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Independent Environmental Review:

Environmental-Legal Framework and Current status of development affecting the Sand River, Mpumalanga

Submitted to: Sabi Sands Wildtuin

January 2020

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2	January 2020	Updated with comments received

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1 Introduction

The 'Save the Sand' Project is aimed at the Sand River and its catchment upon which the tourism and viability of the Sabi Sands Wildtuin (SSW) ecotourism depends. Tourism lodges in the area rely on the Sand River to flow, but have been experiencing challenges. Some allege that the low-flow experienced in the Sand River is due to over-abstraction, alien invasive trees and other upstream water uses occurring without due regard to the ecological reserve.

The project has been ongoing for many years and a significant number of reports are available in this regard.

Cabanga Environmental has been appointed to compile an independent environmental-legal report outlining the relevant South African legislation that pertains to the management of the Sand River and its catchment. The purpose of this undertaking is to present an updated environmental-legal framework within which:

- the current activities in the River and its Catchment can be evaluated, and
- potential future activities in the River and its Catchment can be considered.

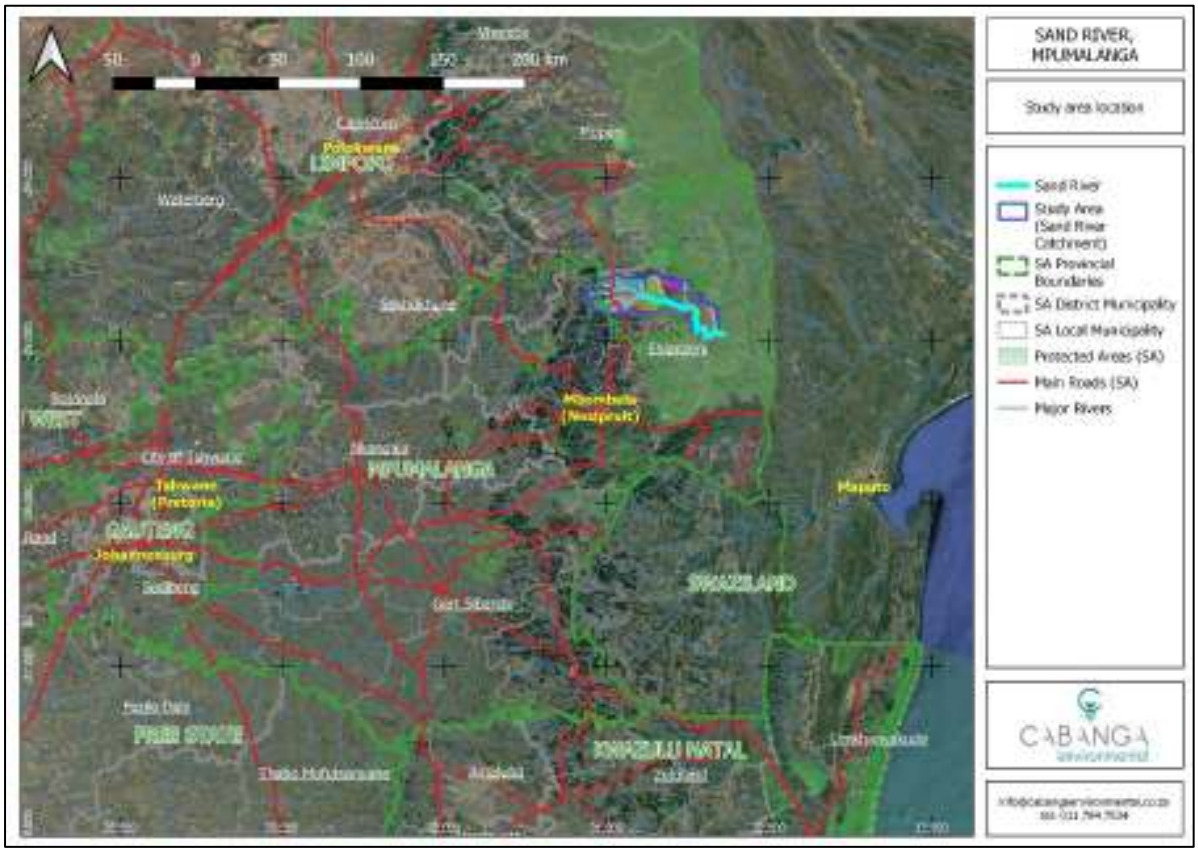
This process should culminate in the development of a strategy for the determination, establishment and management of the ecological reserve for the River, to ensure that both ecological needs and basic human needs are met. The development of the strategy falls outside of the scope of the current appointment and should be considered the next phase of the "Save the Sand" Project.

2 Project Location

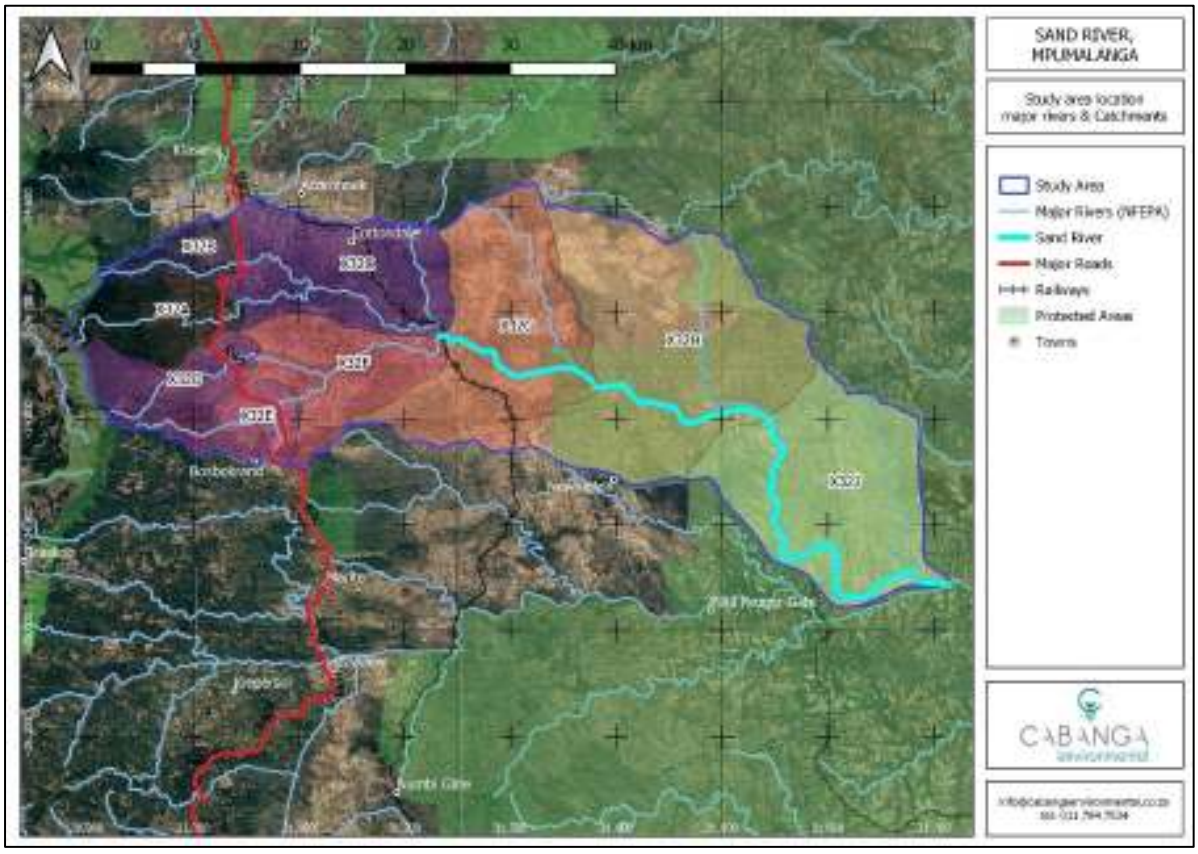
The Sand River originates from the approximate confluence of the Mutlumuvi, Nwandlamuhari and Mphyanyana Rivers just east of central Thulamahashe (north-east of Bushbuckridge) in the Bushbuckridge local municipality of the Ehlanzeni District Municipality in Mpumalanga Province. The Sand River flows in a roughly south-easterly direction for about 10km to the border of the Sabi Sands Private Nature Reserve and on to the Mala-Mala Game Reserve 20km further, where the River turns southwards towards Sabi Park (roughly another 15km), and again south-east for a further 15km to confluence with the Sabie River in the Kruger National Park.

All but about 10km of the Sand River is located within formally protected areas in terms of the National Environmental Management: Protected Areas Act, 2003 (Act No 57 of 2003) (NEMPAA). The rivers and catchments that feed into the Sand River must also form part of the study area; these areas are not formally protected and impacts to these upstream systems are expected to eventually manifest in the downstream Sand River.

The study area has therefore been defined as the entire Sand River Catchment comprising of quaternary catchments X32A to X32H and X32J (Plan 1, Plan 2)



Plan 1: National Context of the Study Area



Plan 2: Local Context of the Study Area

3 Water Management Context

Water Management in South Africa is principally guided by the National Water Act, 1998 (Act No. 36 of 1998) (NWA). Over-all responsibility for and authority over the nation's water resources is vested in National Government, with delegation of management functions to a regional or catchment level as appropriate.

The Department of Human Settlements, Water and Sanitation (DHSWS)[1] is the Government Department acting as the custodian of the nation's water resources and is responsible for water management in South Africa. In accordance with Section 5 of the NWA, the DHSWS has published the National Water Resources Strategy (NWRS) (DWA, June 2013) which aims "to ensure that national water resources are protected, used, developed, conserved, managed and controlled in an efficient and sustainable manner."

As it is well understood that water does not respect political boundaries, water management cannot be based on provincial sub-divisions. The country has been divided into nine (9) Water Management Areas (WMA), revised in 2016, which includes the Inkomati-Usuthu WMA within which the study area is located.

The Regulations hold that a Catchment Management Agency (CMA) must be established in each WMA and the Inkomati-Usuthu CMA (IUCMA) was established in terms of section 78(1) of the NWA under Government Notice No. 330 of 2 May 2014, as an extension of the former Inkomati CMA which was established originally in March 2004 (under Government Notice No. 397 of 26 March 2004). The IUCMA and former Inkomati Catchment Management Agency (ICMA) are the same legal entity and as such it may be said that the IUCMA was established in its original form as early as 2004.

Within the context of the NWRS (DWA, June 2013), the IUCMA has developed a catchment management strategy (CMS), though this document (IUCMA, 2018) relates specifically to the ICMA and thus does not relate holistically to the catchment as a whole. Nonetheless, the CMS is useful to understand the regulator's objectives and challenges with regard to integrated water resources management (IWRM) and is further discussed in Section 3.2 of this report.

The IUCMA has also published a 5-year strategic plan and budget for the fiscal years 2015/16 to 2020/21 which also contributes to our understanding of the present situation from the Regulator's perspective, and the Regulator's planned strategic interventions within the catchment. The plan is further discussed in Section 3.2 of this report.

The IUCMA have also recently published their Annual Performance Plan 2019/20 (01 April 2019 – 31 March 2020, available from https://www.iucma.co.za/reports-and-documents/annual-performance-plans/). The Document acknowledges that illegal water abstraction, discharge of non-compliant effluent from non-functional sewage treatment facilities and encroaching land uses present threats to effective water management in the WMA.

[1] Formerly the Department of Water and Sanitation, DWS and the Department of Water Affairs and Forestry, DWAF

3.1 Project context in terms of the NWRS

The NWRS (DWA, June 2013) describes the Sand River Catchment as an area that predominantly comprises ex-homelands[2], resulting in large concentrations of people living in a semi-rural context. The study area falls in the Bushbuckridge Local Municipality, that has a total population of 541,248 people of which 99.5% are black Africans. One in five households (21%) do not have access to piped water (www.statssa.gov.za).

Backlogs in domestic supply has not been met (DWA, June 2013) and the population is growing at a rate of 0.79% (www.statssa.gov.za).

Further to the growing human needs, the Ecological Reserve in the Sand River Catchment is also not being met, impacting adversely on downstream game reserves (including the Sabi Sands Wildtuin and Kruger National Park) (DWA, June 2013).

The Sand River has very little mountain catchment area to produce runoff and is generally poorly watered. Transfers of water into this WMA from elsewhere in South Africa are not feasible given the distance from all other sources. Opportunities for new dams are very limited (DWA, June 2013).

While there is some groundwater still available for domestic use, all other available water from within the catchment has been used/ allocated and the area is dependent on transfers from the Inyaka Dam, South of Bushbuckridge on the Mariti/ Marite River (Sabie system), outside of the study area. Water resource deficits will have to be met from within the WMA through more efficient use of the limited resources (DWA, June 2013).

Since the completion of Inyaka Dam south of Bosbokrand and just outside of the study area in 2002, many villages have abandoned previous groundwater supply schemes in favour of surface water supply. The conjunctive use of surface- and groundwater resources is however essential to meet demands. The NWRS (DWA, June 2013) suggests that existing groundwater resources must be refurbished, maintained and operated and new groundwater sources developed. This could lead to domestic and agricultural requirements being increasingly met by groundwater supply, thereby relieving some of the pressure on surface water resources in the catchment, and the Sand River itself.

