anne bindoff CONSULTANCY

Reg no: 2014/011805/07

MOTIVATION IN SUPPORT OF THE APPLICATION TO EXCLUDE SLUDGE WASTE FROM THE DEFINITION OF WASTE

for

ILLOVO SUGAR (SOUTH AFRICA) (PTY) LTD - NOODSBERG SUGAR MILL

by

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Revision 1.

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DETAILS OF THE SPECIALIST

Name of Company: Anne Bindoff Consultancy.
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Qualifications: MSc (Eng – Enviro) UKZN, BSc (Chem and App Chem) UKZN, HED UNISA. RMPASA and Plant Science Consultants Association (PSCA) attendance for GHS training.
Professional Affiliations: RPMASA, IWMSA, PSCA.
Professional Registration: SACNASP: application pending
Company Specialities: Environmental Management, specialising in Waste Management, Hazardous Waste, Legal aspects, GHS: UN Standards Safety Data Sheet Compilations for Hazardous chemicals, Agri-Remedies (New standards) and fertilizers (New standards).
Experience:

- **Regulatory DAEA/EDTEA–** Pollution and Waste Management: Acting Assistant Manager ILembe DM 2006 - 2009.
- **Corporate: SAPPI Mandeni:** 2009 – 2013: Environmental Specialist: SHEQ systems, landfill site management, waste management, legal compliance for permits licences, waste classifications, water permits, waste permits, etc.
- **Own Business: Anne Bindoff Consultancy: As above:**
  Clients:
  - **Sappi Mandeni,** Hazardous waste removal.
  - **INDIFLORA: Brookdale Assessment Centre** - Rehabilitation: Waste removal for legal compliance.
  - **Aquasol** – SDS and labels, HCA and DALRD new requirements.
  - **NCP Chlorchem**: Waste assessment.
  - **Intellichem:** Tremcards supply.
  - **IFF:** Tremcards supply.
  - **SAPREF:** Tremcards supply.
  - **Bowisolve:** Legal requirements for road transportation of waste/Hazardous waste.
  - **Andermatt Madumbi:** Agri-remedies SDS assessments and advisory.
  - **RPMASA:** GHS training for Safety Data Sheets.
  - **IWMSA:** Hazardous waste management training.
  - **ECOGUARD:** Agri-remedies SDS compilations – new requirements and advisory.
  - **Aquasolve:** Supply of Safety Data Sheets: Fertilizers, new agricultural standards as per Dept of Labour HCA requirements.
  - **Dow/Corteva** – SDS advisory and tremcards supply.
  - **BPL**: Tremcards Supply.
  - **WALLACE AND GREEN ENVIRONMENTAL SPECIALISTS**: Waste Specialist –
    - Motivation in support of the removal of SUMITOMO waste ash and rubber compound from definition of waste.
    - Motivation in support of the removal of various waste streams from Illovo mills: Eston, Noodsberg and Gledhow.
    - Motivation in support of the removal of various waste streams from the Umfolozi mill.

1. INTRODUCTION

Illovo Sugar (South Africa) (Pty) Ltd, is an invested, long-term contributor to South Africa's economy, committed to partnering for the continuing transformation of its agricultural and sugar production sectors. The Noodsberg mill is part of the Illovo Sugar South Africa Group.
The Illovo Sugar (South Africa) (Pty) Ltd - Noodsberg Sugar Mill mill is located at Noodsberg (near Dalton) in the KwaZulu-Natal Midlands. The GPS coordinates of the site are 29°21'35.31" S, 30°41'12.85" E.

Figure 1: Google Earth photo of the Noodsberg Sugar Mill in Dalton: KZN. (Screen shot from GOOGLE EARTH)

Figure 2 Google Earth view of the effluent treatment ponds of the Noodsberg Sugar Mill.

The mill at Noodsberg (near Dalton) in the KwaZulu-Natal Midlands is in the uMshwathi Local Municipality (LM), Umgungundlovu District Municipality, KwaZulu-Natal, South Africa. The cane supply area stretches as far as Baynesfield to the west (55 km) includes the Muden area and Kranskop area (60 km). UMshwathi LM economy is focused on the agricultural sector and other economic activities primarily related to this sector. The informal sector is also is playing an ever-increasing role in uMshwathi Municipality although its contribution to the local GDP has not been quantified. The site of the mill is in a rural area with high unemployment rate of approximately (25% and youth unemployment of approximately 32% from 2011 data. https://www.statssa.gov.za/?page_id=993&id=umshwathi-municipality.). The presence of the mill supports the local communities through the employment it offers directly at the mill, the farmers which supply the mill with the sugar cane and the local community members that supply services to the community: shops, doctors, contractors, schools, informal sector, etc.

The Noodsberg mill crushes about 1.45 million tons of cane and produces 150,000 tons of sugar per annum. This in turn produces large quantities of waste streams that require management to prevent human and environmental harm. One waste type is the waste water treatment plant sludge, which is the settled solids from the collection of all the waste water from the mill area into the sludge dams. As part of the South African Waste Management Strategy, the sludge is to be beneficiated in a legal and responsible way by moving it away from landfill disposal and redirecting it to the sugar cane farms as a soil enhancer.

