

APPENDIX 1 - WATER COLUMN AND SEDIMENTARY ENVIRONMENT

1.10 Chemical Analysis Method Statement

METHODOLOGY FOR SEDIMENT ANALYSIS OF NAMIBIAN MARINE PHOSPHATE

VERIFICATION SURVEY

Prepared for:

Namibian Marine Phosphate (Pty) Ltd.

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June 2014

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contents

1	INTRODUCTION	1
1.1	BACKGROUND	1
1.2	OBJECTIVES	1
2	ANALYTICAL METHODS SUMMARY	1
2.1	METHOD STEPS FOR SUB-SURFACE CORE SEDIMENTS	1
2.2	METHOD STEPS FOR SURFICIAL GRAB SEDIMENTS	2
2.3	SCHEMATIC FLOW DIAGRAM OF SUB-SURFACE CORES METHOD PROTOCOL	3
2.4	SCHEMATIC FLOW DIAGRAM OF SURFICIAL GRAB SEDIMENTS	4
3	SAMPLE PRE-PREPARATION FOR SUB-SURFACE CORES	5
3.1	EQUIPMENT	5
3.2	PROCEDURE	5
4	OXIDATION REDUCTION POTENTIAL FOR SUB-SURFACE CORES	8
4.1	EQUIPMENT & CHEMICALS	8
4.2	PROCEDURE	8
5	ACID VOLATILE SULPHIDE AND SIMULTANEOUSLY EXTRACTED METALS FOR SUB-SURFACE CORES AND SURFICIAL GRAB SEDIMENTS	8
5.1	EQUIPMENT & CHEMICALS	8
5.2	PROCEDURE	9
6	INTERSTITIAL WATER-SOLUBLE NUTRIENTS FOR SUB-SURFACE CORES	10
6.1	EQUIPMENT & CHEMICALS	10
6.2	PROCEDURE	10
7	%MOISTURE AND ORGANIC MATTER DETERMINATION FOR SUB-SURFACE CORES AND SURFICIAL SEDIMENTS	10
7.1	EQUIPMENT	10
7.2	PROCEDURE	11
8	%TOTAL ORGANIC CARBON AND NITROGEN DETERMINATION FOR SUB-SURFACE CORES AND SURFICIAL SEDIMENTS	12
8.1	EQUIPMENT & CHEMICALS	12
8.2	PROCEDURE	12
9	TOTAL HEAVY METAL DETERMINATION FOR SUB-SURFACE CORES AND SURFICIAL SEDIMENTS	13
9.1	EQUIPMENT & CHEMICALS	13
9.2	PROCEDURE	13
10	PARTICLE SIZE ANALYSIS BY LASER DIFFRACTION AND WET SIEVING FOR SUB-SURFACE CORES AND SURFICIAL SEDIMENTS	14

SECTION D, APPENDIX 1 - WATER COLUMN AND SEDIMENTARY ENVIRONMENT
1.10 Chemical Analysis Method Statement

10.1	EQUIPMENT	14
10.2	PROCEDURE	14
11	SEAWATER ELUTRIATION TESTING	15
11.1	EQUIPMENT & CHEMICALS	15
11.2	PROCEDURE	15
12	LABORATORY ACCREDITATION	16
13	REFERENCES	19

1 INTRODUCTION

1.1 BACKGROUND

Namibian Marine Phosphate (NMP) is developing the world's first marine phosphate project which will establish Namibia as a premier rock phosphate producer in the global market. There is potential to establish future downstream processing of NMP's beneficiated phosphate into higher value phosphorus and compound fertilisers. Local production of phosphate will help to secure agricultural productivity and food security in Namibia and the region, as well as elsewhere in the world. The project will contribute to national and regional growth through employment, royalties and tax revenues. Direct permanent employment will be created, as well as indirect jobs in supporting services. These will include short-term employment during construction and the opportunity for capacity development and training.