Within the catchment, a significant volume of water is allocated to irrigation, however, water distribution to irrigation schemes like New Forest, Dingleydale and Champagne are in a poor state and the level of inefficiency is high (DWA, June 2013). Improved efficiency at these schemes presents an opportunity for allocating the water to meet domestic and ecological demand, rather than proposing new schemes such as additional dams that are associated with their own ecological and political implications.

[2] Territory set aside by the Apartheid Government to which the majority of black South Africans were moved to prevent Black South Africans from participating in the economic activity of the urban areas. The Homelands were abolished and incorporated into the nine South African Provinces on 27 April 1994.

3.2 Project context in terms of the IUCMA CMS and Strategic Plan

The ICMA CMS (which now applies to the IUCMA) contains a matrix of objectives and strategic action programmes aimed at achieving the desired state of water resources and management within the WMA.

The highest IUCMA priorities that pertain to the ecological reserve and flow management include (https://www.iucma.co.za/catchment-management-strategy/):

- Facilitate the progressive, and stakeholder centred implementation of the Reserve;
- Consolidate systems for integrated planning and operations of river systems;
- Promote coordinated river operations, and - Establish and maintain appropriate River Operations Committees;
- Ensure implementation of Resource Quality Objectives and Reserve are transparent and inclusive; and
- Ensure appropriate enforcement of the different water uses.

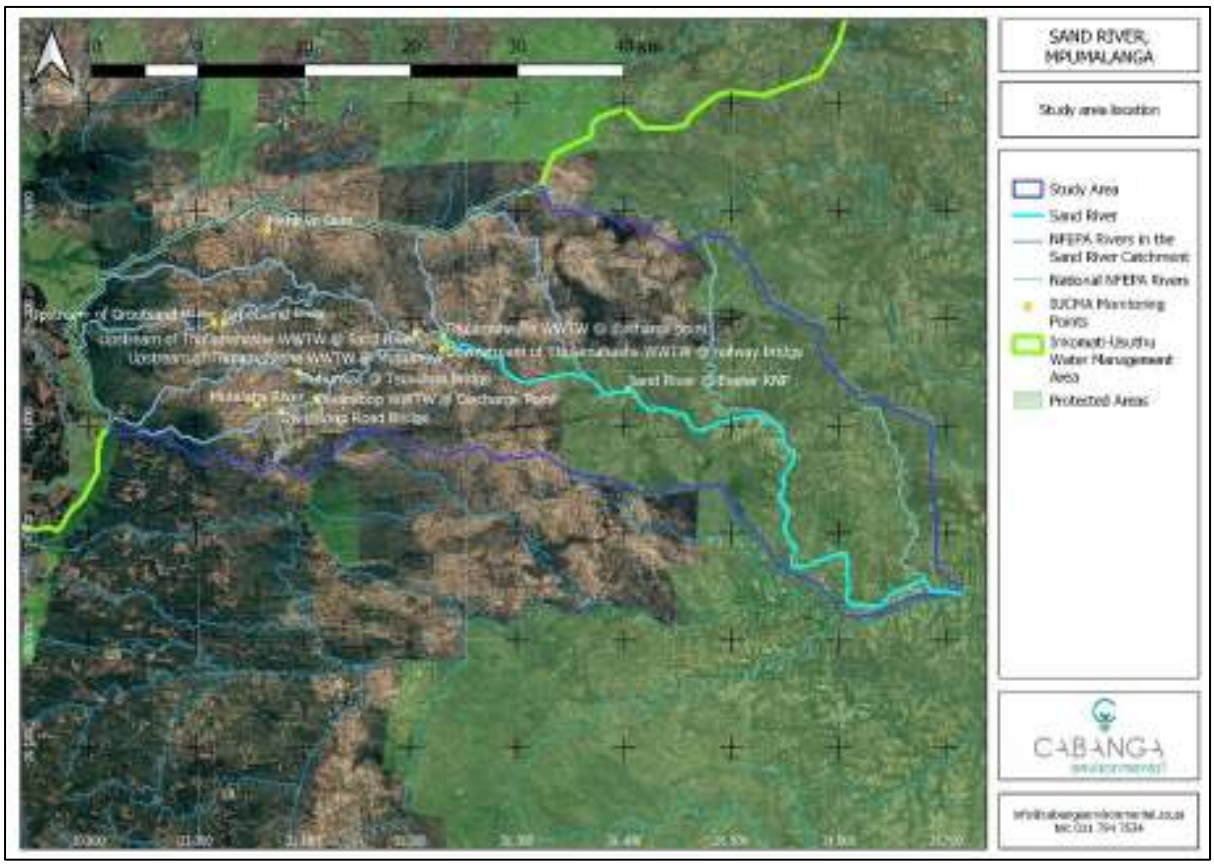
It is clear from the IUCMA's stated priorities that integration forms the core of their strategy, which is largely focussed on human demand and less so on the ecological reserve directly. The IUCMA's 5-year strategic plan (IUCMA, November 2017) identifies the following key priorities the IUCMA will commence and continue with:

- The IUCMA will continue to prevent and remedy water pollution in the WMA;
- The IUCMA has completed a validation of Existing Lawful Use (ELU) in the former Inkomati WMA, and has to now also complete this validation for the Usuthu catchment. Once completed, the IUCMA will commence with a water allocation plan for the catchment and finalize compulsory licensing to achieve Water Allocation Reform;
- Water Resource Management Charges (billing of water users) is a priority currently done by the DHSWS and to be handed over to the IUCMA;
- Stakeholder empowerment and interactions is another key priority for the IUCMA, who will thus ensure that all stakeholders actively and effectively participate in IWRM;
- The progressive implementation of the Reserve is directly related to the operation of River Systems, in which the IUCMA plays a leadership role;
- The IUCMA plays an important role in the River Health Programme (including monitoring);
- The IUCMA will continue to operate and maintain river flow and rainfall data loggers to support their river operations process mentioned above;
- The IUCMA will implement a water quality monitoring network;
- The IUCMA will continue to support trans-boundary water resources management;
- Compliance monitoring and enforcement; and
- Strengthening co-operative governance.

The IUCMA has one flow gauge in the Sand River Catchment. It is located on the Sand River at Exeter. On 14 October 2019 flow was recorded at 0.12m³/s which is regarded as low flow. Flow data from 22 September to 14 October 2019 recorded an average flow of 0.12m³/s (low flow) and maximum flow of 0.129m³/s (low flow). The low flow conditions recorded during this period are not unexpected as the records reflect the dry-season. Very low flow (0.001 m³/s) was recorded on 09 November 2019, despite the onset of the rainy season.

With only one flow meter in the entire study area, it is impossible to reliably compare river flows upstream and downstream of points where abstraction, diversion or impediments of the River occur. It is therefore impossible to measure the extent to which surrounding activities impact on flow rates in the Sand River, or in any of the Rivers or streams that feed the Sand River.

The IUCMA has no reservoirs in the Sand River Catchment indicated on their Water Resources Information Management Dashboard. According to the Dashboards, the IUCMA also does not record rainfall within the Sand River Catchment. There are a number of water quality monitoring points in the Sand River Catchment (Plan 3), measurements are available at http://riverops.inkomaticma.co.za/.



Plan 3: IUCMA water quality monitoring points in the Sand River Catchment

Based on the IUCMA Water Resources Information Management Dashboard http://riverops.inkomaticma.co.za/#, the following is observed:

- The Majority of surface water quality monitoring points are located in the upper reaches of the catchment, with the monitoring point "Sand River @ Exeter Kruger National Park (KNP) being the only downstream monitoring point within the protected areas associated with the catchment.
- There are no true reference points (natural points) being monitored, all of the upstream monitoring points are located within surrounding peri-urban and suburban areas.
- It is noted that the catchment contains at least two Waste Water Treatment Works (WWTW). E-Coli measured at the Dwarsloop WWTW discharge point was compliant to standards, however downstream of the Dwarsloop WWTW discharge, and upstream of

the Thulamahashe WWTW in the Mutlumuvi River, E-Coli measured did not meet the stated thresholds, implying an impact on the River between these two points. The river systems between the Dwarsloop WWTW and Thulamahashe WWTW are characterized by semi-formal and informal settlements along the River and relatively small-scale, medium and large agricultural activity (irrigation and dryland farming).

4 Ecological Status

In 2016, the Mpumalanga Tourism and Parks Agency (MTPA) undertook an environmental biomonitoring exercise to determine the eco-status of the Sabie and Sand River Catchments (MTPA, January 2017).

According to the Report, the Motlamogatsana (called the "Klein Sand River in the Report), Tlulandziteka (named the Sand River in the Report) and Mutlumuvi Rivers make up the main sources of the Sand River.

Commercial forestry is the dominant land-use in the headwaters. The upstream sites were generally in a relatively good condition, but affected by forestry, associated roads and sediment inputs. High sediment deposition is characteristic of the rivers and streams draining the highly erodible soils of the escarpment foothills.

Three sites on the Tlulandziteka River were sampled and assessed as being in a moderately impaired Category C condition. The upstream site was in a relatively good condition, with high sand inputs and deposition noted in the middle and lower sampling sites within the reach. The report further noted domestic waste inputs from surrounding communities in the downstream sites and a noticeable decrease in the volume of water in the River between the two downstream sites. Several invasive weed species were also noted including Eucalyptus, known to use significant quantities of water. The most downstream sampling point within this reach is at the Champagne Citrus Farm with irrigation pumps and dams noted. A severe decrease in flow volumes was noted at this point.

One monitoring point on the Motlamogatsana River was included in the study. Commercial forestry dominates in the upper reaches, with towns and rural settlements dominating further downstream. The stream substrate is dominated by sand with bedrock and boulders. Cobble runs and cobble rapids are present but limited. The stream at the sampling point was characterised by high sand deposition, shallow sand-filled pools and very low baseflow.

One site on the Nwandlamuhari was sampled during the study. The River is "representative of a Lowveld stream characterised as a low inclined, braided and sand dominated stream with multiple channels with sandy runs and large pools. The instream habitat lacks riffles and runs with stones and cobbles in current". The accumulation of sediments and nutrients have led to Phrigmites reed beds dominating the riparian vegetation. Sand dominated the stream substrate and illegal sand mining was recorded in the river and riparian zone. Flow was extremely low, even when compared to upstream flows (e.g. at Champagne Citrus Farm) that were also low.

At the site near the confluence of the Nwandlamuhari and Mutlumuvi where the Sand River starts, at the Thulamahashe WWTW, extremely low volumes of water were noted in the stream. The River at this point is used as a waste disposal site, and a strong smell of raw sewage is noted in the report.

Two sites on the Sand River, corresponding to the "Sand River at Exter" IUCMA monitoring point, and the Londolozi Reserve Game Lodge, were characterized as braided, low inclined, sand dominated streams with a low abundance of instream habitat in the forms of riffles and runs with stones in current only occurring at dolerite intrusions. It was noted that low-level bridges in this reach impedes the water, causing high sediment deposition above the bridges. The biggest impact on the river at this point was attributed to "extremely low flow as a result of over abstraction in the upper catchment" (MTPA, January 2017).

Further downstream of Londolozi, the report noted that "sand deposition and movement is extremely high, with the river bed wide and shallow. Flow was restricted to a trickle because of the drought and upstream over abstraction" (MTPA, January 2017).

The report noted decreasing water qualities from the upper reaches to the downstream Sand River, along with decreasing ecological conditions. The river is affected by domestic and sewage waste deposition, alien invasive species and surface water abstraction activities. Illegal mining was also noted.

5 Legal Context

The Constitution (1996) is the supreme law of the Republic of South Africa. Law or conduct inconsistent with it is invalid, and the obligations imposed by it must be fulfilled.

The Bill of rights contained in Chapter 2 of the Constitution is the cornerstone of democracy and enshrines the rights of all people in South Africa. It is important to note that constitutional rights are all-inclusive; i.e. one person's right to freedom of expression (section 16) does not over-ride another person's right to human dignity (section 10).

From a Constitutional context, the following basic human rights are relevant to the assessment of water resources and water use in the Sand River and its catchment:

- Section 22 of the Constitution confirms the right of every person to choose their trade, occupation or profession freely, and also that the practice of a trade, occupation or profession may be regulated by law. In this context, agricultural practices, for example, occurring on the banks of the Sand River tributaries are allowed by the constitution, subject to the provisions of the NEMA, NWA, CARA and potentially other laws.
- Section 24 of the Constitution states that: "*Everyone has the right to (a) 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 –*
    - *Prevent pollution and ecological degradation;*
    - *Promote conservation; and*
    - *Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*
- Section 27 affirms everyone's right to have access to sufficient water (among other things).

To give effect to Section 24 of the Constitution, several laws have been promulgated towards realization of these rights. The key legislation that is pertinent to the management of the Sand River Catchment are described in Sections 5.1 and 5.2.