This report serves as a basis for the application to remove the sludge waste from the definition of waste as per the NEM:WA legal requirement and is compiled as the basis for the risk assessment and the risk management plan. This report fulfils the requirements as set out in the legislative framework given in Section 2 below

2. LEGISLATIVE FRAMEWORK

2.1. Acts

- The Constitution of the Republic of South Africa, Act 108 of 1996.
- National Environmental Management Act (NEMA): Act No 107, 1998. 27 November 1998. (NEMA)
- National Environmental Management: Waste Act. (NEM:WA) No. 59 of 2008.
- The National Environmental Management: Waste Amendment Act (NEM:WAA), 2014 (Act No 26 of 2014).
- National Environmental Management: Waste Act (59/2008): National Waste Management Strategy, 2020 (NWMS)
- National Road Traffic Act (RTA), No. 93 of 1996.
- Occupational Health and Safety Act (**OHSA)** no: 85 of 1993.

2.2. National Norms and Standards. Listed Activities and other relevant documents

- **NEM:WA** Regulation 331 National Norms and Standards for the Remediation of Contaminated Land and Soil Quality. 2013.

- The Framework for the Management of Contaminated Land, Department of Environmental Affairs (DEA), May 2010.
- National Norms and Standards for the Storage of Waste. 2013.
- NEM:WA (Act 59 of 2008) Government Notices (23 August 2013):
  - R.634 Waste classification and Management Regulations
  - R.635 National norms and standards for the assessment of waste for landfill disposal
  - R.636 National norms and standards for disposal of waste to landfill.
- National Environmental Management: Waste Act (59/2008): Regulations regarding the exclusion of a waste stream or a portion of a waste stream from the definition of waste (18 July 2018).
- **SANS 10234 (2019)(2nd ed):** Globally Harmonized System (GHS) of Classification and Labelling of Chemicals.
- **GHS:** UN Standards Purple Book 9th ed.

3. NOODSBERG SUGAR MILL CONTACT DETAILS

Name: Illovo Sugar Limited - Noodsberg Sugar Mill.
Physical address: 1 Oliver Pierce Avenue, Noodsberg, KwaZulu-Natal.
Postal address: Private Bag 501, Dalton, 3236

Contact person:
Name: Shaun Ramsunder
Portfolio: Country SHERQ Manager
General Mill Contact no: 033-5029500.
Mobile: 084 554 9664
email: SRamsunder@illovo.co.za.

4. ILLOVO INTEGRATED MANAGEMENT SYSTEM

As part of the mill operations, the Illovo Integrated Management System which include the SHERQ Management Systems are adopted for best practice in the industry. The Illovo group have a policy which is adhered to by all its sugar mills. In relation to environmental responsibility, the following is an extract from the Code Of Conduct And Business Ethics (refer to Attachment 1: ILLOVO GROUP Code of Conduct and Business Ethics).

ENVIRONMENTAL MANAGEMENT

- Illovo supports and encourages operating, manufacturing, farming and agricultural practices and production systems that are sustainable.
- As an environmentally sensitive business, Illovo supports a precautionary approach to environmental challenges and is committed to promoting environmental responsibility and encouraging the development and diffusion of environmentally friendly technologies in our operations.

- Suppliers should adopt a precautionary approach to environmental challenges and continually strive towards improving the efficiency and sustainability of their operations, including water conservation programmes, initiatives to promote greater environmental responsibility and encourage the development and diffusion of environmentally friendly technologies.
- The following aspects of environmental management will be included in the assessments of Suppliers:-
    - they should be aware of, and be able to demonstrate compliance with all current environmental legislation that may affect their activities;
    - they should conduct an environmental review of all aspects of their products and services.
- Any enforcement, improvement or prohibition notices served on a Supplier within the last three years by any competent authority must be disclosed and will be reviewed.

5. FACILITY WASTE GENERATING PROCESS.

5.1. Facility processing of sugar cane to sugar.

Refer to Figure 3: Production Process Flow Chart Showing The Generation Of The Waste Streams Ash, Bagasse And Filter Cake./Attachment 2: Production Process Flow Chart Showing The Generation Of The Waste Streams Ash, Bagasse And Filter Cake.

This process flow shows the different process streams as well as the waste generated off these streams. Sludge is the solids component from the effluent treatment works.