NMP has commissioned a detailed Environmental Impact Assessment (EIA) Report to establish the degree to which its operations may affect the environment and in particular the marine environment. The EIA consists of three phases: Scoping, Specialist Studies and Assessment of Impacts. The primary environmental impacts which the EIA is examining include the following:

- Potential loss of marine habitat
- Potential effects on the marine benthic fauna
- Potential impact on marine food chain functionality
- Potential creation of new habitat colonised by as yet unknown fauna

1.2 OBJECTIVES

Lwandle Technologies (Pty) Ltd was commissioned to undertake a Verification Survey of the sediment properties and water column features of the proposed mining area. Lwandle in turn sub-contracted the CSIR CAS Analytical Laboratory in Stellenbosch to conduct all the chemical analyses for surficial grab sediments and sub-surface core sediments.

The document is a compilation of all analytical methods employed by the CSIR CAS Analytical Laboratory to provide the sediment quality data required by Lwandle for its verification survey.

2 ANALYTICAL METHODS SUMMARY

2.1 METHOD STEPS FOR SUB-SURFACE CORE SEDIMENTS

- Cut cores into sections: *0-10 cm, A, *20-30 cm, B, *50-60 cm, C, *100-110 cm
- Remove sections* and store in nitrogen-purged Ziploc bags.
- Intermediate sections A, B and C stored in plastic bags.
- The centre of nitrogen-purged sections* is sub-sampled into small Ziploc plastic bags and nitrogen-purged. These samples are for AVS/SEM (acid volatile sulphide/simultaneously extracted metals) analysis.
- A second sub-sample taken from the centre of nitrogen-purged sections* will immediately be used for ORP (Oxidation Reduction Potential) measurement.
- The remainder of section* is split into a specimen jar (%moisture, %loss on ignition, total heavy metals, organic carbon and nitrogen) and a large plastic bag (Particle size analysis).