5.1 General Environmental Management Legislation

South Africa first enacted legislation which provided for the determination of environmental policy to guide decision-making in 1989 (The Environmental Conservation Act, No. 73 of 1989), though evidence of the value placed on South Africa's environment is known from our earliest histories (Sowman, Fuggle, & Preston, 1995).

A clear distinction is made in the regulatory environment today between the concept of conservation (i.e. the preservation of natural resources) and environmental management (i.e. the sustainable development of natural resources).

During the 1970s the debate on the necessity for and appropriateness of EIA as a tool in decision-making was raised in several forums in South Africa. In 1974, an inter-disciplinary committee representing various environmental planning professions was established to prepare a set of guidelines to assist planning professionals in effectively taking environmental aspects into account. The Guidelines were published in 1980, but never adopted officially (Sowman, Fuggle, & Preston, 1995).

Further evidence of the government's recognition of the value of EIA as an aid to decision-making was given in the 1980 "White Paper on a National Policy Regarding Environmental Conservation." It is noted that a white paper is a declaration of intention and is not legally binding. Following the White Paper, a Commission of Inquiry into environmental legislation was appointed (in1981), who proposed a draft bill on environmental conservation.

The White Paper and Draft Bill formed the basis of the Environmental Conservation Act, 1982 (Act No 100 of 1982). The act contained limited provision to regulate activities and decisions that could impact on the environment.

During the 1980s the voluntary undertaking of EIAs as an input to decision-making increased. The publication of the Integrated Environmental Management (IEM) procedural document in 1989 coincided with the promulgation of the new Environmental Conservation Act 73 of 1989, which provided for protection, sustained utilization, maintenance and improvement of the environment, and incorporation of IEM in decision-making as a regulatory tool (Sowman, Fuggle, & Preston, 1995).

5.1.1 The National Environmental Management Act, 1998

The National Environmental Management Act, 1998 (Act No 107 of 1998) (NEMA), as amended was set in place in accordance with Section 24 of the Constitution, to regulate activities that could potentially threaten a person's right to an environment that is not harmful to their health or wellbeing, and to ensure that the environment is protected for the benefit of present and future generations.

Certain environmental principles under NEMA have to be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that the potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing (or prohibiting) the implementation of an activity.

The Environmental Impact Assessment (EIA) Regulations promulgated in terms of NEMA contain lists of activities that must first undergo an EIA process and gain authorization from the relevant authority, prior to being undertaken. Table 1 shows some of the Listed Activities that are identified in the regulations, that specifically relate to activities in or near watercourses.

Prior to undertaking such activities, authorization in terms of the NEMA must be obtained. Such authorization may be applied for by following a Basic Assessment, or Scoping and EIA Process, depending on the nature of the intended activity. A person who intends to undertake a Listed activity must appoint an independent Environmental Assessment Practitioner (EAP) to undertake the EIA and apply for authorization. From February 2020, only EAPs that are registered EAPs with the Environmental Assessment Practitioners Association of South Africa (EAPASA) will be allowed to undertake an EIA Process (including Basic Assessment, or Scoping and EIA).

Environmental Authorization granted in terms of NEMA are usually conditional, and place an obligation on the Holder of the authorization to undertake their activities in a certain manner so as to minimize environmental impacts. Holders are also required to monitor and report on the environmental impacts of their activities.

Typically, in the context of the "Save the Sand" project, activities that require environmental authorization will include mining and prospecting activities, construction of infrastructure such as roads or bridges, the clearing of indigenous vegetation, construction of dams and weirs, and construction of wastewater treatment facilities, to name a few.

There are 11 relevant authorities in terms of the NEMA and granting of environmental authorizations, the National Department of Environmental Affairs, Provincial Departments of Environmental Affairs (9 Provinces) and the Department of Mineral Resources, who is responsible for the implementation of NEMA as it pertains to Listed Activities associated with mining and prospecting operations.

In terms of the NEMA (Section 49A) a person is guilty of an offence if they commence with the undertaking of a Listed Activity without having obtained Environmental Authorization, or fails to comply with or contravenes a condition of an environmental authorisation. Furthermore, a person is guilty of an offence in terms of NEMA if they unlawfully and intentionally or negligently commit any act or omission which causes significant pollution or degradation of the environment. NEMA provides for penalties of up to R10 Million, or ten years imprisonment, or both, if a person is convicted of an offence.

NEMA grants the Minister of Environmental Affairs, Water Affairs and of Mineral Resources, and an MEC the authority to designate certain persons as an environmental management inspector (EMI's). EMI's are responsible for the undertaking of compliance monitoring and enforcement in terms of the relevant laws, including NEMA and other specific environmental management acts (SEMA's) including the NWA, NEMBA, NEMWA etc (see relevant sections to follow).

The Environmental Management Inspectorate (also known as the Green Scorpions) represent the environmental compliance and enforcement capacity in respect of the NEMA, SEMAs Provincial and Local legislation pertaining to environmental matters. As at 31 March 2017, the national EMI Register had 2 880 EMIs, comprising 2 577 from national and provincial authorities and 303 from municipalities. In 2016/17, EMIs inspected a total of 4,379 facilities countrywide

(https://www.environment.gov.za/sites/default/files/docs/publications/greenscorpions_newspaperinsert.pdf).

Despite noted improvements in compliance monitoring being undertaken by EMIs, non-compliance with environmental laws is still quite common in South Africa. Much attention is focused on "big polluters" such as the mining industry, with little investigation into smaller activities such as subsistence farming. It must be noted, however, that even a small-scale farmer abstracting comparatively little water from a river, could have profound cumulative effects on that river system when seen in the peri-urban landscape dominating the upper reaches of the Sand River catchment, for example.

5.1.2 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) and Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983) (CARA)

The NEMBA provides for the management and conservation of South Africa's biodiversity within the framework of the NEMA.

A List of alien plants has been published in terms of NEMBA and grouped into three categories, including those that require compulsory control (Category 1a and 1b), those that are only regulated in specific areas (Category 2) and those that are regulated by activity (Category C). in other words, Category 1 species are illegal and must be removed, they are not allowed to grow anywhere in the country. Category 2 and 3 plants are illegal within 30 metres of the 1:50 year flood line of a watercourse.

The responsibility for the management and eradication of alien invasive species lies with the owner of the surface rights where such plants are located. Land-users may also be held accountable for the control and management of invasive weed species on their land.

CARA provides for control over the utilization of the natural agricultural resources of the Republic to promote the conservation of soil, water sources and vegetation and the combating of weeds and invader plants. The Act specifically prohibits any person from spreading weeds or allowing weeds to be spread or reproduced.

Negative impacts of alien invader plants include (but are not limited to) the replacement of indigenous vegetation, decreased biodiversity, increased fire risk, increased water use, and access problems (dense vegetation).

It is reported that the extent of invasive weed species in the study area is severe, with numerous species recorded in high abundance (MTPA, January 2017).

Table 1: Some of the Listed Activities associated with watercourses

Listing Notice	Activity No	Activity description	Exclusions?
Listing Notice 1	Activity 12	The development of—dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 m²; or infrastructure or structures with a physical footprint of 100 m² or more; where such development occurs— (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;	excluding— (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; (ee) where such development occurs within existing roads, road reserves or railway line reserves; or (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.
Listing Notice 1	Activity 13	The development of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50 000 m³ or more,	unless such storage falls within the ambit of activity 16 in Listing Notice 2 of 2014.
Listing Notice 1	Activity 19	The infilling or depositing of any material of more than 10 m³ into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 m³ from a watercourse;	but excluding where such infilling, depositing, dredging, excavation, removal or moving— will occur behind a development setback; is for maintenance purposes undertaken in accordance with a maintenance management plan; falls within the ambit of activity 21 in this Notice, in which case that activity applies; occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or

Listing Notice	Activity No	Activity description	Exclusions?
			where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.
Listing Notice 1	Activity 25	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 m³ but less than 15 000 m³.	-
Listing Notice 1	Activity 48	The expansion of— (i) infrastructure or structures where the physical footprint is expanded by 100 m² or more; or (ii) dams or weirs, where the dam or weir, including infrastructure and water surface area, is expanded by 100 m² or more; where such expansion occurs— (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;	excluding— (aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such expansion activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such expansion occurs within an urban area; or (ee) where such expansion occurs within existing roads, road reserves or railway line reserves.
Listing Notice 2	Activity 11	The development of facilities or infrastructure for the transfer of 50 000 m³ or more water per day, from and to or between any combination of the following — (i) water catchments; (ii) water treatment works; or (iii) impoundments;	excluding treatment works where water is to be treated for drinking purposes.
Listing Notice 2	16	The development of a dam where the highest part of the dam wall, as measured from the outside toe of the wall to the highest	-

Listing Notice	Activity No	Activity description	Exclusions?
		part of the wall, is 5 metres or higher or where the highwater mark of the dam covers an area of 10 hectares or more.	
Listing Notice 2	24	The extraction or removal of peat or peat soils, including the disturbance of vegetation or soils in anticipation of the extraction or removal of peat or peat soils,	but excluding where such extraction or removal is for the rehabilitation of wetlands in accordance with a maintenance management plan.
Listing Notice 2	25	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of 15 000 m^3 or more.	
Listing Notice 3	14	The development of— (i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 m^2; or (ii) infrastructure or structures with a physical footprint of 10 m^2 or more; where such development occurs— (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; In Specified areas in Mpumalanga.	excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.

5.2 Water Management Legislation

The NWA provides for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, and that a person can only be entitled to use water if the use is permissible in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). A person may only use water if the water use is licensed, if the responsible authority has dispensed with a license requirement, if the water use is permissible under Schedule 1 (see Section 5.2.1), as a continuation of an existing lawful use (Section 5.2.2), or is the water use is permissible in terms of a General Authorisation (Section 5.2.3).

A "water resource" includes a watercourse, surface water, estuary, or aquifer, according to the NWA, while a "watercourse" is defined as (a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA identifies a number of "water uses" that require authorization in terms of the NWA before being undertaken. Water Uses as defined in the Act, include the following:

Table 2: Water Uses according to the NWA

Water Use as defined in the NWA		Definition / description
a)	Taking water from a water resource.	This includes abstraction of water from surface- and/or groundwater resources, regardless of the reason for the abstraction.
b)	Storing of water	Raw water containment facilities constructed in-stream and in off-channel dams.
c)	Impeding or diverting the flow of water in a watercourse.	This is relevant to activities occurring in watercourses (construction of bridges for example).
d)	Engaging in a stream flow reduction activity contemplated in section 36	Stream flow reduction activities is currently limited to the use of land for afforestation for commercial purposes.
e)	engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);	Controlled activities include irrigation of land with waste or water containing waste, activities aimed at the modification of atmospheric precipitation, power generation that alters a flow regime, and intentional aquifer recharge with water containing waste.
f)	discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit	e.g. discharging treated effluent into a river or a wetland.
g)	disposing of waste in a manner which may detrimentally impact on a water resource	Disposal of effluent into a water containment facility, use of dirty water for dust suppression etc.

Water Use as defined in the NWA		Definition / description
h)	disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process	Discarding of industrial/power generation waste water or water which has been heated.
i)	Altering the bed, banks, course or characteristics of a watercourse	This activity often relates to activities occurring near watercourses that may affect runoff to a watercourse and is often closely associated with section 21(c). It is important to note that Section 21(c) water use, will always be associated with a section 21(i) water use, but that the converse is not the case, as many activities alter the banks of a watercourse without in fact impeding or diverting the flow.
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	This water use is most closely associated with dewatering of mine workings.
k)	Using water for recreational purposes	The use of surface water for fishing, boating, etc.

A water Use is authorised in one of the following ways:

- If the water use is permissible under Schedule 1 of the NWA;
- If the water use constitutes the continuation of an existing lawful use (ELU);
- If the water use is permissible in terms of a General Authorisation (GA) promulgated in terms of the NWA (should still be registered as a GA with DHSWS); or
- If the water use is authorised by a Water Use License (WUL) issued in terms of the NWA.

5.2.1 Schedule 1 water uses

Schedule 1 use is generally associated with small scale domestic use, including for example:

- water taken for reasonable domestic use in a person's household from any source;
- small gardening (but not for commercial purposes);
- watering of livestock (excluding feedlots) that graze on that land (within the carrying capacity of that property);
- storing and using run-off water from a roof (rain water harvesting);
- in emergencies, e.g. fire-fighting; and
- small-scale / personal recreation, e.g. swimming, angling, etc.

A person may commence with Schedule 1 water uses without informing the DHSWS, however a CMA (such as the IUCMA) may limit the taking of water in terms of schedule 1 in accordance with Schedule 3(2)(e) of the NWA.

5.2.2 Existing Lawful Use

ELU refers to any use of water that was authorized by or under any law that took place at any time for a period of two years before the commencement of the NWA (i.e. water uses that occurred lawfully between 1996 and 1 October 1998).

The NWA prescribes that an ELU may continue only if it is not limited, prohibited or terminated by the NWA, and that a responsible authority may require the registration of an ELU. The call for the registration of ELU's was made in the Government Gazette on 12 November 1999.