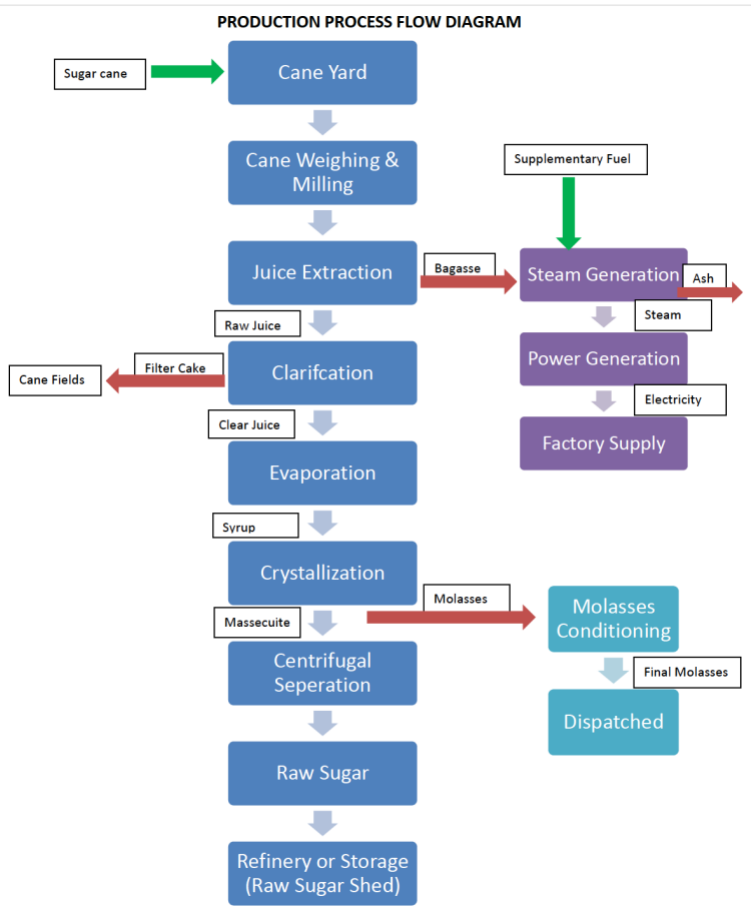

Figure 3: Production Process Flow Chart Showing The Generation Of The Waste Streams Ash, Bagasse And Filter Cake.

5.2. Summary of the potential inputs into the waste water treatment works sludge

Table 1: Summary of the main processes in producing sugar from sugar cane, summarises the processes which are represented in Figure 3: Production Process Flow Chart Showing The Generation Of The Waste Streams Ash, Bagasse And Filter Cake. This describes the potential inputs that would be washed into the effluent drains.

Table 1: Summary of the main processes in producing sugar from sugar cane.

Process	Inputs	Process description	Waste generated
Cane Yard	Sugar cane, litter, cane juice, squashed sugar cane, oil.	Cane received in mill cane yard from vehicles,	• Sugar cane bits/sweepings, • litter from human sources, • cane juice from squashed cane ridden over by trucks, • squashed sugar cane, • oil from truck/vehicle sources, • ash from boiler

			stacks fall-out.
Cane weighing and milling	Sugar cane, cane juice, squashed/chipped/shredded sugar cane,	After being weighed the cane is then mechanically chipped and/or shredded	• Sugar cane bits, • litter from human sources, • cane juice from squashed cane ridden over by trucks, • squashed sugar cane, • oil from truck/vehicle sources,
Juice extraction/diffusion	Water, shredded cane.	• A stream of water is dribbled/dripped over the bed of cane. • The sugar depleted cellulose solids after the juice extraction are removed in one stream to form the bagasse waste stream.	• Splashed raw sugar juice, • cellulosic fibres, • bagasse.
Steam generation in boilers	Waste cellulosic fibres - bagasse	Bagasse is fed into the boiler furnace where it is burnt to create heat to generate steam for the process.	Boiler ash.
Water treatment for boilers	Chemical addition to treat water for suitability to boilers	Treated water is fed into boilers.	Chemical splashes.
Clarification	Chemical and polymer additive into the raw cane juice	Raw juice needs to be clarified to remove suspended solids and organics like waxes, proteins, etc.	Chemical splashes.
Filtration of clarified juice.	Mechanical Vacuum Filtration of raw juice and settling facilitation chemicals.	Mechanical Vacuum Filtration to remove clarified juice.	Sludge - Filter Cake.
Clarified juice evaporation and crystallization.	Clarified juice.	If temperature is too high in this process, sugar is lost in the condensate.	Condensate water and possibly sugar carry-over.
Cooling ponds	Condensate from the juice concentration and crystallization.	The condensation is hot so is sent to the cooling pond in order to treat the possibly contaminated water for return back into the system.	• Spillages, • Sludges.
Centrifugal separation of crystalised sugar and concentrated juice	Concentrated crystalized Sugar juice	The thickened sugar crystalised juice, is spun in a high speed centrifuge consecutively	• Molasses, • spilt sugar.

		to remove the crystalised sugar (solids) and juice (liquid).	
Effluent waste water treatment works.	All floor washings from the housekeeping processes to keep the mil clean.	• General mill housekeeping requires a comprehensive cleaning regime. • Dry waste is swept up and placed back into the system or into waste bins and legally disposed of. • Liquid spills and washings of these spills to flush the remaining dry waste with prudent water washings.	All mill fall out: • spillages, • ash, • oils, • dirt, • fibres, • sugar cane, • juices, • chemicals, • sludges, • storm water • other.

5.3. Treatment of Sugar Industry Wastewater:

The Noodsberg Sugar Mill has a waste water treatment system. The waste water is collected in dams. This has a residence time that allows the sludge to settle out and to stabilise to reduce the Chemical Oxygen Demand (COD) (organic components) using the anaerobic dam system of treatment.

The sludge is removed from the dam once the sludge level rises to a predetermined level in the dam. It is then dried out where it is then collected and dispatched to the farmer's lands.

5.4. Sugar mill sludge: beneficial use as a fertilizer.

The following citation is from**:** Dotaniya ML, et al. (2016;5(3):185–94). (https://link.springer.com/article/10.1007/s40093-016-0132-8).

5.3.1. Conclusions

"Application of sugarcane industries by-products reduces the recommended dose of fertilizers and improves organic matter of soil during the crop production.

