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AQUATIC ASSESSMENT REPORT FOR THE PROPOSED SOCIAL HOUSING TOWNSHIP IN SOSHANGUVE SS EXTENSION 7 AND 8, NORTH OF PRETORIA, GAUTENG.

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TITLE:	**Aquatic assessment report for the proposed social housing township in Soshanguve SS Extension 7 and 8, north of Pretoria, Gauteng**
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Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as information available at the time of study. Therefore the author reserves the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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EXECUTIVE SUMMARY

I. INTRODUCTION

Instratin Properties (Pty) Ltd plans to develop social houses in Soshanguve SS Extension 7 and 8, northern Pretoria, Gauteng, therefore Sazi Environmental Consulting cc was appointed by Instratin Properties (Pty) Ltd to conduct an aquatic assessment in the area of concern.

II. SITE DESCRIPTION

The area of concern is located Soshanguve SS extension 7 and 8, within the Tshwane Metropolitan Municipality, Pretoria. Soshanguve is a township located at about 45 km north of Pretoria.

III. METHODOLOGY

The Present Ecological State (PES) of each biophysical attribute of the river/s being assessed was determined and categorized during field surveys. The health of the river was assessed based on the response of the biota (macro-invertebrates and fish) to changes of the physical drivers (habitat, physico-chemical variables).

Water quality *in situ* was done, where chemical variables (conductivity, pH, water temperature, dissolved oxygen and oxidation reduction potential) were sampled. Aquatic invertebrates were also assessed where available biotopes were identified on arrival. An impact assessment was done of the proposed activities on the river.

IV. RESULTS

The stream flow at Soutpanspruit was low to moderate and anthropogenic impacts were observed.

- Water quality in situ assessment

The conductivity (EC) levels in the Soutpanspruit was 0.353 mS/cm, the pH fell within the target water quality ranges for fish health, irrigation, aesthetics and human health at the site.

- IHAS assessment

The site was found to have poor habitat integrity, therefore does not have sufficient habit available to house/support a diverse community of macro invertebrates.

- Macro invertebrate's assessment

The Soutpanspruit site was dominated by aquatic macro-invertebrate taxa with low requirement (11) for unmodified water quality, followed by taxa with very low requirement (10) for unmodified water quality.

V. IMPACTS OBSERVED ON SITE

Various impacts were observed at Soutpanspruit and these include:

- Impeding structures;
- Excavation;
- Dumping site;
- Presence of storm water drainage closer to site; and
- Evidence of the river bank being impacted by floods.

VI. RECOMMENDATIONS AND CONCLUSION

The dominance of only aquatic macro - invertebrate taxa with low /very low requirement for unmodified water quality implies poor water quality. These types of taxa are able to tolerate high level of pollution. It is recommended to continue with SASS5 monitoring at the selected Soutpanspruit site as further monitoring will give insight on the aquatic conditions of the Soutpanspruit.

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Acronyms

ACRONYM	DESCRIPTION
ASPT	Average Score per Taxa
BDI	Biological Diatom Index
CBA	Critical Biodiversity Area
CI	Conservation Importance
COD	Chemical Oxygen Demand
CRS	Catchment Resource Strategy
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DEMC	Default Ecological Management Classes
DL	Detection Limit
DO	Dissolved Oxygen
DO%	Percentage Saturation
DWA	Department of Water Affairs (previously known as DWAF)
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation (previously known as DWA)
EA	Environmental Authorisation
EC	Electrical Conductivity
ECA	Environmental Conservation Act (ECA; Act 73 of 1989).
ECO	Environmental Control Officer
EI	Ecological Importance
EIS	Ecological Importance and Sensitivity
EISC	Ecological Importance and Sensitivity Categories
EMPR	Environmental Management Programme
EN	Endangered
ES	Ecological Sensitivity
EWT	Endangered Wildlife Trust
FEPA	Freshwater Ecosystem Priority Areas
FAII	Fish Assemblage Integrity Index
FFGs	Functional Feeding Groups
FRAI	Fish Response Assessment Index
FROC	Frequency of Occurrence
FSA	Fish Support Area