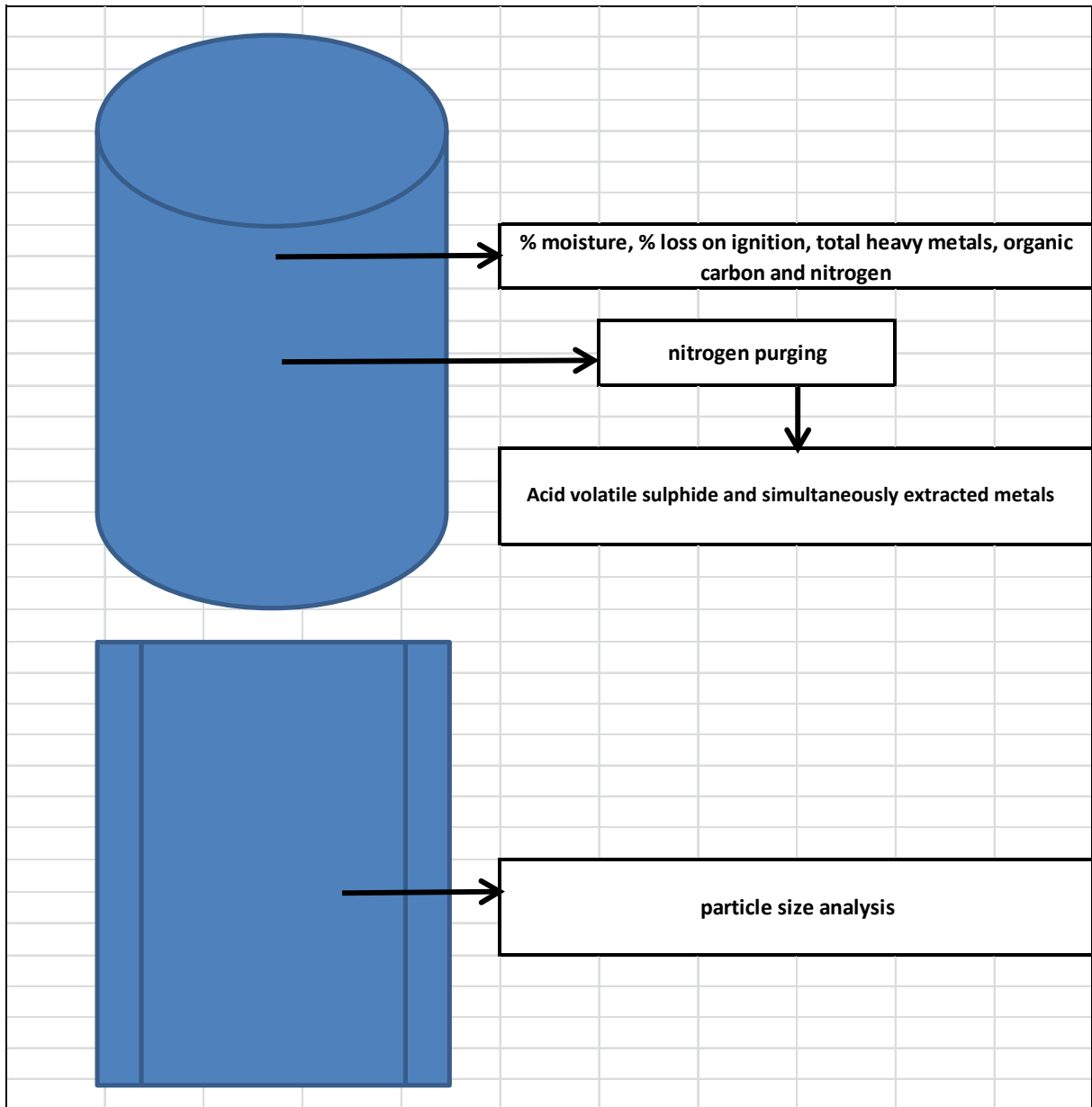
SECTION D, APPENDIX 1 - WATER COLUMN AND SEDIMENTARY ENVIRONMENT
1.10 Chemical Analysis Method Statement

- The specimen jar is pre-weighed, filled with sample, re-weighed, freeze-dried and re-weighed (%moisture).
- Dried sample is ball-milled.
- A homogenised dried sub-sample is microwave digested and analysed by ICP OES and ICP MS (total heavy metals, total phosphorus and total sulphur).
- A second homogenised dried sub-sample is weighed into a pre-weighed foil dish, ignited at 450°C and re-weighed (%loss on ignition).
- A third homogenised sub-sample is acidified, washed with Milli-Q doubly de-ionised water, oven-dried and analysed by Vario Elementar for total organic carbon/ nitrogen.
- An AVS/SEM sub-sample is extracted with HCl, titrated for AVS and residual acid extract analysed by ICP OES for SEM.
- A second AVS/SEM sub-sample is water-extracted (1:1 w/v) and analysed by FIA (Flow injection analyser for nutrients (nitrate, ammonia, phosphate)
- Sections A and B are used for metal elutriation with filtered seawater (400:600 w/v) and analysed by ICP MS for dissolved heavy metals.
- Sections C and D are stored.

2.2 METHOD STEPS FOR SURFICIAL GRAB SEDIMENTS

- Surficial grab sediment samples are received frozen in 375 mL glass jars and plastic Ziploc bags.
- Samples contained in the Ziploc bags were used for particle size analysis.
- First sub-sample is taken from the glass jar for %moisture, %loss on ignition, total heavy metals, organic carbon and nitrogen analyses.
- The specimen jar is pre-weighed, filled with sample, re-weighed, freeze-dried and re-weighed (%moisture).
- Dried sample is ball-milled. A homogenised dried sub-sample is microwave digested and analysed by ICP OES and ICP MS for total heavy metals, total phosphorus and total sulphur).
- A second homogenised dried sub-sample is weighed into a pre-weighed foil dish, ignited at 450°C and re-weighed (%loss on ignition).
- A third homogenised sub-sample is acidified, washed with Milli-Q doubly de-ionised water, oven-dried and analysed by Vario Elementar for total organic carbon/ nitrogen.
- The second sub-sample is taken from the inner core of the glass jar under anoxic conditions created by nitrogen purging for acid volatile sulphide/simultaneously extracted metals analyses.
- An AVS/SEM sub-sample is extracted with HCl, titrated for AVS and residual acid extract analysed by ICP OES for SEM.
- The remaining samples in the glass jars and Ziploc bags are kept frozen.