The results of the research work done on the use of the waste streams to enhance soils and the sugar cane crop are very positive. The caution used in the applications of the waste streams on soils are the toxic metallic components in these waste streams. Careful management and monitoring of the process with the guidance of agronomists is necessary. However, further research is being done on the combinations of the waste streams in order to potentially reduce the toxicity of the waste streams. "

6. CONSEQUENCES OF NOT RECYCLING OR REUSING THE SLUDGE

6.1. Challenges to be faced without beneficiating the sledge waste

The challenges with the waste generated from the sugar industry are:

- Storage space. Pollution from sugar mill waste is well documented. Particularly from uncontrolled spills from milling process incidents. Hence the storage space on site is to be monitored carefully to not have extensive build-up of sludge to cause spillage out of the containment areas. The management of this would be to dispose onto landfill.
- The on-site landfill available airspace is minimal. The current EMPr requirement is to reduce the volume of ash waste currently on the landfill site.
- There is a current prohibition/restriction from disposal to landfill due to the flash point achieved at 60^{o}C, which poses a hazard.
- The waste stream would require further treatment in order to reduce the potential for fire.
- Landfilling of the (treated) waste stream combined with the other waste streams would place a great burden on the receiving landfill.

Landfilling is the option chosen often to dispose of waste as the easiest option. Unfortunately landfilling is a waste management process that uses up airspace. The NEM:WA: National Waste Management Strategy (NWMS - 2020); is to focus on amongst others diversion of waste from landfilling and to implement the circular economy principles. These are to beneficiate the waste in a responsible manner as a resource stream for other operations.

The farmer needs to use fertilizer on the soils to obtain an optimum crop. Without the sludge and other waste streams from the milling processes, the farmer would need to buy commercial fertilizers. This way the budget available to develop the farm and employ locals would be compromised in an economy which is already stressed.

A negative aspect to the removal of the waste sludge after dewatering to acceptable moisture levels, to a permitted and properly managed landfill site is:

- The waste stream has prohibited/restricted properties, based on the NEM:WA Regulation 636: National norms and standards for disposal of waste to landfill:

GN R636 S.5: Current Prohibition/Restriction from Disposal:
Type 0, Prohibited Waste per GN R636 (5)(1)(c) Flammable waste with a closed cup flashpoint <61 °C. Analytical value of: 60 - Flash°C.

In summary the disadvantage to not using the sludge is to Illovo Noodsberg mill through the cost of waste disposal by landfilling onto its own site which is almost full, and to those downstream users who would benefit from the waste as a fertilizer.

6.1. Benefits of reuse and recycling

The objectives of the NWMS - 2020, are aligned with the Sustainable Development Goals:

SDG 3: to avoid/minimize waste related environmental factors that prevent ill-health and disease.
SDG 6: Clean water and sanitation through:

- minimising discharge of wastewater from. Human activities into rivers/oceans/dams.

- Supporting sustainable management of water to better manage food production.

SDG 8: Promoting the waste management sector as a key contributor to overall economic growth and development.
SDG 9: use of natural resources to improve people's standard of living without damaging the environment.
SDG 12: Through: ensuring production patterns, implementing initiative that reduce waste, promote re-cycling, re-use.

The NWMS 2020 strategy is directing South Africa to a future with zero waste in landfills. This will be achieved through eight strategic goals, three of which are relevant for this report namely:
Goal 1: Promote waste minimisation, re-use, recycling and recovery of waste.
Focuses on implementing the waste management hierarchy, and with the ultimate aim of diverting waste from landfill.
Goal 8: Establish effective compliance with and enforcement of the Waste Act.
Ensures that everyone adheres to the regulatory requirements for waste management, and builds a culture of compliance.

The benefit of beneficiating would be that the main stakeholders:

- the farmers, would save on commercial fertilizers,
- the mill would be able to engage the local community in their small enterprises because of the benefits of the waste stream as a fertilizer.

To be able to benefit from this opportunity, the sludge will need to be characterised to minimize the risk to human health and to the environmental. The following section describes this process and the results of the nature of the waste.

7 METHODOLOGY USED TO ASSESS THE CHEMICAL/HAZARDOUS NATURE OF THE WASTE

7.1. Rationale

Research work has been done on the use of sludge on agricultural crops. There are promising results that this may be successful with proper understanding of the chemical makeup. To understand the potential implications on the environment, this section focuses on the chemical makeup of the sludge and the potential hazards and risks these pose in its proposed application.

8 RESULTS

Refer to the complete results for given in:

- Attachment 3a: Certificate of Analysis
- Attachment 3b: Waste Assessment and Classification,
- Attachment 3c: Sludge Safety Data Sheet SDS.

Notes in this section are the notes given in the laboratory reports.

8.1. Characterisation of the waste

The waste was sampled on 1st September 2022, sent to an accredited laboratory (Talbot and Talbot) and:

- tested for its chemical composition and quantitative make-up of the elements,
- classification of the waste for any hazards, and
- for assessment for waste type and landfill class using the **NEM:WA Norma and standards Regulations** for assessment and classification of waste.

  Using NEM:WA (Act 59 of 2008) Government Notices (23 August 2013):
  - R.634 Waste classification and Management Regulations
  - R.635 National norms and standards for the assessment of waste for landfill disposal
  - R.636 National norms and standards for disposal of waste to landfill.

The second approach is to determine the hazard of the chemicals on the soils and hence what would the effect be on the environment and on the health of the community. The Framework for Contaminated Land Rehabilitation (DEA- May 2010) guideline thresholds were used, and compared with the Total Concentration values (TC) and the Leachable Concentration (LC) results obtained.