Water Users were informed that the lawfulness of the water uses still needed to be determined during the validation and verification process. Validation for the Inkomati Catchment has been completed, with verification in its final stages while validation and verification for the Usuthu Catchment is underway (commenced in November 2016).

The NWA also empowers the relevant authorities to require a person claiming entitlement to water in terms of ELU, to apply for a License. If such license is issued, it supersedes the ELU entitlement, and if it is not granted, the water use is no longer permissible.

5.2.3 General Authorizations

A GA is an authorisation to use water without a licence, provided that the water use is within certain limits and complies with conditions set out in the Gazetted GA. This authorisation requires a registration with the Department prior to exercising the water use(s).

The following GA's have been published:

- GN 1198 – GA for Section 21(c) and (i) water uses for the purpose of rehabilitating a wetland for conservation purposes. Note the GA only applies to persons who are organs of state carrying out this water use;
- GN 665 – revision of GA's for Section 21(e); (f); (h); (g) and (j), and GN 383 which confirms the continuation of the GA;
- GN 509 – GA for Section 21(c) and (i) water uses; and
- GN 538 – Revision of GA for Section 21(a) and (b) water uses.

It must be noted that the GA's are all subject to specific areas of applicability, conditions, monitoring requirements and exclusions.

5.2.4 Water Use Licensing

If a water use is intended and cannot be undertaken in terms of a GA or ELU and exceeds the limitations of Schedule 1, then the user must apply for a Water Use License (WUL) from the responsible authority (in the Inkomati-Usuthu Water Management Area, the IUCMA is the responsible authority).

The process to apply for a WUL is prescribed by the Water Use Licence Application and Appeals Regulations, 2017 (WULA Regulations) published in GN R 267 of 24 March 2017, and involves the following key steps (Table 3):

Table 3: Steps in the WULA Process

Steps / Action	Purpose / outcome
Pre-application enquiry meeting	A meeting is held between the IUCMA, the applicant (water user) and environmental assessment practitioner (EAP) to ensure that the intended application process meets the requirements of the regulator and verify that all relevant intended water uses have been included in the application.

Steps / Action	Purpose / outcome
Application submission	The EAP, on behalf of the applicant, submits the required application forms on the E-WULAAS online application portal. The applicant is required to approve the EAP and the applications on the portal as well.
IUCMA site inspection	The IUCMA will in most instances undertake a site inspection, to comprehensively understand the on-site conditions and intention of the proposed water use(s).
Technical Report and Supporting Documents	Following the site inspection, the IUCMA communicates their requirements for a technical report to the applicant and EAP. The EAP then compiles the technical report on behalf of the applicant, including the required specialist inputs. This phase is also associated with Public Participation.
IUCMA assessment, decision and communication to applicant	The IUCMA will evaluate the application and technical report, in the context of the site and intended water uses, and reach a decision on the application. The IUCMA will communicate their decision to the applicant and EAP and may also request additional information.

5.3 Reserve determination

The "reserve" consists of two parts – the basic human needs reserve and the ecological reserve. The NWA defines "reserve" as "the quantity and quality of water required –

a) to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act, 1997 (Act No. 108 of 1997), for people who are now or who will, in the reasonably near future, be –
    i) relying upon;
    ii) taking water from; or
    iii) being supplied from,

the relevant water resource; and

b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource."

The NWA stipulates the requirements for the determination and maintenance of the reserve in both the NWRS and CMS.

On 10 November 2017, the reserve determination of water resources in the Inkomati Catchment was published in Government Gazette No 41237, in terms of Section 16(1) & 16(2) of the NWA. The surface water quantity component for Rivers in the WMA defines the following parameters that are relevant to the Rivers that are the subject of this Report:

Table 4: Summary of the quantity component for the Rivers

Catchment	Water Resource	PES[3]	EIS[4]	REC[5]	Ecological Reserve (%NMAR[6])	BHN [7] Reserve (%NMAR)	Total Reserve (%NMAR)	NMAR (MCM[8])
X32B	Motlamogatsana	C	High	C	25.7	0.69	26.39	15.40
X32C	Tlulandziteka	C	Moderate	C	31.7	0.57	32.27	28.88
X32E	Nwarhele	C/D	High	C	26.10	2.87	28.97	10.6
X32F	Mutlumuvi	C	High	B	32.20	0.42	32.62	44.99
X32G	Khokhovela	C	Moderate	C	17.00	8.57	25.58	3.90
X32H	Phungwe	A	High	A	26.10	2.33	28.43	7.60
X32J	Sand River	B	High	B	25.30	0.30	25.60	133.61

In terms of water quality, the reserve determination classed catchment X32A to X32E as class 0 with no water quality parameters of concern. Fluoride was flagged as a concern in catchment X32F, NO_3 in catchment X32G, and EC and Na in catchment X32H, while EC, Na and Cl were highlighted in catchment X32J, showing a clear deterioration in water quality from the upstream catchments to the downstream environment (http://www.gpwonline.co.za/Gazettes/Gazettes/41237_10-11_NationalGovernment.pdf).

[3] Present Ecological State
[4] Ecological Importance and Sensitivity
[5] Recommended Ecological Category
[6] Natural Mean Annual Runoff
[7] Basic Human Needs
[8] Million Cubic Metres

6 Physical Context

To understand the nature of the Sand River and how it is used (by ecological systems and humans alike), it is important to gain an understanding of the greater physical, ecological and social context that could manifest in changes to the River System, and the legislative requirements of such land use practices and activities.

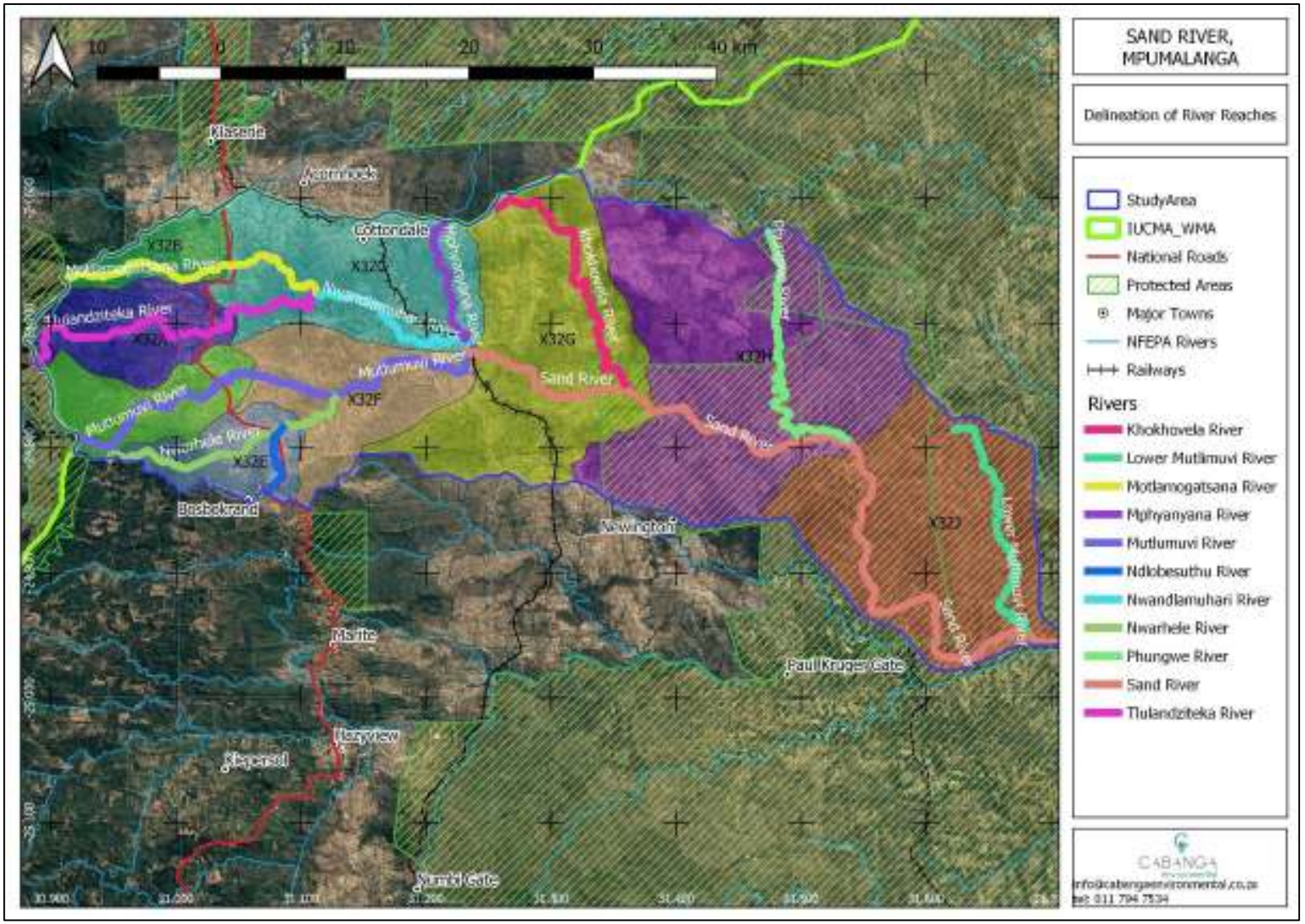
To simplify this task, the study area (which comprises the Sand River Catchment) is separated into units of different scales and analysed based on aerial imagery obtained from Google Earth Pro. No ground-truthing is being undertaken as part of this report.

The study area is divided as follows:

Table 5: Rivers in the study area

No	Description	Catchment(s)	Rivers
1	Rivers Contributing to the Sand River	X32A X32B X32C	Tlulandziteka
2			Motlamogatsana
3			Nwandlamuhari
4			Mphyanyana
5		X32D X32E X32F	Ndlobesuthu
6			Nwarhele
7			Multlumuvi
8		X32G	Khokhovela
9		X32H	Phungwe
10	The Sand River	X32G X32H X32J	Sand River

An overview of the Rivers is provided in Plan 4.



Plan 4: River Reaches – Overview

6.1 Discussion of Rivers that contribute to the Sand River

6.1.1 Tlulandziteka River

The Tlulandziteka River originates in the mountainous regions of the Blyderivierspoort Nature Reserve, where it flows through commercial forestry and relatively natural areas without encumbrance until it reaches it first significant anthropogenic impact, a local dirt road crossing at approximately 24°42'41.71"S; 30°55'48.80"E (Figure 2). Review of aerial imagery from Google Earth Pro indicates the road has been in existence since before 2007 and no significant impacts on the river downstream can be observed from the photographs.

The landscape changes significantly once the River flows onto the Farm Wales 463KT, at approximately 24°42'31.45"S; 30°56'50.91"E (Figure 3) where the more natural surrounding landscape gives way to agricultural fields, potential overgrazing and many more roads and homesteads than previously present in close proximity of the River.

The River then flows through various areas characterized as residential settlements with associated land uses including commercial and institutional facilities. It appears as though some of these land uses encroach on the floodline of the river in places (Figure 4). Additionally, there are numerous built structures in and immediately adjacent to the River (Figure 5 to Figure 7). Figure 6 shows a weir (Dingleydale Weir) constructed in the river, that diverts flow to an off-stream channel that extends for approximately 5.5km over a portion of the Farm Kasteel 231KU and a portion of the Farm Champagne 230KU, all the way to the Champagne Citrus Farm, and beyond

The Dam illustrated in Figure 7 has a surface area (measured on Google Earth) of just over 8 Hectares, but the Dam's capacity and wall height are not known and it should be confirmed whether this dam classifies as a dam with a safety risk.

At approximately 24°40'38.81"S; 31° 6'53.96"E, the Tlulandziteka confluences with the Motlamogatsana River (Section 6.1.2) to form the Nwandlamuhari River (Section 6.1.3).

The IUCMA has two monitoring points on the River at 24°42'17.10"S; 31° 1'2.03"E and at 24°42'16.12"S; 31° 1'35.46"E. No marked difference in water quality between these two points are identified from the available data (http://riverops.inkomaticma.co.za/#) though it is noted that E-Coli exceeds the allowable CFU/100m at both points.

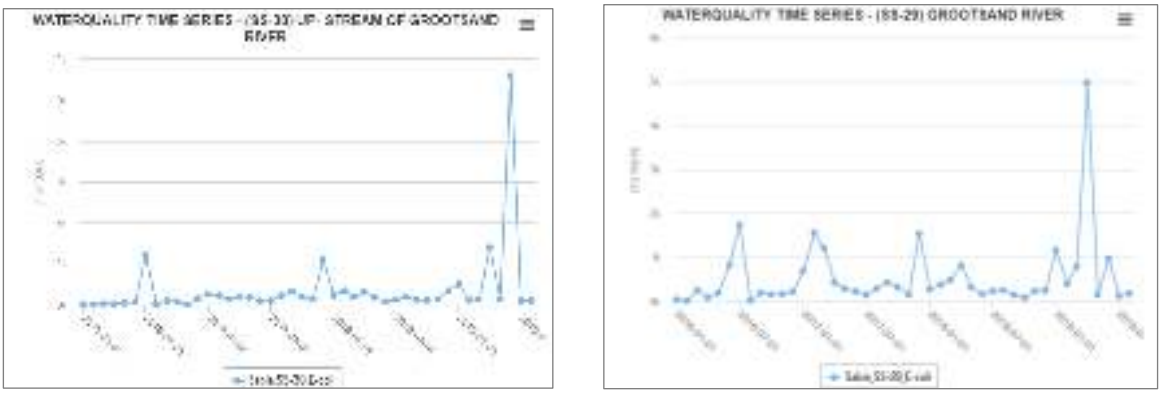


Figure 1: E-Coli measured Upstream (Left) and Downstream (Right)

Figure 2: Tlulandziteka River flowing through natural area at Road Crossing

Figure 3: Tlulandziteka River where it enters the Farm Wales 463KT

Figure 4: Tlulandziteka River with surrounding settlements

Figure 5: Land clearing, potential diversion and abstraction from Tlulandziteka River

Figure 6: Weir, with off-stream channel in yellow

Figure 7: Agriculture (Champagne Citrus Farm), Dam and diversion channel.

