2</td><td>0</td><td></td><td></td><td>/</td><td>m</td><td>m</td><td>/</td><td>d</td><td>d</td><td>Time:</td><td></td><td></td><td>:</td><td></td><td></td><td>Location:</td><td></td></tr>
<tr><td>Nature of incident or risk type:</td><td>Procedure/ Process</td><td>Environmental</td><td>Safety</td><td>Health</td><td>Equipment/ Machinery</td><td>Other</td></tr>
<tr><td>Description / nature</td><td>Quantity of Spill/ Release:</td><td></td><td>Pollutant/ Substance:</td><td></td></tr>
<tr><td>Clean up or containment method:</td><td></td><td>Product Used:</td><td></td></tr>
<tr><td>Hours lost:</td><td></td><td>Cost:</td><td></td><td>Root Cause:</td><td></td></tr>
<tr><td colspan="19"></td></tr>
<tr><td colspan="19"></td></tr>
<tr><td>Corrective actions taken:</td><td></td></tr>
<tr><td colspan="19"></td></tr>
<tr><td colspan="19"></td></tr>
<tr><td colspan="19"></td></tr>
<tr><td>Incident reported by:</td><td></td><td>Signature:</td><td></td></tr>
<tr><td>Capacity of person above:</td><td></td><td>Repeat Incident</td><td>YES</td><td>NO</td></tr>
<tr><td>Further investigation required:</td><td>YES</td><td>NO</td><td>Person handling further investigation:</td><td></td></tr>
</table>

7.6 Auditing and reporting

7.6.1 Audits and reviews

Each component within this document and the anticipated WUL has an audit and performance review component associated with it. Regular review and auditing is important to ensure systems are up-to-date and still relevant for current situations. Evaluation is required to verify its appropriateness and suitability by comparing performance to objectives set. Changes or adjustments to systems are required where review/auditing highlights shortcomings or where gaps occur.

Performance should be measured against set objectives.

All systems will be reviewed and modified to ensure continual improvement. An auditing programme will be established to facilitate this process. It is considered good practice to review or audit all systems at least annually. This includes monitoring programmes as discussed in this Chapter.

A checklist or procedure will also be put in place for audit purposes, which should include compliance auditing with respect to performance indicators (objectives/targets). Auditing should include physical aspects, procedural aspects (ISO or similar system), as well as behavioural (training, skills development) aspects.

7.6.2 Reporting

Reporting is an essential component of any management system. The necessary reporting structures will be put in place to ensure that information is reported to the responsible persons, and that the necessary people (including authorities and stakeholders) are informed of any relevant water and waste (and general environmental) information. Reporting must include as a minimum, emergency situations or non-compliances, results of performance or compliance monitoring, malfunctions (operating errors, mechanical failures and/or loss of supply services), and stakeholder communication.