(i) Waste assessment to landfill: (ref: Based on GN R635 (7)(2)), the waste is assessed overall as a Type 0 waste, which is Very high risk due to the flash at 60°C.

(ii) The waste is CHEMICALLY assessed as TYPE 3 waste which is low risk.

Notes:

- Confirmatory analysis is required for Type 0 and Type 1 wastes treated in order to achieve a lower final Waste Type and Landfill Class. Where applicable, this Waste Assessment and Classification report and associated Safety Data Sheet will be updated.
- Prohibited or restricted under GN R636 (5) Waste Disposal Restrictions, but assessed as a different waste type under GN R635 (7). Subject to waste treatment and re-assessment per GN R634, the prohibition or restriction may be excluded.

- Type 0 Waste: Based on GN R635 (7)(2),
- Chemically assessed as a Type 3 waste; which is low risk waste.
- Classed Type 0 per prohibited characteristics GNR 636 (5)(1)(c) - refer to section 1.2 of the classification report.
- No future prohibition from or restriction to disposal

(iii) **GHS Classification and Hazard Management.** *(refer to the Safety Data Sheet SDS):*

- Classification in accordance with SANS 10234:2019 concluded that:
  - Physical: H226 Cat 3. Flammable Liquid.

- Health No applicable waste constituent, characteristic, property, or hazard was identified.
- Environmental No applicable waste constituent, characteristic, property, or hazard was identified..
- **Conclusion: HAZARDOUS WASTE.**

- **Uses advised against**: WASTE - if a commercial product residue, not intended for original use. KEEP AWAY FROM clothing. Take precautionary measures against static discharge. DO NOT eat, drink or smoke when using this product. AVOID release to the environment. Collect spillage.

Table 1: Summary of sludge hazard classification

Classification in accordance with SANS 10234:2019:	
Physical: H226 Cat 3	Flammable Liquid.
Health:	Not classified
Environment	Not classified
Overall classification:	Hazardous.

SANS 10228:2012 Classification for Transportation by road:

Class	**Un Number**	**Proper Shipping Name (Road and Rail Modes)**
4.1	3175	**SOLIDS CONTAINING FLAMMABLE LIQUID, N.O.S**

8.2. Precautionary Measures

8.2.1. Prevention

- KEEP AWAY FROM clothing.
- Keep container tightly closed
- Ground/bond container and receiving equipment.
- Take precautionary measures against static discharge.
- AVOID breathing dust, fume, gas, mist, vapours, spray.
- DO NOT get in eyes, on skin, or on clothing.
- DO NOT eat, drink or smoke when using this product.
- AVOID release to the environment.
- Wear protective gloves, protective clothing, eye protection, face protection.

8.2.2. Responses

- Get medical advice / attention if you feel unwell.
- Fight fire with normal precautions from a reasonable distance.
- Collect spillage.
- **IF SWALLOWED**: Call a POISON CENTRE or doctor/physician if you feel unwell.
- **IF ON SKIN** (or hair): IMMEDIATELY remove/take off all contaminated clothing. IMMEDIATELY rinse skin with water/shower.

- **IF INHALED:** Call a POISON CENTRE or doctor/physician if you feel unwell.
- **IF IN EYES:** Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- If exposed or concerned: Call a POISON CENTRE or doctor/physician.

8.2.3. Storage

Store in a well-ventilated place and keep cool.

8.2.4. First-aid measures

Immediate actions: IF ON SKIN (or hair): IMMEDIATELY remove/take off all contaminated clothing**.** IMMEDIATELY rinse skin with water/shower. If exposed or concerned**: Call a POISON CENTRE** or doctor/physician

Actions to be avoided: DO NOT eat, drink or smoke when using this product. AVOID release to the environment.

Inhalation: AVOID breathing dust, fume, gas, mist, vapours, spray. IF INHALED: Call a POISON CENTRE or doctor/physician if you feel unwell.

Skin Contact: Keep away from clothing. DO NOT get in eyes, on skin, or on clothing. Wear protective gloves, protective clothing, eye protection, face protection.

Eye Contact: DO NOT get in eyes, on skin, or on clothing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Ingestion: DO NOT get in eyes, on skin, or on clothing. IF SWALLOWED: Call a POISON CENTRE or doctor /physician if you feel unwell.

Anticipated effects and symptoms summaries

Acute effects: No data available

Delayed effects: No data available

Symptoms/Effects: No data available

Protection of first-aiders and notes for attending physicians

Physician notes: Get medical advice / attention if you feel unwell.

8.2.5. Fire Fighting:

Extinguishing media and methods: Use extinguishing media suitable to the surrounding fire.

Protection of fire-fighters KEEP AWAY FROM clothing. Take precautionary measures against static discharge. AVOID breathing dust, fume, gas, mist, vapours, spray. Fight fire with normal precautions from a reasonable distance.

8.2.6. Accidental release measures

Responders, personal precautions, PPE: KEEP AWAY FROM clothing. Wear protective gloves, protective clothing, eye protection, face protection.

Environmental precautions: AVOID release to the environment. Collect spillage.

Methods and materials for containment and for clean-up: Take precautionary measures against static discharge.