6.1.2 Motlamogatsana River

The Motlamogatsana River originates in the west of the study area, in the mountains, and flows in a roughly easterly direction through predominantly natural landscape with limited road crossings and some adjacent agricultural activities for about 15km before it reaches the more built-up areas of Setlhake and Arthur's Seat.

The outflow from the Mahleve Dam joins the Motlamogatsana at approximately 24°38'46.01"S; 31° 4'19.03"E around Rooiboklaagte (Figure 9). There is an apparent abstraction point at 24°39'7.42"S; 31° 3'25.23"E, reportedly also supplying water to the Champagne Citrus Farm. From here, the River forms the northern boundary of the agricultural activities at Champagne Citrus Farm, before its confluence with the Tlulandziteka River. Downstream of the confluence, the River is known as the Nwandlamuhari River (Section 6.1.3).

The IUCMA does not have any monitoring points on the Motlamogatsana River, but does monitor water quality in the Mahleve Dam. Elevated EC is recorded in the Dam, but a lack of upstream and downstream reference points makes it difficult to conclude anything pertaining to the dam's compliance with water quality standards. Review of aerial imagery from Google Earth indicates the Dam was built prior to 2003.

Figure 8: Agriculture and residential activities adjacent to the River

Figure 9: Mahleve Dam in relation to Motlamogatsana River

Figure 10: Rivers confluence

Figure 11: Mahleve Dam and its outflow

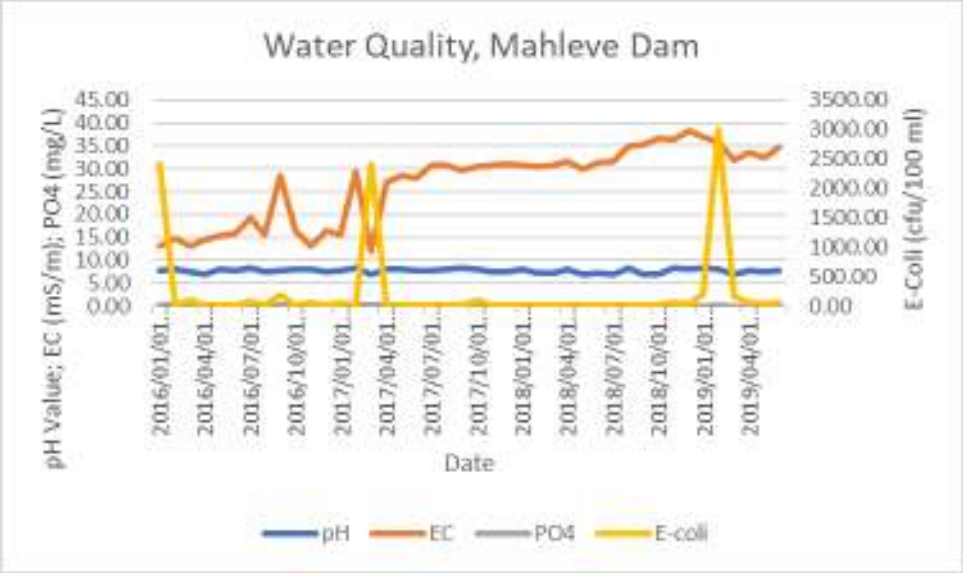


Figure 12: Water quality in the Mahleve Dam (http://riverops.inkomaticma.co.za/#)

6.1.3 Nwandlamuhari River

The Nwandlamuhari starts at the confluence of the Motlamogatsana and Tlulandziteka Rivers. This area is characterised by extensive agricultural activities, especially south of the River. It flows for only about 300m before being impeded by a significant rocky outcrop that succeeds in damming up the flow and releasing water to the downstream environment over very rocky terrain, that splits the River into separate streams (Figure 13). This anabranching flow pattern continues through a relatively natural area for approximately 2km before the river enters more built-up areas once more (Figure 14).

The mostly anabranching flow pattern continues over rocky outcrops, but the Nwandlamuhari also becomes increasingly affected by built structures and assumed abstraction activities (notably **Edinburgh Weir**) (Figure 15).

Figure 13: Nwandlamuhari River

Figure 14: River flowing over rocky outcrops

Figure 15: Structures and abstraction from the River

Figure 16: damming of the River, aided by a large weir / construction (Edinburgh Weir)

Figure 17: Potential abstraction from the Nwandlamuhari River

Figure 18: Confluence of the Mutlumuvi, Nwandlamuhari and Sand rivers at the Thulamahashe WWTW

The IUCMA has two monitoring points on the Nwandlamuhari River, one upstream and one at the discharge of the Thulamahashe WWTW. There is another point slightly downstream, in the Sand River at the Railway bridge (Figure 18).

The upstream monitoring location is shown in Figure 17. It is noted that the upstream monitoring point is located approximately 4km upstream of the dishcharge point, and therefore quality comparison between the upstream point and the quality at the discharge point also show contributions from other sources, including the Mphyanyana River that joins the Nwandlamuhari in this reach.

Comparison of pH recorded upstream, at the discharge point and downstream reveals no major impacts, however recorded Electrical Conductivity (EC) is markedly increased at the discharge point, and again comparable to upstream values at the downstream monitoring point. This may be as as result of dilution from the Mutlumuvi River water contributions. Similarly, E-Coli measured at the discharge of the WWTW is significantly elevated when compared to the upstream point but compares well to the upstream point, after the Mutlumuvi confluence. This could indicate some dilution taking place, though it is noted that E-Coli recorded in the

Mutlumuvi, upstream of the WWTW, also did not comply to the relevant guideline values (not detected).

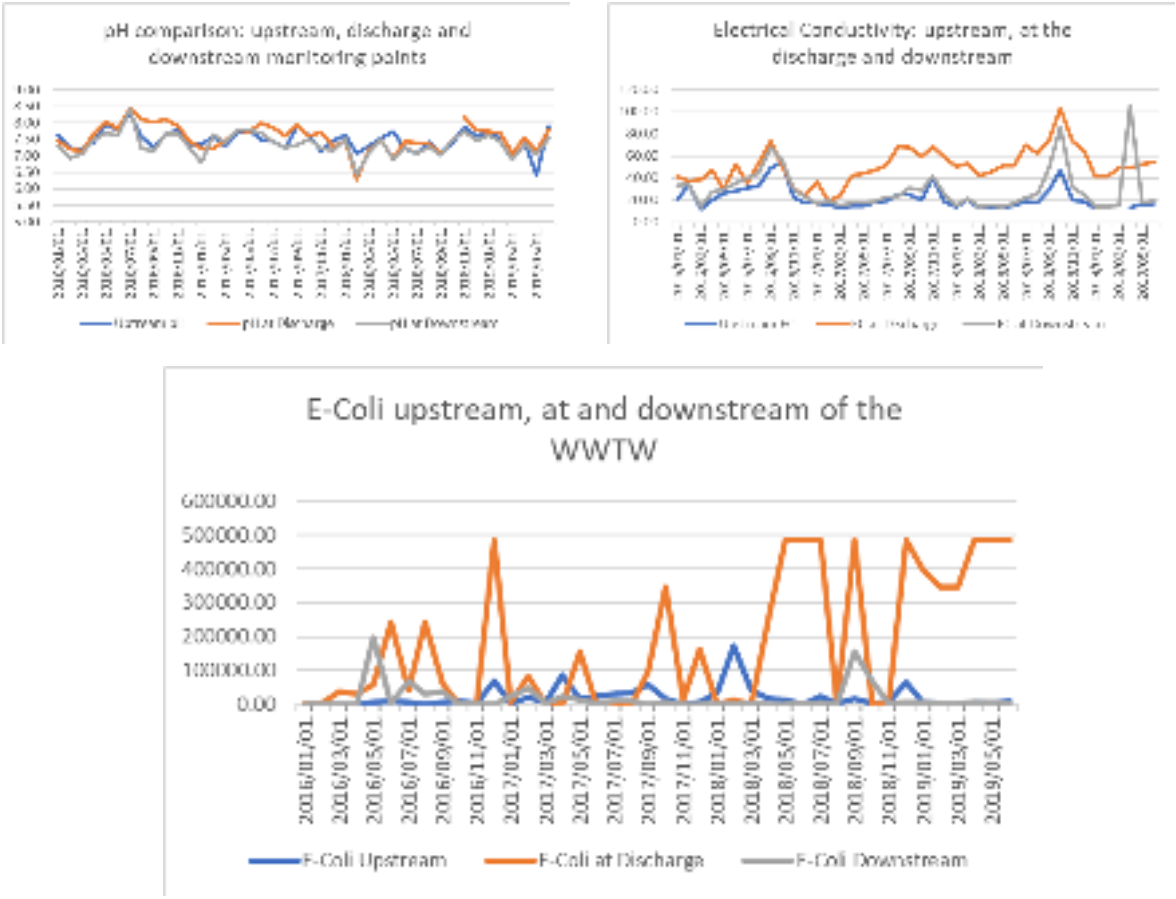


Figure 19: water quality upstream, at, and downstream of the Thulamahashe WWTW

6.1.4 Mphyanyana River

The Mphyanyana River originates in the north of the study area, amongst residential and associated land uses of Burlington Settlement. It is joined by numerous tributaries as it flows in a generally southerly direction through mostly natural landscape, until it reaches the settlement of Edinburgh, and the Edinburgh Dam.

A canal from the weir identified in the Nwandlamuhari River (Edinburgh Weir, Figure 16) appears to divert water from that point (at roughly 24°41'46.91"S; 31°10'8.32"E) to the Edinburgh Dam. Water from the Dam is in turn gravity fed to an open reservoir at 24°43'23.41"S; 31°15'28.67"E, which appears to be used for irrigation purposes.

The Mphyanyana River joins the Nwandlamuhari River upstream of the Thulamahashe WWTW.

The IUCMA have no flow gauges or water quality monitoring points on the Mphyanyana River or at the Edinburgh Dam. The Dam was purportedly constructed for irrigation purposes and has a capacity of 3,300,000 cubic metres (http://www.dwa.gov.za/documents/dws_dams%20list%20internet.pdf).

Bushbuckridge Water reported in 2008 that the Edinburgh Dam had very poor water quality (http://pmg-assets.s3-website-eu-west-1.amazonaws.com/docs/080507bushbuck.ppt)

Figure 20: Critical influences on and of the Mphyanyana River

6.1.5 Ndlobesuthu River

The Ndlobesuthu River originates in the town of Bushbuckridge (Mapulaneng) in the south-east of quaternary catchment X32E. The entire river reach is characterized by encroaching residential and supporting land uses (Figure 21, Figure 22).

The IUCMA has no flow monitoring or water quality monitoring points on the Ndlobesuthu River. The Ndlobesuthu flows into the Nwarhele at approximately 24°47'2.14"S; 31° 5'6.34"E, less than 1km downstream of the monitoring point on the Nwarhele at the R40 road bridge crossing, and approximately 3.5km upstream of the Dwarsloop WWTW. Contribution of poor-quality water from the Ndlobesuthu may therefore be contributing to the poor-quality water monitored at the Dwarsloop WWTW, but it is anticipated that the WWTW itself is a larger contributor to the pollution measured at this point (Figure 25).

Figure 21: Full extent of the Ndlobesuthu River affected by residential land uses

Figure 22: Encroaching residential land use and suspected manipulation of the River

Figure 23: suspected abstraction point

Figure 24: Encroaching agricultural activities

6.1.6 Nwarhele River

The Nwarhele River originates in the mountains in the west of the study area and flows through seemingly predominantly natural areas on the Farm Onverwacht 501KT for approximately 7.5km. Upon entering the Farm London 249KU, the Nwarhele River flows into a Dam (Figure 27), which covers a surface area of approximately 5Ha. Review of Google Earth Aerial Imagery shows that the Dam existed by 2012 but its date of construction is not known.

From the Dam, the river flows in a north-easterly direction for about 4km before entering the settlements of London-B and Dwarsloop-A (south of the River), and London-D and Shatale-A (north of the River) (Figure 28). The Ndlobesuthu River joins the Nwarhele at approximately 24°47'3.50"S; 31° 5'5.99"E, within these settlements. Along this stretch of the Nwarhele River, there are at least four road crossings affecting the River, along with the encroachment of residential buildings and agricultural activities (Figure 29; Figure 30).