8 OPERATIONAL MANAGEMENT

8.1 Organisational structure

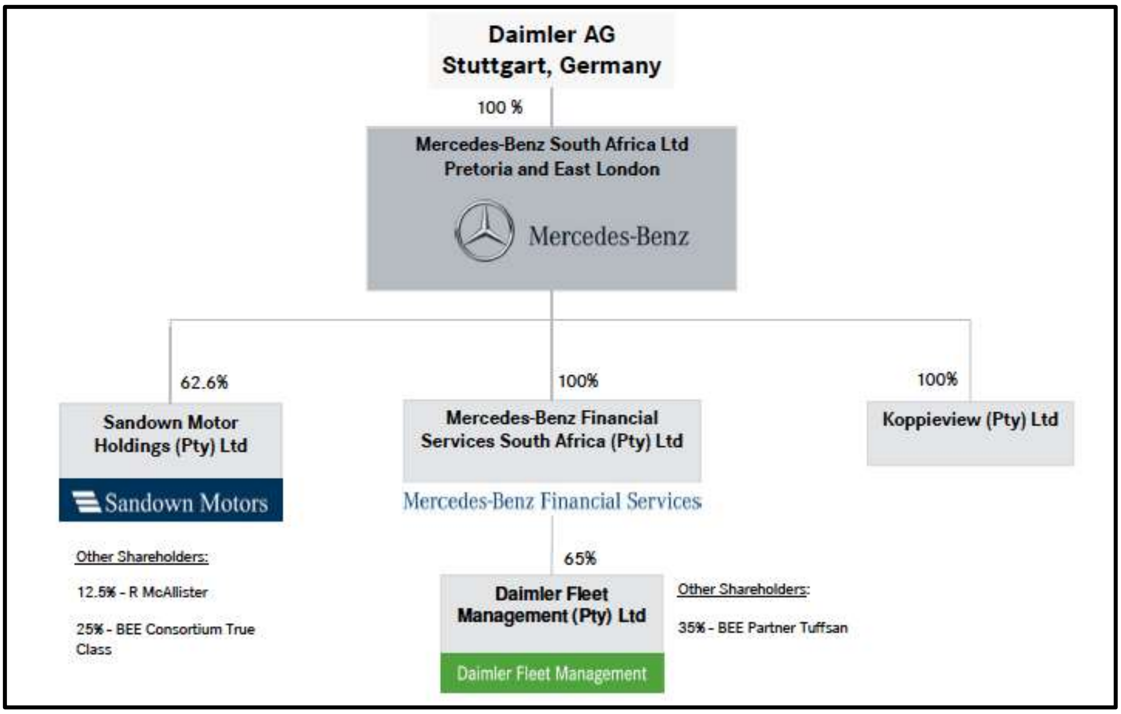


Figure 8-1: Company group structure (MBSA, 2014)

8.2 Communication

As part of the process for obtaining licences and authorisations, public participation was also undertaken. A scoping document (WSP, 2015) was therefore prepared to provide all I&APs with clear, accurate and comprehensible information in terms of the project. A background document was prepared by HydroScience and attached to the Scoping Report to address legal requirements in terms of the NWA, describe the existing water environment and the proposed project with its water uses as well as planning for the remainder of the project (see Appendix B). The document provided I&APs with the necessary background information and an opportunity to comment and contribute to the project as well as to indicate their viewpoints on issues and concerns relating to water.

The aim of the public participation process is not only to adhere to the required legislation, but also to give as many stakeholders and I&APs as possible an opportunity to be actively involved in this process. The public participation process enhances transparency and accountability in decision-making as it allows all I&APs to suggest ways of avoiding, reducing or mitigating potential negative impacts as well as enhance positive impacts. All inputs from the I&APs are considered in the planning and consequently clear recording of all issues and concerns raised has been maintained.

Table 8-1: Stakeholder engagement

Date	Stakeholder	Venue	Attendees
2015-01-22	DWS	DWS office, Louisvale Road, Upington	Daimler AG MBSA IngenAix HydroScience Ixhaphozi Enviro Services DWS National (c & i) DWS Regional
2015-07-10	DWS	DWS Head Office, Pretoria	WSP HydroScience DWS Engineering
2015-10-14	NC DENC	Protea Hotel, Upington	Daimler AG MBSA IngenAix WSP Environmental NC DENC
2015-10-15	Public	Protea Hotel, Upington	Daimler AG MBSA IngenAix WSP Environmental 5 neighbours
2015-10-15	Local & District authority	Protea Hotel, Upington	Daimler AG MBSA IngenAix WSP Environmental Macroplan ZF Mgcawu District Municipality //Khara Hais Local Municipality DENC DAFF

Table 8-2: Issues raised

Department/ Organisation	Comments:
DWS National Head Office, Pretoria Wetlands and Hydrology Dr Paul Meulenbeld	• **Wetland:** Satisfied with project team's approach and indicated that based on the current planning, he would not object to the project. **NOTED.** • **Borrow pit & quarry:** Wetland SP6 is fed by surficial runoff water and not by groundwater. No concerns regarding the proposed material sourcing activity at the outcrop, and the proposed borrow area in terms of influence to wetland and groundwater. **NOTED.** • **Fuel Storage:** ○ Above ground fuel storage would be more favourably considered since underground storage tanks often leak and then impact groundwater. ○ Include a Section 21(g) for the fuel storage tanks if underground as it could impact groundwater. Recommends that

	the tanks must be put in bunkers (made of concrete) to avoid impact to the groundwater if tanks are leaking. **NO UNDERGROUND FUEL STORAGE**. • **Runoff and storm water management:** It is important to not canalise and to keep flows as natural as possible. The wetland should receive natural runoff. Diversion of water around main surface structures, bridge across the drainage line etc. It is critical that these structures do not obstruct the flow of water. In terms of sustainability, construction with sand should be avoided. **CONSIDERED IN SWMP**.
DWS Upington Regional Office Geohydrology Mr Danie Potgieter	• **Water quality:** Project team to assess water quality as saline water with high nitrate concentrations is expected from boreholes and water might not be suited for intended use and require treatment. • **Water Quantity:** Water depth ranges between 7m and 35m. He uses zero (0) as recharge because of the low rainfall in the area (<350mm/annum). Water quantity will have to be determined and it is uncertain whether there will be sufficient water. **REFER TO GEOHYDROLOGY STUDY.**
DWS Upington Regional Office Geohydrology Mr Shaun Cloete	• **Fuel Storage:** Felt that a Section 21(g) relating to the fuel storage is not necessary.
DWS Head Office Engineering Mr Kelvin Legge & Mr Keith Mnisi	• **Sewage and wastewater from oil separator:** No discharge of wastewater on site. Storage facilities to comply with standards. Sewage is type 2 waste, conservancy tank is Class B facility; generally concrete reinforced tank (BSA007), 1km away from water source. Oil is hazardous waste; vent for VOC and double composite liner – reinforced concrete primary container followed by secondary liner. **NOTED AND AGREED. REFER TO SECTION 6 ON DESIGNS.** • **Hydrology:** Percolation rate expected around 90%. Adequate to design culverts for 1:50 year return period – SANRAL drainage manual. No float finish for culvert floor, box culverts; no pressure release valves. **NOTED AND AGREED. REFER TO SECTION 6.** • **High Speed Oval Hydrology:** 2 concepts discussed; concept 2 - V-drain for full northern section will be scrutinized by DWS, drains not concrete lined but earth drains with minimum velocity of 1.5m/s. Gabions for erosion protection at culverts downstream – gabion basket or Reno mattress. **NOTED AND AGREED. REFER**