2.4 SCHEMATIC FLOW DIAGRAM OF SURFICIAL GRAB SEDIMENTS



3 SAMPLE PRE-PREPARATION FOR SUB-SURFACE CORES

3.1 EQUIPMENT

- Freezers
- Pre-measured and marked workbench
- Camera
- Angle Grinder
- Protective gear (heavy-duty gloves, goggles, visors, heavy-duty overalls and safety boots)
- Nitrogen cylinder
- Large Ziploc plastic bags
- Small Ziploc plastic bags
- Pre-calibrated ORP meter
- 50 mL plastic specimen jars
- Calibrated and Verified top-loader 2 decimal place balance
- Freezedrier
- Ball-mill

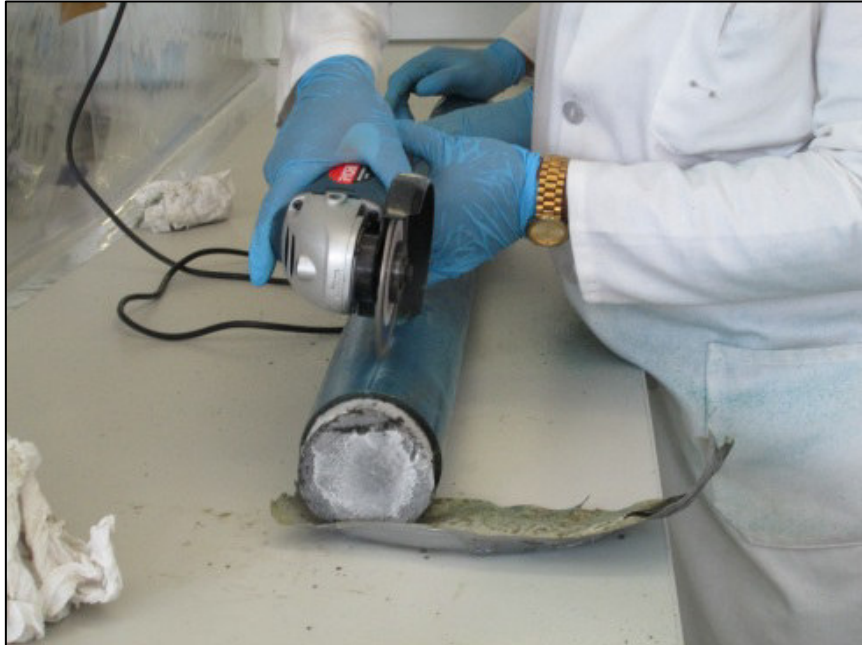
3.2 PROCEDURE

- The frozen PVC core is removed from the freezer and placed onto a plastic covered pre-marked workbench with the caps at each end removed to record the sample identity (id).
- A picture of the core is taken.



SECTION D, APPENDIX 1 - WATER COLUMN AND SEDIMENTARY ENVIRONMENT
1.10 Chemical Analysis Method Statement

- An angle grinder is carefully used to cut the outer cover.



- The outer cover is carefully removed to expose the frozen sediment core.



SECTION D, APPENDIX 1 - WATER COLUMN AND SEDIMENTARY ENVIRONMENT
1.10 Chemical Analysis Method Statement

- The frozen sediment core is then cut into Sections (*0-10 cm, A , *20-30 cm, B, *50-60 cm, C, *100-110 cm, D) dependent on the length of the sample core.