Downstream of the confluence of the Ndlobesuthu, the Nwarhele is still impacted by encroachment of residential and agricultural activities.

Significant siltation and potential increased abstraction are clearly visible when comparing older aerial photographs (Figure 31) to the current situation (Figure 32).

The Dwarsloop Waste Water Treatment Works (WWTW / sewage works) are located at approximately 24°46'33.11"S; 31° 6'47.85"E. The Nwarhele River flows to the north of the sewage works. The IUCMA monitors water quality at the discharge point of the WWTW. The IUCMA also monitors water quality about 4km upstream of the WWTW, at the road bridge where the R40 crosses the Nwarhele River. Key comparisons of monitoring results obtained from http://riverops.inkomaticma.co.za/# are illustrated in Figure 25 to Figure 26.

Notably, E-Coli is consistently and significantly higher at the WWTW, than upstream thereof, indicating the WWTW is contributing to increased E-Coli in the River. Electrical Conductivity (EC) is also consistently higher at the WWTW than it is upstream.

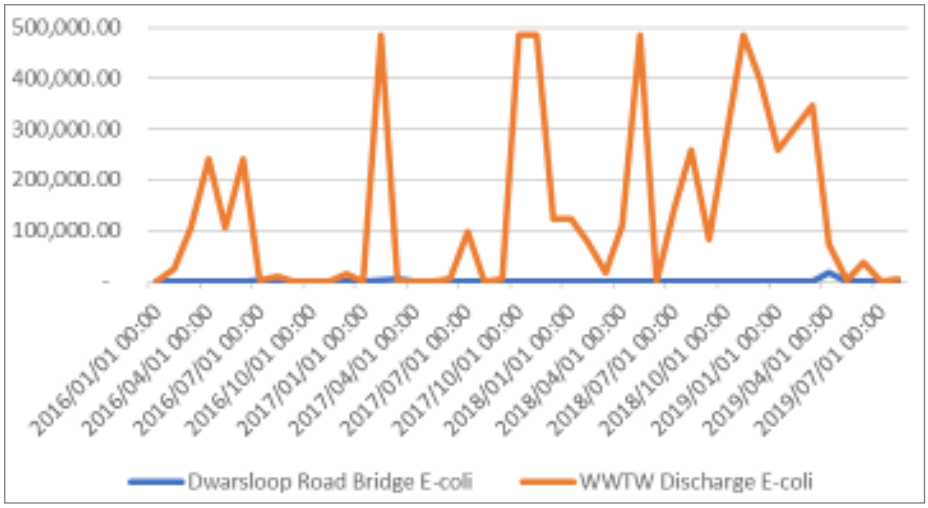


Figure 25: E-Coli measured upstream of and at the WWTW discharge

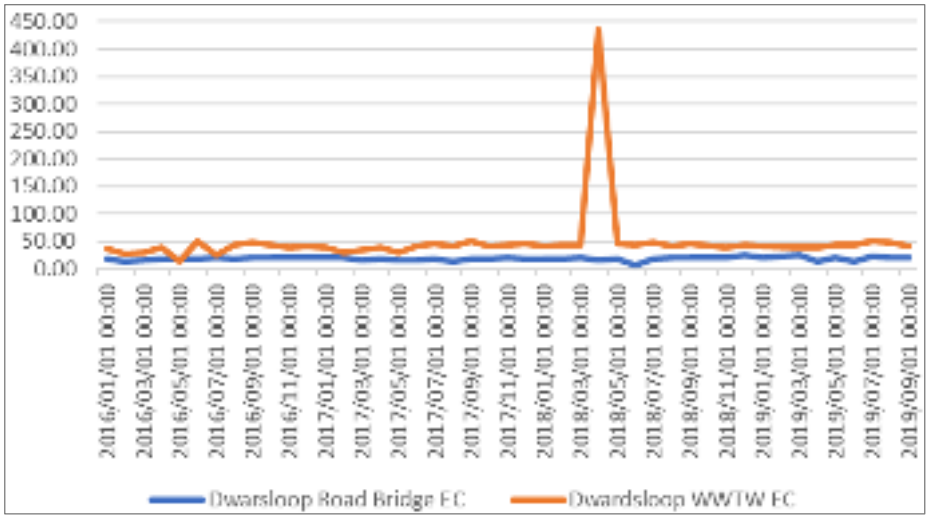


Figure 26: Electrical Conductivity (EC) measured upstream of and at the WWTW discharge

The Nwarhele River confluences with the Mutlumuvi River approximately 2.5km downstream of the Dwarsloop WWTW. This last stretch is still characterized by numerous agricultural and residential land uses in close proximity to the River banks.

Figure 27: Large Dam on the Nwarhele River

Figure 28: Nwarhele and settlements

Figure 29: Residences and road crossing

Figure 30: Nwarhele and Ndlobesuthu

Figure 31: Nwarhele River - 2017

Figure 32: Nwarhele River - 2019

Figure 33: Nwarhele River at Dwarsloop WWTW

Figure 34: Confluence of Nwarhele and Mutlumuvi Rivers

6.1.7 Mutlumuvi River

The Multumuvi River also originates in the more mountainous areas in the west of the study area, but flows for only about 6km before moving from the Farm Onverwacht, to the Farm Zoeknog where marked deterioration of surrounding vegetation is observed on aerial photographs, likely as a result of overgrazing, unsuitable land management practices and human settlement (Figure 35).

A large reservoir is present at approximately 24°45'43.10"S; 30°59'52.02"E (Figure 36), with assumed abstraction taking place from the River.

Smaller disturbances that appear to be private weirs, with and without pump houses, are also observed along this stretch (Figure 37; Figure 38).

The River then meanders past the settlements of Champagne, Violet Bank, Orinoco and New Forest B, downstream of which the Nwarhele River joins the Multlumuvi River at approximately 24°45'37.30"S; 31° 7'38.07"E. This section of the Multumuvi River before its confluence with the Nwarhele River is characterized by these settlements and significant agricultural activities that sometimes affect the land right up to the edge of the River. The agricultural activities (and some of the domestic activities) are supported by various off-stream channels or canals shown in Figure 41.

Immediately downstream of the Nwarhele confluence, the Mutlumuvi River flows over another small weir (24°45'35.06"S ; 31° 7'42.78"E) and then through a more natural landscape for approximately 2.5km before reaching the intense agricultural activities and human settlements of New Forest and Thulamahashe, before its confluence with the Nwandlamuhari River and the Sand River.

Figure 35: Multumuvi River where it flows from Onverwacht to Zoeknog

Figure 36: Reservoir on the Mutlumuvi River

Figure 37: Apparent abstraction point

Figure 38: Apparent weir / dam

Figure 39: Dam on the Multumuvi River (New Forest Abstraction)

Figure 40: Start of irrigation canal next to River

Figure 41: Mutlumuvi River (blue) and irrigation canal (red)

Figure 42: Weir in the river, and homes immediately adjacent to the river

6.1.8 Khokhovela River

The Khokhovela River originates in the north of the study area and flows first east, then south through landscapes comprising relatively low-density residential settlements, agricultural activities and natural veld. Aerial imagery shows the River is very sandy, up to the point where it flows into a dam at roughly 24°37'28.21"S; 31°18'15.03"E. Aerial imagery shows the dam existed by 2013 (Figure 43).

Downstream of the Dam, the river remains sandy (based on aerial photographs where almost no water is visible in the River). Past research in similar environments has revealed that Dam construction, preventing natural flooding of downstream environments, can cause significant siltation of River systems, and alter aquatic ecosystems historically associated with such systems. It also presents economic opportunity to people in the construction industry – such river sand often displays ideal properties for use as construction sand and is readily extracted by persons who have access to the River, and the equipment (often without the necessary permits and environmental licenses) (Figure 44).

There are no IUCMA monitoring points on the Khokhovela River, and it is suspected that the River would be difficult to obtain water samples from as it is silted up in most places. A slightly wetter environment is observed immediately at and downstream of the tributary dam at 24°41'42.85"S; 31°19'57.48"E (Figure 45 & Figure 46), however, the river remains sandy as it meanders in a predominantly southern direction, through the mixed landscape of residential and agricultural land uses and natural veld.

The Khokhovela River enters the Sabi Sands Private Nature Reserve at approximately 24°43'56.82"S; 31°20'39.72"E, from where it travels a further 4.5km before its confluence with the Sand River.

Figure 43: Khokhovela River flowing into the unnamed Dam

Figure 44: Vehicle activity in the River – potential sand / water abstraction (24°39'6.20"S; 31°19'9.95"E, imagery date 5/9/2018

Figure 45: Dam on a tributary of the Khokhovela River (image date 24 September 2013)

Figure 46: Dam on a tributary of the Khokhovela River (image date 29 July 2019)

6.1.9 Phungwe River

The Phungwe[9] River originates in the Manyeleti Game Reserve (a designated Nature Reserve according to the South African Protected Areas Database, SAPAD). The river meanders in a southern direction through largely undisturbed natural areas, with only limited game tracks affecting its flow or likely contributing to pollution (siltation).

[9] Note, some maps and databases refer to this as the Manyeleti River. The NFEPA Project names it the Phungwe River and this name will be used throughout this report.

It exits the protection of the reserve at the settlement of Phungwe, which is located well over 100 metres from the River itself. The surrounding areas remain largely natural and unimpacted by human intervention.

There are small dams at 24°42'28.12"S'; 31°29'8.06"E and further upstream at 24°42'31.53"S; 31°29'50.84"E, that prevent water from upstream reaching the Phungwe River (Figure 47).

Despite this area not being identified in SAPAD, surrounding land use seems largely to comprise natural areas and is assumed to be some form of conservation or game farming.

The Phungwe River then enters the Sabi Sands Private Nature Reserve at approximately 24°43'35.77"S; 31°28'51.34"E. Anthropogenic impacts are still limited to small game tracks and low-density development in the form of tourism lodges, affecting the Phungwe River and its tributaries (Figure 48).

The Phungwe flows through the Sabi Sands Private Nature Reserve for roughly 18km up to its confluence with the Sand River, near the MalaMala Main Camp.

The IUCMA has no flow or water quality monitoring points on the Phungwe River.

Figure 47: Dams on the tributary of the Phungwe River

Figure 48: Tourism activities in the vicinity of the Phungwe River

6.1.10 Lower Mutlumuvi River

This river is entirely located in the Kruger National Park and flows for roughly 23km from its origin before joining the Sand River, roughly 4km before the confluence with the Sabie River. This Reach is not detailed in this report as it is not located such that it could influence large sections of the Sand River, only joining the Sand River in its lower reaches. It is mentioned as it is a NFEPA River located within the Study Area.

The IUCMA has no flow or water quality monitoring points on the Multlumuvi River in this section. Like the Phungwe River, it is largely unimpacted by large-scale human activity with potential anthropogenic impacts limited to game tracks and tourism lodges.

6.2 Discussion of the Sand River

The Sand River originates from the confluence of the Nwandlamuhari and Mutlumuvi Rivers, immediately downstream of the Thulamahashe WWTW (Figure 18). It flows for less than 500m before it reaches the railway bridge, where the IUCMA undertakes water quality monitoring. Selected water quality parameters are shown in Figure 19. Water quality recorded at this point is not compliant with all relevant water quality standards, though it is noted that some dilution appears to occur due to inflow from the Mutlumuvi.

The Sand River flows through a mixed-use landscape comprising various residential and supporting activities, agriculture and natural areas. In these upper reaches of the Sand River itself, water is still visible on aerial photography (Figure 50).

There appears to be relatively little physical impact on the Sand River in this reach and downstream (Figure 51), up to where the Khokhovela River joins the Sand River, already within the boundaries of the Sabi Sands Private Nature Reserve (Figure 52). Before this point, the Sand River can be described as having a braided channel through a mixture of sandy banks and rocky outcrops. After the Khokhovela confluence, the rocky outcrops largely disappear and the braided channels continue through increasingly sandy banks.

The Inyati Game Lodge appears to be the first major tourism lodge situated on the Sand River. About 500m upstream of the Lodge, the River finds a more well-defined channel, through large sand banks up to an impeding structure assumed to be a low-water bridge (Figure 53).

About 800m downstream of the Inyati Lodge, near the confluence of another extremely sandy tributary (the Mabrak River) joining the Sand River from the South, lies Dulini Leadwood Lodge. The Duluni River Lodge is located a mere 400m further downstream. This section of the Sand River still displays a more defined channel than the braided river noted further upstream, with large sand banks colonised by reeds, grasses and some larger trees. There is a River crossing at Dulini River Lodge (Figure 54).

Only about 500m downstream of this lodge at approximately 24°45'58.86"S; 31°24'13.09"E, the IUCMA monitors surface water quality and flow. No flow has been recorded since 26 October 2019 (http://riverops.inkomaticma.co.za/#). While pH values and Electrical Conductivity (EC) fall within the acceptable range for drinking water (between 4 and 9.7 pH and EC not exceeding 170mS/m), significance exceedances of E-coli are noted (the South African National Standard (241-1:2015) for drinking water specifies that E-coli limits for drinking water are "not detected") (Figure 49).