8.2.7. Safe Handling and Storage

Safe handling: Keep container tightly closed. Ground/bond container and receiving equipment. Take precautionary measures against static discharge. DO NOT get in eyes, on skin, or on clothing. DO NOT eat, drink or smoke when using this product. AVOID release to the environment. Wear protective gloves, protective clothing, eye protection, face protection
Safe storage: Store in a well-ventilated place and keep cool.
Technical measures: No data available
Incompatible materials: No data available
Packaging: No data available
Additional information: Eating, drinking and smoking in work areas is prohibited. Remove contaminated clothing and protective equipment, and wash hands after use and before entering eating areas.

8.2.8. Exposure controls and personal protection (PPE)

Engineered controls: No data available
Respiratory: Use respiratory protection approved under appropriate government standards.
Hand/Arm: Use respiratory protection approved under appropriate government standards.
Eye/Face: Use equipment for eye protection tested and approved under appropriate government standards.
Skin/Body: Wear protective clothing.
Hygiene: Handle in accordance with good hygiene and safety practice. Wash hands before and after handling.

Special conditions posing a hazard: KEEP AWAY FROM clothing. Ground/bond container and receiving equipment.

8.2.9. Clean-up

Not specified, but apply reasonable care.

8.2.10. Stability and reactivity

Conditions to avoid: Heat

8.2.11. Disposal

Do not fly tip. Do not dispose into sewer, stormwater, or environment. Do not burn unless by means of compliant incineration practices.

9 CHEMICAL AND TECHNICAL SPECIFICATIONS – PRE-BENEFICIATION

9.1. Introduction

Pre-beneficiation: the chemical and technical specification are reported by the laboratory as given in the attachments:

- Attachment 3a: Certificate of Analysis,
- Attachment 3b: Waste Assessment and Classification,
- Attachment 3c: Sludge Safety Data Sheet SDS

Note: The basis of the leachability of the sludge was in anticipation of the environment of the landfill site with putrescible waste and hence to low pH conditions. The leachate pH of the sludge is 7.4, which is neutral. The leachability test was done with leaching liquid at pH 5. This does affect the leaching potential of the sludge when comparing the acidic conditions of leaching in the laboratory analyses and in the environment with the rain at pH 5.6 from the rain. The rain itself is intermittent. The result may be a lower leaching out of the metallic components from the sludge into the environment.

Total concentrations for the sludge were determined as per NEM:WA - National norms and standards for the assessment of waste for landfill disposal. The quantitative results present the hazard risk to all stakeholders when exposed directly to the sludge. These exposures have been given toxicity values. The GHS classification for the hazard of sludge is presented in Table 2: Summary of sludge hazard classification.
. The sludge was given a hazard classification because of physical implications of the sludge under certain conditions.

The results for the Total Concentration (TC) and the Leachability Concentration (LC) are presented in Table 3: LC and TC laboratory results for the Noodsberg Sugar Mill sludge.
These were used for the Framework for the Management of Contaminated Land database of the Soil Screening values. The Soil Screening Values (SSV) are the soil quality values, expressed as mass of contaminant per mass of soil, that are:

For SSV1: protective of both human health and ecotoxicological risk for multi-exposure pathways, inclusive of contaminant migration to the water resource. Soil Screening Values 1 are applicable to all land-uses, and thus represent an ‘acceptable-risk’ situation, with no adverse effects on human health and the aquatic environment.

For SSV2: that are **protective of risk to human health in the absence of a water resource.** Soil Screening Values 2 are land-use specific and have been calculated for three key land-uses namely, standard residential, informal residential settlements and commercial/industrial land-uses.

This approach was followed because Noodsberg Sugar Mill has the intention of applying the sludge to agricultural land as a fertilizer. Hence this provides a valuable tool to assess the risks and the management of the activity and material to the land.

9.2. Laboratory results

The Table 3: LC and TC laboratory results for the Noodsberg Sugar Mill sludge.
shows the results of the metal and anionic components of the sludge. No organic components are shown as they are not shown to be above any of the thresholds given from the Norms and Standards Threshold Specifications.

Table 2: LC and TC laboratory results for the Noodsberg Sugar Mill sludge.

CHEMICAL	**LC** (mgX/l)	**TC** (mgX/kg)

CHEMICAL	LC (mgX/l)	TC (mgX/kg)
Antimony	<0,05	<5
Arsenic	<0,08	<8
Barium	0,32	8,4
Boron	<0,16	<16
Cadmium	<0,17	<17
Chromium Cr^{+3}	<0,16	421
Hexavalent Chromium	<0,0031	<0,031
Cobalt	<0,17	<17
Copper	<0,17	<17
Lead	<0,08	**31**
Manganese	**1,35**	93
Mercury	<0,0031	<0,31
Molybdenum	<0,31	<31
Nickel	<0,18	<18
Selenium	**<0,63**	**<63**
Vanadium	<0,02	104
Zinc	0,15	5,96

Chloride	5,93	-
Cyanide (Total)	0,02	<10
Fluoride	0,35	3
Nitrate	<0,25	-
Sulphate	<2,5	-
TDS	1262	-

Note:

(i) figures reported as < have a concentration below the detection limit of the laboratory equipment. Hence the figure is given as the very upper limit of the instrument detection limit. The implication of this is that the real figure is most likely much lower than the reported concentration.

(ii) Bold analytical results exceed at least the lowest applicable concentration threshold.