- Sections (*0-10 cm, *20-30 cm, *50-60 cm, *100-110 cm) are immediately placed into nitrogen-purged Ziploc plastic bags and allowed to defrost.
- Sections (A, B, C, D) are placed in a separate Ziploc plastic bag.
- The centre of the sections (*0-10 cm, *20-30 cm, *50-60 cm, *100-110 cm) are swiftly removed under a nitrogen-filled atmosphere to ensure that the sub-sample is not exposed to atmospheric oxygen.
- The centre sub-sample is placed in a nitrogen-purged small Ziploc bag for analysis of acid volatile sulphide and simultaneously extracted metals (AVS/SEM).
- A second sub-sample of 20 mL volume taken from the centre of this section is placed in a nitrogen-purged 50 mL plastic specimen jar and immediately measured for oxidation reduction potential (ORP) with the addition of 20 mL double – deionised Milli Q water after a single inversion of the sealed specimen jar.
- From the remaining sections (*0-10 cm, *20-30 cm, *50-60 cm, *100-110 cm) a 50 mL pre-weighed specimen jar is filled with sediment, freeze-dried, re-weighed and homogenised by ball-milling with zirconium balls. This homogenised sample will be analysed for %moisture, %organic matter/ loss on ignition, total heavy metals and total organic carbon and nitrogen.
- The remainder of the sample in the large plastic Ziploc bag is kept for particle size analysis.
- Sections A and B are combined for seawater elutriation testing.

4 OXIDATION REDUCTION POTENTIAL FOR SUB-SURFACE CORES

4.1 EQUIPMENT & CHEMICALS

- Eutech Instruments pH700 mV Bench Meter
- Doubly de-ionised Milli Q water
- ORP Pretreatment 475 solution
- ORP Quinhydrone 263 standard solution
- ORP Quinhydrone 86 standard solution

4.2 PROCEDURE

- The ORP meter is pre-treated as per instrument manual with pre-treatment solution and allowed to stabilise for 30 minutes.
- The ORP meter is calibrated with the above standards as per instrument manual.
- The electrode is thoroughly rinsed with Milli Q water before the quality control (QC) solution is measured.
- If the QC measurement is within specifications the electrode is rinsed with doubly de-ionised Milli Q water and the ORP measurements of the samples commence.
- The electrode is rinsed between each sample measurement and the QC solution is measured after every 12 samples to ensure instrument and electrode response and accuracy.

5 ACID VOLATILE SULPHIDE AND SIMULTANEOUSLY EXTRACTED METALS FOR SUB-SURFACE CORES AND SURFICIAL GRAB SEDIMENTS

5.1 EQUIPMENT & CHEMICALS

- AVS extraction apparatus
- Nitrogen cylinder
- Plastic weighing boats
- Pre-verified calibrated two decimal place toploader balance
- Doubly de-ionised Milli Q water
- 6M Hydrochloric Acid
- 20 g/l Zinc Acetate
- 100 mL measuring cylinder
- 250 mL Erlenmeyer Flasks
- Standard Iodine solution, 0.025N
- Standard Sodium Thiosulfate solution, 0.025N
- Starch Indicator Solution
- 50 mL A grade Burette
- 10 mL A grade Pipette
- 200 mL A grade Volumetric flask
- Thermo ICap Inductively Coupled Plasma Optical Emission Spectrometer