Another tourism lodge is located on the northern banks of the Sand River immediately downstream of the monitoring point. Another River crossing is also located here (Figure 55).

After flowing in a relatively well-defined channel for approximately 700m, alongside significant sand banks, the Sand River regains some of the braided flow patterns observed further upstream, but only for about 1.3km, where water is observed collecting in a fairly large pool (dam), seemingly constructed of rocks and also acting as a river crossing point (Figure 56).

The two Singita Lodges (Ebony and Boulders) are located downstream of the "dam", 300m and 800m respectively. In this section, the Sand River first displays a slightly braided flow pattern through prominent sand banks, then changes to a more braided pattern as rocky outcrops increase (Figure 57).

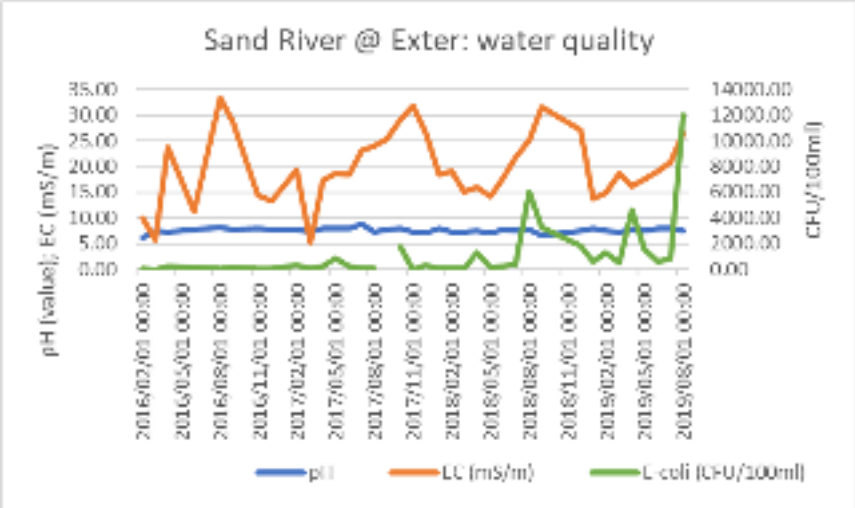


Figure 49: Water Quality: Sand River

Figure 50: Mixed-land-uses around the Sand River, where water is visible.

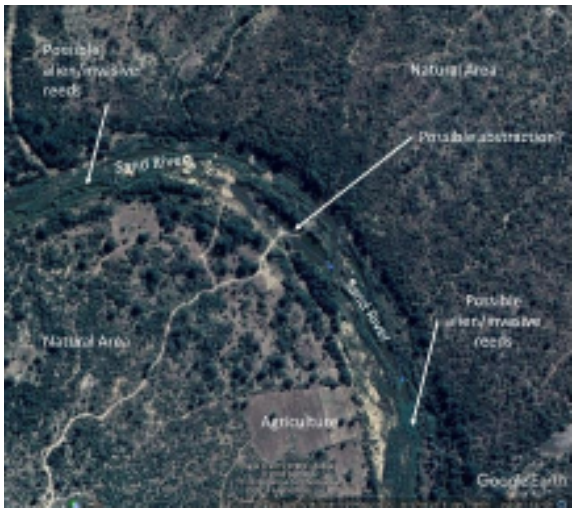


Figure 51: Land uses around the Sand River, between Thulamahashe and Dumphries

Figure 52: Confluence of the Khokhovela and Sand Rivers

Figure 53: Game lodge and River Activity

Figure 54: Sand River at Dulini River Lodge

Figure 55: Another lodge on the Sand River

Figure 56: River crossing damming up flow

Figure 57: Sand River at Singita Lodges

The Sand River continues to flow unimpeded (other than by natural rocky outcrops and sandy banks) and is joined by various smaller tributaries, many of which contain small dams, presumably constructed for purposes of watering game (Figure 58).

The next major development on the banks of the Sand River, is the Londolozi Game Reserve Lodge, about 8km downstream of the Singita Lodges. There are no obvious weirs or in-stream dams in the Sand River immediately at Londolozi, there is evidence that the River is crossed relatively regularly at certain points (Figure 59). The Sand River at Londolozi contains significant boulders and rocky outcrops, with silt build-up still visible among the rocks on the riverbanks. It is also worth noticing that many of the tributaries to the Sand River contain dams in this area (Figure 60).

About 1km downstream of Londolozi, a private home is visible on the northern banks of the River, with a river crossing / weir construction just 200m downstream of the structure, which is concrete lined and likely facilitates water abstraction. This practice seems quite common among the River-based lodges; the construction presumably aims to generate an area

immediately in front of a lodge where animals would appear regularly (such as at natural watering holes) or to dam up water to facilitate abstraction for domestic use (Figure 61).

It is noted that practically all of the tourism lodges and private homes on the banks of the Sand River abstract water from the River and/or from groundwater sources under allocations determined by the size and use of land. It is unclear whether such abstraction is monitored and whether such abstraction is reported to the IUCMA.

About 3km further downstream, the Phungwe River and Mlowati River join the Sand River, close to the Mala Mala Game Reserve Camp (Figure 62). It seems that both of these rivers contribute significant silt load to the Sand River (as they are very sandy themselves and the Sand River downstream of this confluence also appears increasingly silted). There is a river crossing about 200m downstream of the camp, though this crossing does not appear to have the same "damming up" effect that was evident at some of the other river crossings (Figure 62). Downstream of the crossing, however, the Sand River channel seems to diminish to little more than a meandering flow pattern, through extensive sand banks colonized by (assumed) invasive reeds (Figure 63). Other Lodges and tourism facilities are located further downstream on the river (Rattray's on MalaMala; Unknown Lodge at 24°51'45.07"S; 31°32'33.63"E; Umkumbe Safari Lodge; Tydon Safaris bush camp; unknown buildings at 24°53'34.30"S; 31°32'54.26"E; Chitwa; Tengile River Lodge; Kirkman's Camp; buildings at 24°56'42.78"S; 31°36'27.99"E).

Almost immediately upon entering the Kruger Park from the Sabi Park at 24°57'17.69"S; 31°36'26.16"E, the number and physical size of the buildings and structures near the Sand River increases considerably. The River, however, seems to continue its meandering braided flow patterns amongst sandy banks with the occasional rocky outcrop, until it joins the Sabie River at approximately 24°57'23.28"S; 31°42'43.79"E, at the edge of the study area.

Figure 58: Dams on the Sand River tributaries

Figure 59: River crossing

Figure 60: Dams on the Sand River tributaries

Figure 61: River crossing about 1km downstream from Londolozi

Figure 62: Confluence of the Sand, Phungwe and Mlowati Rivers at Mala-Mala

Figure 63: Sand River downstream of Mala-Mala

7 Summary of the key issues

Table 6 indicates the Key aspects that may be impacting on the Rivers discussed in Section 6.

Table 6: Summary of key impacts per River reach

Rivers	Aspects	Potential Impacts
Tlulandziteka	Commercial Forestry	Potential sedimentation, reduced flow due to over-use by plantations.
	Subsistence and small-scale agriculture	Pollution (fertilizers, sedimentation). Overgrazing leading to pollution, erosion.
	Human settlements	Improper domestic and sewage waste management – pollution.
	Dingleydale Weir	Reduced downstream flow and altered downstream hydrology.
	Commercial agriculture (Champagne Citrus Farm)	Potential over-abstraction reduces stream-flow and water availability for downstream users.
Motlamogatsana	Commercial Forestry	Potential sedimentation, reduced flow due to over-use by plantations.
	Subsistence and small-scale agriculture	Pollution (fertilizers, sedimentation). Overgrazing leading to pollution, erosion.
	Human settlements	Improper domestic and sewage waste management – pollution.
	Champagne Abstraction at 24°39'7.42"S; 31°3'25.23"E	Reduced downstream flow and altered downstream hydrology.
Nwandlamuhari	Commercial agriculture	Potential over-abstraction reduces stream-flow and water availability for downstream users.
	Human settlements	Improper domestic and sewage waste management – pollution.
	Weirs (abstraction) specifically **Edinburgh Weir** & canal to Edinburgh Dam	Reduced downstream flow and altered downstream hydrology.
	Thulamahashe Sewage Works	Pollution from non-compliant discharge
Mphyanyana	Human settlements, small-scale agriculture.	Pollution from improper waste management, overgrazing
	Edinburgh Dam	Reduced downstream flow and altered downstream hydrology.
Ndlobesuthu	Human settlements, small-scale agriculture.	Pollution from improper waste management, overgrazing

Nwarhele	Commercial Forestry	Potential sedimentation, reduced flow due to over-use by plantations.
	Dam at 24°48'58.02"S; 31° 0'29.19"E	Reduced downstream flow and altered downstream hydrology.
	Human settlements	Pollution from improper waste management.
	Dwarsloop WWTW	Pollution from non-compliant discharge
	Potential abstraction	Over-abstraction leading to reduced downstream flow
Multlumuvi	Commercial Forestry	Potential sedimentation, reduced flow due to over-use by plantations.
	Human settlements, small-scale agriculture.	Pollution from improper waste management, overgrazing
	Reservoirs, dams & weirs (at least 5), specifically **New Forest abstraction** at 24°44'31.47"S; 31° 4'16.68"E	Reduced downstream flow and altered downstream hydrology.
Khokhovela	Human settlements, small-scale agriculture.	Pollution from improper waste management, overgrazing
	Numerous dams and tributary dams	Reduced downstream flow and altered downstream hydrology.
Phungwe	Game lodges, dams and tributary dams	Reduced downstream flow and altered downstream hydrology
Sand River	Human settlements	Improper domestic and sewage waste management – pollution.
	Game lodges and associated activity	River crossings, leading to damming up of river, and sedimentation. Water abstraction[10].
	Numerous tributary dams	Reduced downstream flow and altered downstream hydrology[11].

The key issues / impacts on the Sand River, including its tributaries, can be categorized as follows:

- Quality impacts:
  - Pollution from waste (litter and illegal dumping of domestic waste);
  - Discharge of non-compliant water from WWTW;
  - Siltation due to poorly designed road crossings, encroaching agricultural activities and due to the local geology (natural silt contributions to the system).

[10] Abstraction from the River by some of the lodges is reportedly monitored by the Sabi Sands Ecological Committee but such records were not reviewed as part of the compilation of this report.
[11] It was reported that all the Sabi Sands Wildtuin Lodges are in the process of ensuring that their dams are registered with DWS but the exact status of this process in not known.

- Quantity impacts:
  - Impoundments;
  - Over-abstraction;
  - Losses to poorly maintained infrastructure (such as leaking irrigation canals) and due to excessive water use by alien invasive species.

Quality impacts can only be addressed if waste management is improved in the residential areas where the waste originates. This is a function of the municipality and won't be discussed in further detail in this report.

Impacts to water quantity has the potential to relieve or exacerbate pollution impacts to some extent due to dilution effects. Infrastructure maintenance and control of alien invasive plants is the responsibility of respective land owners and will not form the focus of the discussion. The effects of impoundments and over-abstraction will be discussed jointly as these generally go hand-in-hand within the study area and is expected to have the greatest influence on river flows in the downstream environment.

To better understand the larger abstraction and reticulation systems within the Sand River Catchment, consultation will be required with those institutions responsible for the implementation and maintenance of this infrastructure (which could be the IUCMA, Irrigation Organizations, the Bushbuckridge Municipality or individual land owners). Confirmation of ownership should form part of the next phase of this project. In the meantime, a brief overview of the most prominent abstraction points and associated canals that have been identified in Section 6 is presented in Table 7 overleaf.

Consultation with the IUCMA in the next phase of the project should aim to confirm the legal status of these abstraction points and their management. It is assumed that all of these points would be regarded as ELU's in terms of the NWA (Section 5.2.2 of this report), however, the IUCMA still requires the registration, validation and verification of ELU's, to determine their sustainability and management requirements, as may be prescribed by the IUCMA.

It is not currently known whether the amount of water being abstracted / diverted from the Rivers at the points is measured or monitored. It is also not known what the water quality at these abstraction points is, and whether the water being abstracted is suitable for the intended use, which is predominantly irrigation for agriculture. The need for the supply of sufficient water (and adequate quality water) to the agriculture schemes in the area cannot be ignored but is not currently managed or monitored comprehensively.

It must also be mentioned that the Inyaka Dam, located just south of the study area, was constructed specifically (among others) to supplement water supply to the Bushbuckridge area for domestic and agricultural (irrigation)use, and yet many communities depend on abstraction from rivers for basic needs, sanitation and subsistence agriculture, while it is noted that commercial agriculture also depends directly on abstraction from Rivers, and is not effectively serviced by water supply from the Inyaka Dam, as was the original plan.