GPS	Global Positioning System
GSM	Gravel, Sand and Mud
ICP-MS	Inductive Coupled Plasma Mass Spectrometry
IDW	Inverse Distance Weighted
IHASv.2	Integrated Habitat Assessment System Version 2
IHI	Index of Habitat Integrity
LC_{50}	Lethal Concentrations 50
MAPE	Mean Annual Potential Evaporation
MAP	Mean Annual Precipitation
MAT	Mean Annual Temperature
MFD	Mean Frost Days
NAEHMP	National Aquatic Ecosystem Monitoring Programme
NRF	National Research Foundation
NWA	National Water Act (Act 36 of 1998)
NWRS	National Water Resource Strategy
MIRAI	Macro-Invertebrate Response Assessment Index
PE	Percentage Effect
PES	Present Ecological State
%PTV	Percentage of Pollution Tolerant Valves
REC	Recommended Ecological Category
RDM	Reserve Determination
REMP	River Ecosystem Monitoring Plan
RHP	River Health Programme
RWQO	Resource Water Quality Objectives
SAIAB	South African Institute for Aquatic Biodiversity
SANAS	South African National Accreditation System
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAR	Sodium Absorption Ration
SASS5	South African Scoring System Version 5
SPI	Specific Pollution Index
SS	Suspended Solids
SQ	Sub Quaternary Catchment
TUa	Acute Toxicity Units
PE	Percentage Effect

PSD	Particle Size Distribution
TDS	Total Dissolved Solids
TWQR	Target Water Quality Range
VEGRAI	Vegetation Response Assessment Index
WMA	Water Management Area
WRC	Water Research Commission
WQ	Water Quality
WULA	Water Use License Application
WUL	Water Use Licence
WWF	Worldwide Fund for Nature

1 INTRODUCTION

Instratin Properties (Pty) Ltd plans to develop social houses in Soshanguve SS Extension 7 and 8, northern Pretoria, Gauteng, therefore Sazi Environmental Consulting cc was appointed by Instratin Properties (Pty) Ltd to conduct an aquatic assessment in the area of concern. This document provides information on the present ecological state (PES) of the area of concern per macro-invertebrate and fish data collected. The assessment was undertaken on the 03 February 2018.

2 GEOGRAPHIC LOCATION OF THE STUDY AREA

The area of concern is located Soshanguve SS extension 7 and 8, Quaternary catchment A23J, within the Tshwane Metropolitan Municipality, Pretoria. Soshanguve is a township located at about 45 km north of Pretoria (Figure 1; Table 1 and 2).

Table 1: The site location, river names and co-ordinates of the proposed site

Site	**Co-ordinates**		**River Name**	**Site Description**
Soutpanspruit	28.115616 E	-25.485415 S	Soutpanspruit	Closer to the proposed activity

Table 2: Catchment information, PES information on each of the sites

Quaternary catchment	**WMA**	**PES**
A23J	Crocodile (West) and Marico	**C:** Moderately modified