	TO SECTION 6. • **Handling Track Hydrology:** Requirement to extend culverts to boundary due to safety area and runoff areas. No headwalls on culverts for safety of drivers. **NOTED AND AGREED. REFER TO SECTION 6.** • **Internal of oval:** DWS satisfied with either culverts under roadway or a "flat" roadway with flow over road. **NOTED AND AGREED. REFER TO SECTION 6.** • **Separation of clean and dirty water:** DWS satisfied with planning around building area (workshop, car wash, oil separator, fuel station, water supply from boreholes and storage, sewerage in conservancy tank for off-site removal and disposal, oil removal and off-site disposal). **NOTED AND AGREED. REFER TO SECTION 6.** Recommends kerb line (150mm kerb) along boundary of building area (prevention mechanism to contain spillages/leaks). • **Borrow pit & quarry:** No problem with process or location. GNR704 – mine must be 100m away from wetland and outside 1:100 year flood line. Wetland standards – mine 500m away from wetland. **BUFFER ZONE IMPLEMENTED.** DMR will specify mine closure requirement in terms of free-draining path for area, water not allowed to pond.
Neighbour Farm Steenkampspan 419 Mr Siebert Myburg	• **Water Use:** There is not sufficient water for the construction of the HSPG. How will other water users be impacted? **THIS NEIGHBOUR REQUIRES 7.2M^3/D ACCORDING TO HYDROGEOLOGICAL STUDY. REFER TO SECTION 5.5**
Neighbour Farm Kenilworth 274 Mr Phillip Coreejes	• **Water Use:** There is not sufficient water for the construction of the HSPG. How will other water users be impacted? **THIS NEIGHBOUR REQUIRES 12M^3/D ACCORDING TO HYDROGEOLOGICAL STUDY. REFER TO SECTION 5.5**
Northern Cape Department of Environment and Natural Resources (NCDENR) Revelation Moutshiwa	• **Wetland study:** The site has been identified to have a pan/wetland, is this correct? Will a specialist study be undertaken? **YES ON BOTH ACCOUNTS, SEE ATTACHED WETLAND STUDY.**
NCDENC Ordain Riba	• **Listing Notice 1:** ○ Section 21(c) & (i) will be applied for in terms of the NWA. Therefore, if drainage lines are present onsite wouldn't Listing Notice 1 activity 19 be applicable? ○ Requested a drainage line map. **REFER TO EIA**
DWS	The proposed activity will require a water use authorization from this department as it triggers the water uses in Section 21(a) (b) (c) (g) & (i)

	of the NWA. **AGREED, THIS APPLICATION**

9 REFERENCES

- Barbour, T. 2015. Social Impact Assessment. Mercedes-Benz High Speed Proving Ground, Upington, Northern Cape Province. October 2015.
- Department of Water Affairs and Forestry (DWAF), 2003. Lower Orange Water Management Area. Overview of Water Resources Availability and Utilisation. Report No. P WMA 14/000/00/0203. September 2003.
- Geo-logic Hydrogeological Consultants cc, 2015. Geohydrological - and contamination risk assessment study for a high speed proving ground on Portion 6 of the farm Steenkampspan 419 located north east of Upington in the Northern Cape Province. Report No: G2014/031, August 2015.
- http://www.transtank.com/product/transtank-t10/
- Ixhaphozi Enviro Services, 2015. Wetland Delineation and Assessment. 12 January 2015.
- Weaver, J.M.C, 1992. Groundwater sampling. An abbreviated field guide for sampling methods. Prepared for the Water Research Commission by John M. C. Weaver, Groundwater Programme, Division of Water Technology, CSIR. WRC Project No 339. TT56/92, Pretoria 1992
- WSP Parsons Brinckerhoff, 2015. MBSA Proving Ground South Africa. Drainage and Geometyric Detail Design Report. Report no 19606-01. November 2015.
- WSP Parsons Brinckerhoff, 2015. MBSA Proving Ground South Africa. Water and Waste Water Detail Design Report. Report no 19606-04. November 2015.
- WSP Parsons Brinckerhoff, 2015. MBSA Proving Ground South Africa. Scoping Report.