9.3. TC and LC of components in the sludge presenting the hazards of the sludge

The organic components of the sludge will not be considered as there were none assessed as hazardous. Only the inorganic components will be considered.

The sludge is proposed to be used as a fertilizer on farm fields. There is thus a need to be aware of the effect of these components in the sludge on the receiving environment; the soil, natural water bodies and the people. The assessment conducted for GHS hazard of the sludge indicated that there were NO hazards to human health nor to environmental health. However, the hazard was for the flammability of the wate stream under conditions of heat, flames and sparks.

These are the sources of information for the possible effects that will be used to obtain information to assess the risk of these components as a possible representative of contaminants in soils:

- Department of Environmental Affairs: Framework For the Management of Contaminated Land. May 2010.
- Department of Environmental Affairs, Government Notices.
  - R. 634: National Environmental Management: Waste Act (59/2008): Waste Classification and Management Regulations.
  - R. 635: National norms and standards for the assessment of waste for landfill disposal.
  - R. 636: National norms and standards for disposal of waste to landfill.

9.4. Soil Screening Values as a basis for developing risk assessment and risk management plans.

The remediation of contaminated land is being used as a base from which to determine the effects on the environment and related stakeholders due to the possible effects through this medium as a route for exposure of the various components in the sludge.

This work is used to show the values used to assess the risk to the affected areas when the sludge is applied to the fields.

Soil Screening Value (SSV)1: soil quality values, expressed as mass of contaminant per mass of soil, that are protective of both human health and ecotoxicological risk for multi-exposure pathways, inclusive of contaminant migration to the water resource.

SSV 1 are applicable to all land-uses, and thus represent an 'acceptable-risk' situation, with no adverse effects on human health and the aquatic
environment.

SSV 2: soil quality values, expressed as mass of contaminant per mass of soil, that are protective of risk to human health in the absence of a water resource. **SSV 2** are land-use specific and have been calculated for three key land-uses namely;

- standard residential,
- informal residential settlements and
- commercial/industrial land-uses.

(DEA, May 2010)

This approach will be a useful tool to manage the application of the sludge to the soil, together with the expertise of the agronomist who would know the local soil conditions.

Table 3: LC and TC laboratory results for the Noodsberg Sugar Mill sludge.
shows the soil screening values for contaminated land and for DWA Water Quality Guidelines levels for aquatic ecosystems protection and domestic water use. (Framework for the Management of Contaminated Land. 2010. p 33)

Table 3: Summary of soil screening values for contaminated land and for the protection of water resources. (Note, the highlighted numbers from these thresholds represent exceedances of the components in their total concentration. No leachable components were exceeded)

Parameter	SSV1 **All Land-Uses Protective of the Water Resource** (mg/kg)	SSV2 **Informal Residential** (mg/kg)	**SSV2 Standard Residential** (mg/kg)	**SSV2 Commercial / Industrial** (mg/kg)	**Protection of Human Health** (Drinking water usage) (mg/kg)	**Protection of Ecosystem Health (**mg/kg)
Metals and metalloids						
Antimony	-	-	-	-		-
Arsenic	5,8	23	48	150	5,8	580
Barium	-	-	-	-	-	-
Boron	-	-	-	-	-	-
Cadmium	**7,5**	**15**	32	260	**7,5**	37
Chromium Cr^{+3}	46000	46000	96000	790000	N/A	N/A
Hexavalent Chromium	6,5	6,5	13	40	19	260
Cobalt	300	300	630	5000	-	22000
Copper	**16**	1100	2300	19000	200	**16**
Lead	**20**	110	230	1900	**20**	100
Manganese	740	740	1500	12000	10000	36000
Mercury	0.93	0,93	1	4,5	1	4,1
Molybdenum	-	-	-	-	-	-
Nickel	91	620	1200	10000	91	1400
Selenium	-	-	-	-	-	-
Vanadium	150	150	320	2600	2000	-
Zinc	240	9200	19000	150000	3700	240
Chlorides	12 000					
Fluorides	30					
Nitrate/Nitrite	120					
Sulphates	4000					

Note: Table 3: LC and TC laboratory results for the Noodsberg Sugar Mill sludge.
shows the laboratory results for the Total Concentration (TC) and Leachable Concentration (LC) concentrations of the components in the sludge. The laboratory results for Cadmium and Copper showed exceedances because of the detection limit of the laboratory instruments was higher than the actual concentrations of these metal elements. However, the Lead concentration did exceed the limits of the SSV thresholds. These will be considered with risk assessment and management.

Two tiers of Soil Screening Value have been defined as follows:

- Soil Screening Value (SSV) 1 represents the lowest value calculated for each parameter from both the Human Health and Water Resource Protection pathways calculations as detailed under the preceding sections. SSV1 values are not land-use specific.
- Soil Screening Value (SSV) 2 represents the land-use specific soil value calculated following the methods as detailed under the preceding sections. SSV2 values are land-use specific and are appropriate for screening level site assessment in cases where protection of water resource is not an applicable pathway for consideration.