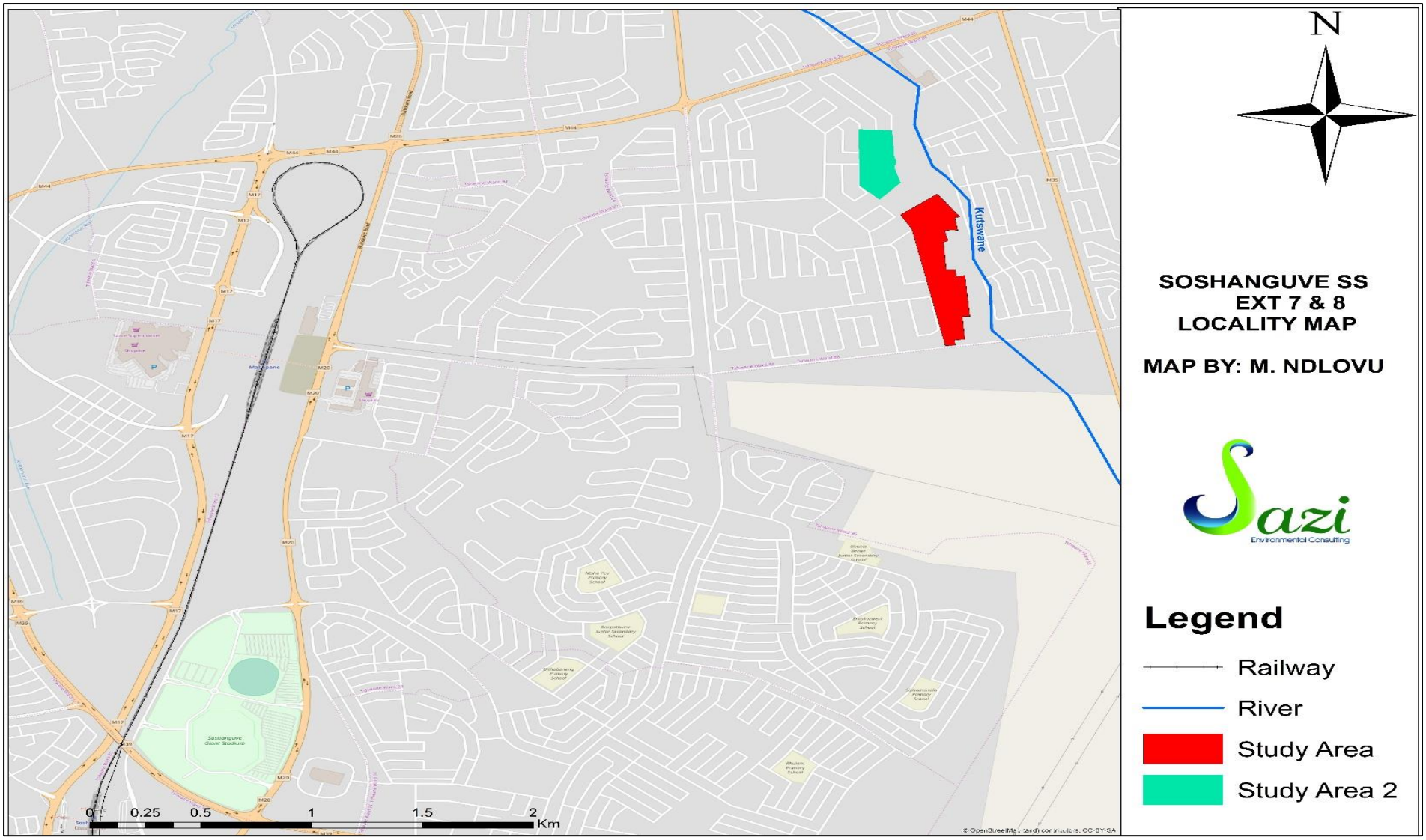


Figure 1: Locality of the proposed development site

3 METHODOLOGY

More than a century ago, people recognised that human activities produced pollution harmful to the biota. They therefore tried to track the extent of biological degradation; biological degradation was even considered an indicator for the presence of human activities. So began biological monitoring (Karr & Chu, 2006). In the past, water quality monitoring focused on physical and chemical measurements. It has, however, become recognised that by using other indicators in addition to traditional water quality measurements, it can enhance the assessment and management of water resources (Hohls, 1996). Bio monitoring can thus be defined as the use of living organisms as biological indicators of ecosystem or environmental health. It is further stated that animals and plants can provide a long-term integrated reflection of water quality, quantity, habitat quality and other environmental conditions.

The Present Ecological State (PES) of each biophysical attribute of the river/s being assessed was determined and categorized during field surveys. The health of the river was assessed based on the response of the biota (macro-invertebrates and fish) to changes of the physical drivers (habitat, physico-chemical variables).

3.1 WATER QUALITY (*IN SITU*)

The *in situ* physico – chemical variables that were sampled included conductivity, pH, water temperature, dissolved oxygen and oxidation reduction potential. This in situ analysis was undertaken using the Lovibond Multi-Meter Instrument (SensoDirect 150). The Lovibond Multi-Meter and all parameters were calibrated to ensure accuracy of the results.