5.2 PROCEDURE

- Purge the AVS system with nitrogen for 30 minutes with a flowrate of 1l/min to ensure all atmospheric oxygen is removed.
- From the centre of the frozen AVS/SEM small sample Ziploc plastic bag snap off pieces of sediment and transfer to a tared weighing boat on the balance.
- Accurately weigh out between 20 – 25 g of frozen sediment and record mass on worksheet.
- Swiftly transfer the sample into the AVS reactor vessel. Ensure the sample is quantitatively transferred to the vessel by spraying the sample with Milli Q water through a squeeze bottle from the weighing boat and removing all residual sample.
- Add 50 mL of doubly de-ionised Milli Q water, close the reactor vessel and allow nitrogen purge for 3 minutes with a flowrate of 1l/min.
- From the acid reservoir connected to the top of the reactor dispense 30 mL of 6M HCl while continuously purging with nitrogen.
- Slowly start the magnetic stirrer to allow the stirrer bar inside the reactor to agitate the sediment/water/acid mixture.
- After extraction for 2 hrs, the Fritz bubblers are carefully removed from the zinc acetate reservoirs and rinsed with doubly de-ionised Milli Q water.
- The zinc acetate/ zinc sulphide mixture is combined and quantitatively transferred to a 100 mL measuring cylinder. The mixture is made up to 100 mL with Milli Q water and transferred to a 250 mL Erlenmeyer flask.
- 10 mL of standard iodine 0.025N is pipetted into the zinc acetate/ zinc sulphide mixture in the Erlenmeyer flask and mixed.
- The excess iodine which has not reacted to the available sulphide is back titrated with standard sodium thiosulphate 0.025N with 0.5 mL soluble starch solution added as indicator just before the blue endpoint is reached.
- $\text{mgS}^{2-}/\text{L} = \{[(\text{mL I}_2 \times \text{I}_2 \text{ Normality}) - (\text{mL Na}_2\text{S}_2\text{O}_3 \times \text{Na}_2\text{S}_2\text{O}_3 \text{ Normality})] \times 16000\} / \text{mL sample}$
- $\text{mgS}^{2-}/\text{kg} = (\text{mgS}^{2-}/\text{L} \times \text{g original sample mass}) / 100 \text{ mL}$
- The acid extractant remaining in the reactor is quantitatively removed and transferred to 200 mL volumetric flask.

- The volumetric flask is made up to the mark with Milli Q water and the extract is analysed by inductively coupled plasma optical emission spectrometry (ICP OES) for the simultaneously extracted metals (SEM) Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Ni, V, Zn.

6 INTERSTITIAL WATER-SOLUBLE NUTRIENTS FOR SUB-SURFACE CORES

6.1 EQUIPMENT & CHEMICALS

- 50 mℓ plastic specimen jar
- Doubly de-ionised Milli Q water
- 20 mℓ A grade Pipette
- Horizontal shaker
- 20 mℓ syringe
- 0.45 µm hydrophilic syringe filter
- Lachat flow injection analyser

6.2 PROCEDURE

- From the centre of the frozen AVS/SEM small sample Ziploc plastic bag snap off fragments of sediment and transfer into a tarred 50 mℓ plastic specimen jar containing 20 mℓ of Milli Q water.
- Weigh 30 g of frozen sediment sample into the specimen jar and seal tightly with screw cap lid.
- Vigorously shake the jar on a horizontal shaker for 30 minutes.
- Allow particulate fraction to settle for 1 – 2 minutes.
- Remove the supernatant aqueous phase with a 20 mℓ syringe.
- Fit the 0.45 µm filter to the syringe and filter the dissolved fraction into the pre-labelled flow injection analyser (FIA) sample cups.
- Soluble nitrate, ortho-phosphate and ammonia are colorimetrically analysed by accredited validated internal FIA Methods (SALM6.0 & SALM7.0).