There is a pipeline from the Inyaka Dam to the Water Treatment Works (WTW) at 24°51'48.01"S; 31° 5'10.13"E. From here, the pipeline reportedly passes close by the sewage works in Maviljan and follows the drainage line for a while, where-after the route is unclear. There is a small WTW next to the Mutlumuvi at approximately 31° 5'10.13"E; 31° 7'41.60"E, into which a large pipeline

reportedly connects. Security at the WTW indicated to staff at Sabie Sands Wildtuin that the pipe transfers water from Inyaka dam to this WTW. The pipeline then enters the Multumuvi River at a weir adjacent to the WTW. The pipe seems to be connected to a pump station which is not functional/ operational (Information provided by Sabie Sands Wildtuin). Further information on the status of the Inyaka / Bushbuckridge Transfer Scheme must be obtained to gain clarity on the current status of transfers from Inyaka into the Sand River Catchment.

Table 7: Summary of significant abstraction points

Abstraction Point	Champagne	Dingleydale	New Forest	Edinburgh
	24°39'7.42"S; 31° 3'25.23"E	24°41'27.04"S; 31° 2'31.56"E	24°44'31.47"S; 31° 4'16.68"E	24°41'46.91"S; 31°10'8.32"E
Elevation @ abstraction	580 mamsl	578 mamsl	555 mamsl	464 mamsl
Elevation @ point if use	547 mamsl (Tlulandziteka River just west of Champagne Citrus Farm)	565 mamsl (@ dam on Champagne Citrus Farm) 540 mamsl (@ dam south of Chochocho)	540 mamsl (@ Orinoco Dam)	450 mamsl (@ Edinburgh Dam) 438 mamsl (@ reservoir downstream Edinburgh Dam)
Photo (provided by client)				
Purpose	Supplement water supply to Champagne Citrus Farm	Supplement water supply to Champagne Citrus Farm and downstream	Supplement water supply to Orinoco Dam and New Forest agriculture scheme	Supplement water supply to Edinburgh Dam and downstream reservoir (predominantly domestic use assumed)

Note: Photographs supplied by Sabie Sands Wildtuin

Coordinates and elevations as per Google Earth Pro.

These aspects should be independently verified in subsequent project phases.

8 Conclusion

The Sand River is not only of vital importance to the ecological systems that rely on it, but also to the tourism sector with infrastructure on its banks. Furthermore, the Sand River and its tributaries are vitally important to communities located close by who rely on the Rivers for water for domestic use and agriculture (including irrigation and stock watering).

Water management is based on two essential principles: the requirement to meet basic human needs and the requirement to protect the ecological reserve, or ecological flow requirements of Rivers. The Reserve refers to water of sufficient quality, *and* quantity, to meet these needs. These two aspects (ecological and human needs) thus compete for the same limited resource, however, authorities cannot afford to place human needs above the water requirements of natural systems - To do so would certainly be counter-productive and short-sighted, considering the reliance of communities on the goods and services provided by river systems (including, for example, water, building material in the form of sand and reeds, food, flood control, etc.).

The legislative framework for water management in South Africa is seemingly anthropocentric, insofar as the NWA states specifically in its preamble that water "belongs to all people". The preamble to the NWA further acknowledges that "the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users". The term "user" is not specifically defined in the NWA, and should be understood to include human users as well as ecological systems in the context of human reliance on the health of water resources we depend on.

Land uses in the upper reaches of the study area comprise predominantly conservation and commercial forestry. The Sand River tributaries discussed in this report are limited to those rivers identified in the NFEPA. These rivers all flow through urban, suburban and peri-urban settlements in the middle reaches of the catchment. Some of the residential and agricultural land uses occurring in this area have encroached significantly on the river systems, not only threatening river health, but also posing threats to humans and infrastructure in the event of floods. These communities are highly reliant on the local river systems. StatsSA reports that 11.9% of the population in the local municipality have access to piped water inside their dwellings, 7.5% have weekly refuse removal services and only 6.8% of the population has a flush toilet connected to a sewage system. Consequently, the local rivers are the only source of drinking water for some, and at the same time are also being used to dispose of domestic and human waste, to wash, to irrigate crops and for livestock watering. The risks associated with such river uses relate not only to over-abstraction from the system and resultant potential water shortages downstream, but also to significant impacts on human health.

From the limited water quality analysis available for inclusion in this report, it is clear that both the Dwarsloop and Thulamahashe WWTW discharges are contributing poor-quality water to the river systems. The impacts of sewage discharge to the rivers from the WWTW is of course exacerbated by the direct contribution of human waste to these rivers, from those communities that do not have access to formal sanitation.

No data was made available pertaining to the volumes of water abstracted from these river systems, or whether such abstraction has been authorized or not, the IUCMA does not keep records of abstraction volumes on their publicly accessible dashboards.

It is possible that abstraction volumes from some of the tourism lodges further downstream is available, and should be considered in subsequent reports / studies.

It may be concluded, however, based on the 2016 eco-status assessment (MTPA, January 2017) and general observation, that flow is affected downstream of more intense agricultural areas, likely due to direct over-abstraction and/or due to water being diverted from the rivers via irrigation canals. There are numerous dams throughout the catchment, including in these middle-reaches, that capture water from tributaries to the NFEPA rivers instead of allowing these tributaries to contribute to the rivers. The legal status of these dams, weirs, abstraction points and canals is not known.

Furthermore, high sediment deposition was recorded in most of the rivers in the Sand River catchment, where commercial forestry is the predominant land use in the upper reaches. Further downstream environments affected by overgrazing and poor road and river crossings further contribute to sediment inputs from erosion (MTPA, January 2017). It is noted that the Sand River is naturally sedimented due to underlying geology and soil types however, levels of sedimentation are being exacerbated by anthropogenic influence.

In the conservation areas towards the lower reaches of the study area, gravel roads (associated with rural communities and nature reserves) generally have steep approaches to natural drainage lines, contributing to high sediment inputs. The MTPA reports that, "in the Sabi Sands, the road network densities appear to be very high, increasing catchment drainage density and due to poor road design and maintenance, contribute to sediment inputs. Sedimentation is legally recognised as a pollutant" (MTPA, January 2017).

A common misconception exists that nature reserves and other types of conservation areas do nothing but protect rivers and have no potential negative impacts on natural river systems. As shown in this report, river crossings, weirs and abstraction points are commonly associated with the tourism lodges located along the Sand River. Though these may be legally compliant to the relevant standards (be they ELU's or licensed activities), such infrastructure and actions may still have negative impacts on River systems. It is acknowledged that the Lodges rely heavily on River water as a visual resource, as well as a water supply resource (along with groundwater abstraction) and that it is in their best interest to ensure impacts to surface water flow and ecological integrity of the system is minimized. However, without a documented and integrated approach, the efficiency of individual efforts may be reduced.

These facilities are also associated with dams in the tributaries of the sand river and it is not known at this stage what sort of sewage management infrastructure each of these facilities has access to, though it is assumed that each lodge has their own on-site wastewater management systems including water treatment plants. It seems rather common practice for these facilities to construct some from form of weir/road crossing or other impediment (sometimes coupled with natural rocky outcrops and the like), immediately downstream of the tourism lodges, effectively causing the damming up of the river immediately at the lodge, providing for increased wildlife activity and associated tourist experience. The practice does seemingly lead to siltation of the river immediately downstream of such impediments.

Water demand in the catchment, especially in the rural residential areas of greater Bushbuckridge, outweigh supply. This problem was anticipated early on, and the Inyaka Dam (constructed in 2002) was built with the intention (among others) to supplement water supply to the Sand River Catchment.

Ideally, drinking water and irrigation should be supplied from the Inyaka Dam (or other existing dams within the catchment), as it is feasible to control water quality used for domestic and irrigation purposes from Dams, where this is increasingly difficult to do if abstraction from Rivers takes place directly.

There is limited information available on the amount(s) of water being abstracted from the Sand River Tributaries for domestic and irrigation supply, however, it is assumed that over-abstraction is occurring. The over-abstraction is likely due to water users (domestic and irrigation) lacking other reliable and cost-effective options to supply their needs.

If the current assumed over-utilization of surface water resources can be reduced, or eliminated (by providing alternative water supply), the ecological flow requirements of the Sand River and its tributaries may be met by the natural systems. For this to happen, a few prerequisites are relevant:

- Determine the water quantity demand of large-scale abstractors from the Sand River Tributaries;
- Determine ownership of the infrastructure being used to facilitate large-scale abstraction (notably the Champagne, Dingleydale and New Forest abstraction);
- Determine alternative water supply to the domestic and agricultural needs that are currently reliant on abstraction from the Rivers, including the aforementioned transfer pipeline from the Inyaka Dam;
- Evaluate / assess the benefits and challenges of potential alternative water supply and engage with the existing water users to identify preferred alternatives; and
- If feasible, remove those installations on the Sand River Tributaries that are impeding downstream flow, in favour of reliable supply from groundwater or existing, lawful dams in the catchment or water being transferred into the catchment.

While this will most likely not address all of the problems in the sand river catchment, it is believed that removal of large-scale weirs will improve downstream flow and move towards equitable distribution of the water resource to meet both the human needs and ecological reserve requirements, providing that alternative and improved supply can be provided from the Inyaka transfer scheme.

9 Next steps

It must be stated upfront that it will be necessary to evaluate in more detail, and manage impacts from further upstream in the catchment, to ensure the downstream areas of the catchment are functional. However, it is acknowledged that such actions may be difficult, due to the following primary challenges:

- The responsibility for monitoring of compliance to the relevant legislation rests with under-resourced regulators. Given the limited resources that government is able to devote to the identification of potentially illegal water uses, farmers and communities

are often overlooked, in favour of larger industrial or mining activities, where compliance and enforcement is emphasized more. This does not imply that mines necessarily have a bigger impact on water resources, especially if impacts of communities and commercial agriculture are considered cumulatively.

- Provision of water and sanitation services to communities in the catchment will prevent the current impacts to the rivers in the upper reaches of the catchment from continuing, as the affected communities will have access to services currently provided by the river systems directly, often to the detriment of the systems. Provision of such infrastructure is an ongoing challenge throughout the country and is not expected to be solved overnight.
- Improved management of municipal WWTWs in the catchment is required: this is a matter of legal compliance, river health and community health and should be prioritized by the relevant authorities.

It is recommended that those areas of the study area comprising nature reserves implement certain management measures at their own facilities, to improve the status of the Sand River in its lower reaches. This recommendation stems from the practicability of implementing such measures, assuming the cooperation of nature reserves in the area, to the benefit of all downstream water users (including tourism (human) use and ecological requirements).

Such measures could include:

- Evaluate the densities of road networks, especially closer to the Sand River and including its tributaries, to identify those gravel roads that are necessary for the activities associated with the reserve. Then close-off and rehabilitate those roads that are superfluous or excessive.
- Reduce the number of river crossings, and where river crossings are necessary, improve the roads leading to the river crossings to reduce sediment input to the river from these roads (reduce slope, improve surface).
- Undertake an evaluation of legislated water uses occurring on the properties and determine the water uses that require licensing and/or registration. Undertake the licensing application/ registration process, where necessary, in consultation with the IUCMA as the licensing authority.
- Assist the IUCMA in improving their water quality and flow recording in the Sand River, by potentially contributing to the database. More monitoring points on the River, recording both water quality and flow, will provide greater insight as to the origin of river impacts, thus enabling improved management of such impacts.
- Evaluate the number of dams on the properties, and decommission those dams that are superfluous, so that these drainages may again contribute to flow in the Sand River.

It is understood that independent "Green Audits" have been undertaken over the past two years at the Sabi Sand Wildtuin Lodges and these reports should be reviewed in subsequent project phases. It is further understood that the SSW lodges are in the process of registering their dams as ELU's with the IUCMA through another consultant. Recent and current efforts are acknowledged and commendable, but cannot be expected to solve the known challenges pertaining to surface water flow in the lower reaches of the Sand River in isolation.

The next phase of this study should be associated with ground-truthing of the infrastructure and activities identified in this report, focussing on the most prominent aspects impacting on the Sand River and its tributaries. This may include a detailed legal review of certain infrastructure and activities. It is emphasized, however, that such an exercise could contribute to the regulator's knowledge and understanding of potentially unlawful activities in the study area, and may not force the regulator(s) to act against transgressors.

Affected land users and water users downstream of activities impacting on the river system have very little recourse, as it is still up to the regulatory authorities to investigate potential transgressions, and advise the transgressors of the appropriate actions to take to address non-compliances. Downstream water users, though affected by the actions of upstream activities, are not legally in a position to act against transgressors and must do so only in consultation and conjunction with the relevant authorities.

Once more comprehensive data exists pertaining to the water demands within the catchment, feasible alternative water supply options can be identified to lessen the burden on surface water resources, while still meeting the current and future demands of residential land uses and commercial agriculture in the catchment.

It is anticipated that the transfer pipeline from the Inyaka Dam was originally intended to meet (at least a level of) domestic demand, which would have alleviated some of the pressure caused by domestic abstraction. Commercial agriculture demand must first be accurately determined, and it must be confirmed whether the demand can be met by transfer from the Inyaka Dam and potentially other existing dams in the catchment. Groundwater resources could also be considered for development to supplement water supply to domestic and commercial agriculture land use, thereby allowing ecological demand to be met by the River systems.

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