Benthic macro-invertebrate communities of the selected site were investigated according to the South African Scoring System, version 5 (SASS5) approach (Dickens and Graham, 2001). This method is based on the British Biological Monitoring Working Party method and has been adapted for South African conditions by Dr. F.M. Chutter (Thirion *et al*., 1995). The SASS method is a rapid, simple and cost effective method, which has progressed through four different upgrades or versions. The current Version 5, is specifically designed to comply with international accreditation protocols.

3.2 AQUATIC INVERTEBRATE ASSESSMENT

An invertebrate net (30x30cm square with 1mm mesh netting) was used for the collection of the organisms. The available biotopes at each site were identified on arrival. Each of the biotopes was sampled by different methods as described below. Note: samples should not be collected when the river is in flood.

The biotopes were combined into three different groups, which were sampled and assessed separately:

- Stone (S) Biotopes

Stones in current (SIC) or any solid object: Movable stones of at least cobble size (3cm diameter) to approximately 20cm in diameter, within the fast and slow flowing sections of the river. Kick-sampling is used to collect organisms in this biotope. This is done by putting the net on the bottom of the river, just downstream of the stones to be kicked, in a position where the current will carry the dislodged organisms into the net. The stones are then kicked over and against each other to dislodge the invertebrates (kick-sampling) for ± 2 minutes.

Stones out of current (SOOC): Where the river is still, such as behind a sandbank or ridge of stones or in backwaters. Collection is again done by the method of kick-sampling, but in this case the net is swept across the area sampled to catch the dislodged biota. Approximately $1m^2$ is sampled in this way.

Bedrock or other solid substrate: Bedrock includes stones greater than 30cm, which are generally immovable, including large sheets of rock, waterfalls and chutes. The surfaces are scraped with a boot or hand and the dislodged organisms collected. Sampling effort is included under SIC and SOOC above.

- Vegetation (Veg) Biotopes

Marginal vegetation (MVeg): This is the overhanging grasses, bushes, twigs and reeds growing on the edge of the stream, often emergent, both in current (MvegIC) and out of current (MvegOOC). Sampling is done by holding the net perpendicular to the vegetation (half in and half out of the water) and sweeping back and forth in the vegetation (± 2m of vegetation).

Aquatic vegetation: This vegetation is totally submerged and includes filamentous algae and the roots of floating aquatics such as water hyacinth. It is sampled by pushing the net (under the water) against and amongst the vegetation, in an area of approximately one square meter.

- Gravel, Sand and Mud (GSM) Biotopes

Sand: This includes sandbanks within the river, small patches of sand in hollows at the side of the river or sand between the stones at the side of the river. This biotope is sampled by stirring the substrate by shuffling or scraping of the feet, which is done for half a minute, whilst the net is continuously swept over the disturbed area.

Gravel: Gravel typically consists of smaller stones (from 2-3mm and up to 3cm). The sampling process is similar to that of sand.

Mud: It consists of very fine particles, usually as dark-coloured sediment. Mud usually settles to the bottom in still or slow flowing areas of the river. The sampling process is similar to that of sand.

- Hand picking and visual observation

Before and after disturbing the site, approximately 1 minute of “hand-picking” for specimens that may have been missed by the sampling procedures, was carried out.

The organisms sampled in each biotope group were identified and their relative abundance also noted on the SASS5 datasheet. There are three main indices used to calculate the SASS5: Number of Taxa, SASS5 Score and Average Score per Taxon (ASPT). The calculation of results was done by ticking any families seen in any of the biotopes in the Total column of the score sheet. Quality scores for each taxon noted in the Total column were summed to provide the SASS5 Score. The SASS5 Score divided by the number of taxa found provides the ASPT.