Interpretation:

- The total concentration values were exceeded for :
  - SSV1: All Land-Uses Protective of the Water Resource. (for Cadmium (Cd), Copper (Cu) and Lead (Pb)
  - SSV2: Informal Residential. (Cd), (Pb)

and for

  - Protection of Human Health (Drinking water usage). (Cd), (Pb)
  - Protection of Ecosystem Health. (Cu)

No leachable components were exceeded. However, the only component of concern is from lead due to a data point from the analyses. The other components are registered as the most sensitive limit of the analytical instruments. Hence the true level in the waste is not known. However, the SSV1 and SSV2 figures were exceeded by lead and hence the management of the fertilizer in the waste will be managed, to have no impact on the SSV1 and 2 areas.

Caution needs to be exercised in exposure to the material to people in the informal residential areas and to be protective of the water resource for human and ecological protection.

9.5. Long term stability and functionality

According to the GHS classification, the only concern for sludge stability was heat. There were no concerns regarding human health and ecological health.

The aspect to the stability and functionality of the sludge would be seen in defining the term “stability” understood to mean to retain its physical and chemical character.

Sludge is a of organic and inorganic components: In terms of stability:

- Physical stability, it will remain stable, as there are no hazardous reactive components.
- Chemical stability:
  - The organic components have constituents that are conducive to microbial and other biological flora and fauna to develop in - hence the use of it as a fertilizer. The organic components will change.

- Inorganic components: have long term stability and hence their functionality will remain stable.

The functionality of the sludge will remain viable as a fertilizer pre-beneficiation and will retain this character post beneficiation.

9.6. Reactivity with environmental factors

The SDS shows no issues with stability and reactivity, only under conditions of heat.

Environmental factors affect the rates of chemical reactions of the waste. The standard environmental factors would include:

In this context the reactivity would be affected by ecological factors:

(i) rain,
(ii) soil type,
(iii) aeration from ploughing,
(iv) anaerobic conditions,
(v) lime addition,
(vi) soil flora and fauna.

The purpose of the sludge is to be reactive to the soil environment as a fertilizer. It will be applied to the soil on sugar cane farms.

9.7. Interpretation of results in terms of GHS classification and SSV of contaminated soils

The results from the GHS classification of the sludge waste: hazardous for the physical component of the waste sludge, but no hazards for the human health and environmental well-being.

The results of the SSV tests gave exceedances of some components for SSV1, 2 and for the human health for drinking water and Eco health. The runoff water must not be allowed to enter any natural water source, or be permitted to enter an informal and standard residential area. Application of the sludge to land as a fertilizer will need to be done away from human residential areas to avoid any potential impact. The application of the sludge to the soils will need to be monitored and done with the guidance of an agronomist.

10 CHEMICAL AND TECHNICAL SPECIFICATIONS – POST-BENEFICIATION

The pre-beneficiation chemical and physical qualities of the sludge have been described above. Once the sludge has been applied to the soil, it is anticipated that it will be assimilated into the soil through natural biological processes to produce good sugar cane crop. The high moisture content will provide good moisture to the soils and will be beneficial for plant growth. The effect on the environment will be minimised as well as managed to not impact human health.

10.1. Intended users of the waste stream

The intended use of the waste sludge is solely for the purpose of soil enrichment. The recipients of these waste streams are primarily large and medium scale private sugar cane farmers. The fields would be far away from any human locations and the correct management would be in place to prevent any run-off into natural water courses. The users would be utilising the services of a qualified agronomist

There is no formal training of the intended recipients of the waste, as the application of fertilizer is practiced the same as with commercial fertilizer application.

10.2. Long term stability and functionality

The sludge has been well researched for the intended purpose of soil enhancement in the field of agriculture. All fertilizers, whether from suitable waste streams or manufactured commercial fertilizers are to be utilized by end users under the supervision of agronomists to protect all stakeholders, the environment, soils and crops. The sludge itself is an organic with micro nutrients available for crop use.

10.3. Reactivity with environmental factors

Described under pre-beneficiation.

11 IDENTIFICATION OF POTENTIAL RISKS AND THE MANAGEMENT THEREOF

Refer to:
Attachment 4: Risk Assessment Sludge Noodsberg Mill, and
Attachment 5: Risk Management Sludge Noodsberg Mill.

12 REFERENCES

1. https://www.illovosugarafrica.com/about-us/south-africa.
2. Sugar Industry: Process Description and Wastewater Treatment. Environmental Pollution. (https://www.environmentalpollution.in/waste-management/sugar-industry-process-description-and-wastewater-treatment/2846).
3. Dotaniya ML, Datta SC, Biswas DR, Dotaniya CK, Meena BL, Rajendiran S, et al. *Use of sugarcane industrial by-products for improving sugarcane productivity and soil health. I*nternational Journal of Recycling of Organic Waste in Agriculture. 2016;5(3):185–94. (https://link.springer.com/article/10.1007/s40093-016-0132-8).
4. Sugar Industry: Process Description and Wastewater Treatment. Environmental Pollution. (https://www.environmentalpollution.in/waste-management/sugar-industry-process-description-and-wastewater-treatment/2846))

13 DECLARATION BY SPECIALIST – Anne Bindoff:

All information and instructions provided in this report in respect of the Risk Assessment and Risk Mitigations/Management Plan substance is given in terms of the provisions of the

National Environmental Management: Waste Act (59/2008): Regulations regarding the exclusion of a waste stream or a portion of a waste stream from the definition of waste.
Information and data is based on available information given by Illovo Noodsberg Mill and is the best information available through general research based on this information as at the date of this report. It is presented in good faith, to be correct.

Name: Anne Bindoff

Signature: ..... **Date:** 5th June 2023