7 %MOISTURE AND ORGANIC MATTER DETERMINATION FOR SUB-SURFACE CORES AND SURFICIAL SEDIMENTS

7.1 EQUIPMENT

- 50 mℓ specimen jar
- Calibrated and verified top-loader 2 decimal balance
- Defy chest freezer
- Virtis freeze-drier
- Retsch PM 400 planetary ball mill
- Aluminium foil dishes
- Calibrated and verified 4 decimal analytical balance
- Naber 2804 furnace
- Desiccator

7.2 PROCEDURE

- The empty specimen jar with lid is weighed on the balance.
- Mass of empty jar is recorded on worksheet.
- The wet sediment is transferred into the specimen jar, sealed with the lid and reweighed on the balance.
- Mass of jar and wet sample is recorded on worksheet.
- The jar is transferred into the freezer and frozen overnight.
- The lid is removed and the frozen jar with sample is placed into the freezedrier and dried for up to 3 days depending on the number of samples and anticipated sample moisture to be removed.
- After the dried sample is removed from the freezedrier it is reweighed on the balance.
- Mass of jar and dry sample is recorded on worksheet.
- % moisture = $100 \times (\text{g mass of wet sample \& jar} - \text{g mass of dry sample \& jar}) / (\text{g mass of wet sample \& jar} - \text{g mass empty jar})$
- The dried sample is removed from the jar and transferred into the planetary mill bowls with zirconium balls.
- The sample is homogenised by milling at 400 rpm for 5 minutes and returned to the specimen jar.
- Weigh an empty aluminium foil dish on an analytical balance.
- Mass of empty dish is recorded on worksheet.
- Add approximately 1 – 3 g of dried sample to the dish and accurately reweigh on the analytical balance.
- Mass of dry sample and dish is recorded on worksheet.
- Transfer the sample and dish into the furnace and heat the furnace to 450°C for 4 hrs.
- Allow the furnace to cool overnight and transfer the sample and dish to a desiccator.
- Weigh the sample ash and dish on the analytical balance.
- Mass of sample ash and dish is recorded on worksheet.
- % organic matter = $100 \times (\text{g mass of dry sample \& dish} - \text{g mass of sample ash \& dish}) / (\text{g mass of dry sample \& dish} - \text{g mass empty dish})$

8 %TOTAL ORGANIC CARBON AND NITROGEN DETERMINATION FOR SUB-SURFACE CORES AND SURFICIAL SEDIMENTS

8.1 EQUIPMENT & CHEMICALS

- 10 mℓ plastic centrifuge tube with screw cap
- 1M hydrochloric acid
- Vortex mixer
- Doubly de-ionised Milli Q water in squeeze bottle
- Centrifuge
- Oven proof centrifuge tube rack
- Laboratory oven
- Round tipped Teflon rod
- Desiccator
- Vario Elementar

8.2 PROCEDURE

- Transfer approximately 2 g of dried homogenised sample into a 10 mℓ centrifuge tube.
- Slowly add drop-wise 2 mℓ of 1M HCl to the sample. Make sure that the initial effervescence does not cause the sample froth to overflow from the tube.
- The acid/sample slurry is then agitated on the vortex mixer for 30 – 60 seconds to ensure that the all inorganic carbon reacts with the HCl to liberate CO₂ gas.
- The slurry is then washed by adding Milli Q water to top of the tube, capped, inverting the tube several times and further mixing on the vortex mixer.
- Place the sample and tube into the centrifuge and spin for 1 minute at 300 rpm.
- Remove the tube from the centrifuge and discard the supernatant aqueous phase.
- Place the tube on an ovenproof rack and in the oven at 100°C for 8 hrs.
- Cool the sample in a desiccator.
- Grind the sample with a round tipped Teflon rod inside the tube.
- The sample is then analysed for total organic carbon by thermocatalytic combustion in the Vario Elementar MALS3.1.
- An unacidified dried homogenised sample is analysed for total nitrogen thermocatalytic combustion in the Vario Elementar MALS3.1.