An evaluation of Integrated Habitat Assessment (IHAS) is important to any assessment of ecological integrity and should be conducted at each site at the time of sampling, therefore site habitat assessments were conducted by using existing habitat evaluation indices (McMillan, 1998). Evaluation of the habitat availability and suitability scores of the biotopes at the site were recorded directly on the SASS5 score sheet. These are the scores for

Stones, Vegetation and GSM biotopes that range from 0 to 5, where 0 is absent and 5 represents full availability and suitability.

3.3 IMPACT ASSESSMENT

The information gained from the functional integrity and EIS assessments was used to inform an assessment of the likelihood and significance of potential impacts associated with the proposed sewer outfall pipeline activities. The following methodology (Table 3) has been adopted from the DWS's Operational Guideline, 2010 entitled "Operational Guideline: Integrated Water and Waste Management Plan'.

Table 3: Ranking scales for impact assessment

DURATION (D)	**MAGNITUDE (M)**
5 - Permanent 4 - Long term (ceases with operational life) 3 - Medium term (5-15 years) 2 - Short term (0-5 years) 1 – Immediate	10 - Very high/do not know 8 - High 6 - Moderate 4 - Low 2 – Minor
SCALE (S)	**PROBABILITY (P)**
5 – International 4 - National 3 - Regional 2 - Local 1 - Site 0 – None	5 - Definite/do not know 4 - Highly probable 3 - Medium probability 2 - low probability 1- Improbable 0 – None
SIGNIFICANCE POINTS (SP) = (D+M+S) X P	
HIGH (H) = >60 POINTS	
MODERATE (M) = 30-60 POINTS	
LOW (L) = <30 POINTS	
NO SIGNIFICANCE = 0	
POSITIVE IMPACT	

The maximum value of significance points is 100. Environmental effects could therefore be rated as either high (H), moderate (M), or low (L) significance, as seen above.

4 RESULTS

On the 03 February 2018, the field assessment was undertaken along the study area. The stream flow of the site was low to moderate, anthropogenic impacts were observed and the sampled biotopes included sampling in riffles. The state of the Soutpanspruit site is moderately modified, which falls under **ecological category (C),** which means that there is loss and change of natural habitat and biota, but the basic ecosystem functions are still predominantly unchanged**.**

4.1 VISUAL ASSESSMENT OF THE SITE

The Soutpanspruit site was locally impacted by various anthropogenic factors (Figure 2), these included:

- Waste – dumping site was located at about 1m – 5m away from the river bank;
- Excavation was observed closer to site;
- A storm water drainage was located closer to site;
- Presence of alien species;
- Evidence of the river bank being impacted by floods was also observed on site; and
- Local residents set up rocks so as to be able to cross over the bridge which impacts water flow.

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Figure 2: General view of the Soutpanspruit River

4.2 WATER QUALITY ASSESSMENT

The conductivity (EC) levels in the Soutpanspruit was 0.353 mS/cm. The criteria for EC and temperature depend on local conditions and the life of species present (Kempster *et al*., 1982). The pH fell within the target water quality ranges for fish health, irrigation, aesthetics and human health at the site (Table 3). The target pH for fish health is between 6.5 and 9.0 as it is expected that most aquatic species will tolerate and reproduce successfully within this pH range (DWAF, 1996).

Table 4: In-situ water quality variables measured at the time of sampling at the Soutpanspruit (February, 2018).

Survey Date	Monitoring Site	Conductivity (EC) (mS/cm)	pH	Dissolved oxygen	Water Temperature	ORP
		(mS/cm)		(%)	(°C)	(mV)
Feb-18	Soutspanspruit	0.353	7.51	25.2	23.2	-52

4.3 INTEGRATED HABITAT ASSESSMENT SYSTEM (IHAS) ASSESSMENT

The table below (Table 4) shows the results of the IHAS analyses undertaken at the Soutpanspruit site. The site was found to have poor habitat integrity, therefore does not have sufficient habit available to house/support a diverse community of macro invertebrates.

Table 5: The IHAS scores and description for each site

Site	IHAS Score	Habitat Class
Soutpanspruit	18	Poor

4.4 MACRO – INVERTEBRATES (SAAS5)

The Soutpanspruit site was dominated by aquatic macro-invertebrate taxa with low requirement (11) for unmodified water quality, followed by taxa with very low requirement (10) for unmodified water quality (Table 5). The majority of the aquatic macro-invertebrate taxa with very low requirements were sampled from the GSM biotope (6 out of 10) which was observed to have the highest habitat availability and suitability scores (Tables 5 and 6).

Although the Veg biotope had the lowest habitat suitability and availability scores, it had the most biodiversity and the majority of the taxa sampled on this biotope were ones with low requirement (7 out of 11 families) for unmodified water quality. The stones biotope had an equal distribution in terms of macro-invertebrate taxa.

The principle as stated by Dickens and Graham (2001) is that reduced habitat diversity results in reduced biotic diversity. The results show that the habitat availability and suitability scores were quite low which might explain the quality of the taxa found in the stream.

Table 6: Aquatic macro-invertebrate taxa sampled at the Soutpanspruit site (February, 2018).

Taxon	Soutpanspruit			
	Stones	Veg	GSM	Total
TURBELLARIA	A	-	-	A
Oligochaeta	-	-	B	B
Leeches	-	A	A	A
Baetidae	B	A	A	B
Caenidae	A	-	-	A
Coenagrionidae	-	A	-	A
Gomphidae	-	-	A	A
Belostomatidae*	-	A	-	A
Corixidae*	-	-	A	A
Nepidae*	-	A	-	A
Pleidae*	-	A	-	A
Hydropsychidae	A	-	A	A
Leptoceridae	-	A	-	A
Dytiscidae (adults*)	-	A	-	A
Gyrinidae (adults*)	A	-	-	A
Hydrophilidae (adults*)	-	A	-	A
Chironomidae	B	A	A	B
Culicidae*	A	-	A	A
Simuliidae	-	B	A	B
Syrphidae*	A	-	-	A
Physidae*	-	-	A	A
Total SASS5 score	34	44	32	85
No. of families	8	11	10	21
ASPT	4.25	4.00	3.20	4.05

Total IHAS				62
IHAS - Habs sampled				44
IHAS - Stream condition				18
Suitability score	7	5	10	22

Key:

High requirement for unmodified water quality
Moderate requirement for unmodified water quality
Low requirement for unmodified water quality
Very low requirement for unmodified water quality

A = 1-10 individuals; B = 11-100 individuals; C = 101-1000 individuals; ASPT = Average score per taxon.

Table 7: SASS5, ASPT and biotope availability and suitability index scores for the Soutpanspruit bio monitoring site (February, 2018)

Monitoring site	SASS5 score	ASPT	SASS5-score per biotope			Biotope availability and suitability (Scores)			
			SASS Stones	SASSVegetation	SASS GSM	Stones	Vegetation	GSM	Habitat availability and suitability
Soutspan spruit	85.00	4.0	34.00	44.00	32.00	7.00	5.00	10.00	22.00

4.5 ICHTYFAUNA ASSESSMENTS

No fish species were observed in the Soutpanspruit site and their absence suggests that the water quality may be an issue.

4.6 ASSESSMENT OF POTENTIAL IMPACTS

An impact assessment was undertaken and mitigation measures prescribed for the proposed development of social houses in Soshanguve SS Extension 7 and 8. Even though the stream has low to moderate water quality and has a loss and a change in the natural habitat and biota, the proposed development might further disturb the functioning of the stream and will result in foreign and unwanted objects entering the system thus further compromising its integrity and state. But the significance of impact on the stream would be low to medium.

Potential impacts resulting from the proposed development would stem from a variety of different activities and risk factors associated with township development. The expected impacts associated with the river due to the township development activities are summarised as follows:

4.6.1 Water quality deterioration within the river

Mitigation:

- Store and handle potentially polluting substances and waste in designated, bund wall facilities.
- Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities.
- Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any river edge.
- Keep sufficient quantities of spill clean-up materials on site.

4.6.2 Increased impervious surfaces

Mitigation:

- Install rainwater harvesting systems to receive runoff from the roofs.
- Construct infiltration trenches to mitigate increases in runoff.
- Convert areas of existing or planned impervious paving to permeable paving products, to allow stormwater runoff to filter through voids in the pavement surface into underlying stone reservoir where it is stored temporarily or and infiltrated.
- Maximize the areas of vegetation and absorbent landscapes.
- Create a rain garden to receive runoff from roofs, patios, and/or driveways.
- Minimize driveway length and width, or share a driveway with neighbouring properties.
- Reduce parking area where feasible.

4.6.3 Increased discharge

Mitigation:

- Create ad restore backwater habitats
- Management and use of large wood
- Rehabilitation of banks and riparian zone
- Remaindering straightened rivers

4.6.4 Increased sediment transport into the river

Mitigation:

- Design and implement a construction stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.

- Install the construction stormwater management system prior to the onset of vegetation clearing activities.
- Phase vegetation clearing activities as far as possible to limit the area exposed at any one time.
- Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to August) to limit erosion due to rainfall runoff.

4.6.5 Altered flow characteristics within the river

Mitigation:

- Design and implement a stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.

Mitigation measures should be stipulated in the Environmental Management Plan for the construction phase and such a plan should require the contractor to supply and discuss method statements for all aspects of work that might have an effect on the aquatic environment. Monitoring by an Environmental Control Officer with appropriate sanctions for non-compliance, should increase the chance of effective mitigation against these impacts.

The above mentioned impacts can be caused by accidental spillages of hazardous chemical or waste, pollution of aquatic systems as a result of chemical pollutants used during the operational phase, polluted runoff from stock piles or work camps situated close to the stream, increases in storm water runoff volumes caused by greater hardened surface areas etc.

During the construction phase, vegetation will be removed leaving soil exposed and vulnerable to erosion especially during rainy days where run-off will be produced causing sedimentation. The consequence of eroded soil will be alien vegetation encroachment as aliens spread easily in disturbed soil.

Table 8: Summary of potential impact assessment

Aspect	Impact	Positive/negative impact	Probability	Duration	Scale	Magnitude	Significance/Risk	Mitigation Required	Mitigation measure
Increased impermeable surfaces, thus increased surface runoff	Gully formations	Negative	3	4	1	6	33	Yes	Introduce stormwater management measures as part of EMP
Site establishment	Disruption of hydrology	Negative	5	4	3	8	75	Yes	Not able to mitigate successfully.
Land clearing	Biodiversity loss	Negative	4	3	1	6	40	Yes	Avoid stockpiling of removed soils in the river.
Land clearing	Soil loss	Negative	3	4	1	6	33	Yes	Construct low level water deflection berms, reduce clearing to a mininum to maintain vegetation cover.
Human dispersal of alien seeds/sapling by construction vehicles, shoes, clothes	Alien invasion of native species habitat	Negative	4	3	2	6	44	Yes	A list of all possible alien vegetation that is probable to occur within site and as a result of mining activities within wetlands should be compiled and eradicated as soon as they occur.
Oil spillages	Water quality contamination	Negative	5	4	2	4	50	Yes	Servicing of machinery procedures; maintenance.

5 CONCLUSION

The state of the Soutpanspruit at Soshanguve, Pretoria is moderately modified (C). The dominance of only aquatic macro - invertebrate taxa with low /very low requirement for unmodified water quality implies poor water quality. These types of taxa are able to tolerate high level of pollution.

Although the taxa found mostly consisted of hardy adaptable species it is worth noting that the site sampled was observed to have been recently impacted by a flooding event. This may impact on the biotic integrity observed as some of the biotopes may have been affected. According to (Dickens and Graham, 2001), sampling on rivers recently impacted by a flooding event may yield inaccurate results.

Various impacts that will be caused by the proposed development on the area of concern were noted and they will result in little change in the functioning of the system.

6 RECOMMENDATIONS

It is recommended to continue with SASS5 monitoring at the selected Soutpanspruit site as further monitoring will give insight on the aquatic conditions of the Soutpanspruit.

7 REFERENCES

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