9 TOTAL HEAVY METAL DETERMINATION FOR SUB-SURFACE CORES AND SURFICIAL SEDIMENTS

9.1 EQUIPMENT & CHEMICALS

- Calibrated & verified top-loader 2 decimal place balance
- MARS XP1500d Digestion vessels
- MARS X Microwave digestion system
- Certified reference material PACS-2 Marine Sediment
- Fume cupboard
- 65% GR nitric acid
- 70% GR perchloric acid
- 50% GR hydrogen peroxide
- Doubly de-ionised Milli Q water in squeeze bottle
- Calibrated and verified bottle dispenser
- Calibrated and verified 1 mL Socorex Pipetman
- 50 mL A grade verified volumetric flasks
- 50 mL plastic specimen jars with screw cap lids
- 20 mL syringe
- 0.45 µm syringe filters
- Thermo ICap Inductively Couple Plasma Optical Emission Spectrometer
- Agilent 4500Cx Inductively Couple Plasma Mass Spectrometer

9.2 PROCEDURE

- Place a clean digestion vessel on the balance and tare.
- Accurately weigh between 0.25 – 0.5 g of dried homogenised sample into the vessel.
- Record the sample mass on the worksheet.
- The digestion carousel will contain 1 reagent blank, 1 certified reference material, duplicate sediment sample and 8 more single samples.
- Transfer the vessels to a fume cupboard.
- Dispense 5 mL of HNO₃ into each vessel.
- Pipette 1 mL of HClO₄ and H₂O₂ respectively into each vessel.
- Close the vessels and torque with the microwave system wrench in the digestion carousel.
- Insert the carousel into the microwave cavity and connect the pressure and temperature sensors before closing the door.
- Digest the samples as per the pre-defined microwave programme settings adapted from the EPA Method SW 5010, internal method reference MALS4.5.
- After the digestion vessels have cooled to room temperature remove the digestion carousel and place in the fume cupboard.
- Loosen the vessels with the torque wrench and quantitatively decant the digestate into 50 mL volumetric flasks.
- Make up to the mark with Milli Q water.
- Transfer the digestate into pre-labelled specimen jars and clean the volumetric flasks.
- Remove 20 mL of digestate from the specimen jar using a syringe and place a 0.45 µm filter on the syringe tip.
- Filter the sample into pre-labelled ICP sample cups.

- The sample is analysed for pseudo-total heavy metals Al, As, Ba, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, V, Zn by the accredited ICP OES Method MALS 6.2A. Mercury is analysed by ICP MS Method SALM20.

10 PARTICLE SIZE ANALYSIS BY LASER DIFFRACTION AND WET SIEVING FOR SUB-SURFACE CORES AND SURFICIAL SEDIMENTS

10.1 EQUIPMENT

- Calibrated and Verified Top loader Balance (max 11 kg)
- Fritsch Pulversette sieve shaker
- Stacked variable mesh size sieves
- Lab oven
- 5 l Erlenmeyer Flask
- Mastersizer 2000 Malvern laser diffraction particle size analyser

10.2 PROCEDURE

- Particle size analyses were sub-contracted to EMS* in Durban.
- The Mastersizer 2000 uses laser diffraction to measure the size of particles. It does this by measuring the intensity of light scattered as a laser beam passes through a dispersed particulate sample. These data are then analyzed to calculate the size of the particles that created the scattering pattern.
- In the event where the sample has no measureable fraction <63 μ (coarse sediment) wet sieving with stacked variable mesh sized sieves are employed.
- Sieves are pre-weighed on a balance.
- Sieve masses are recorded on worksheet.
- The sieves are stacked in a regressively decreasing mesh size on top of the sieve shaker.
- A wet sub-sample of approximately 150 – 200 g is introduced at the top of the stack and closed with the waterspray lid.
- Switch on the shaker and open the tap to allow water to spray the sample for 10 minutes.
- Once the sieving is complete remove the sieves containing the residual fractions and place in the oven at 100°C overnight or at least 4hrs.
- Allow the sieves to cool off for 15 minutes and re-weigh each individual sieve on the balance.
- Sieve + residual sample masses are recorded on worksheet.
- Quantitatively remove the residual fractions from the sieves into a composite sample.
- Re-weigh the composite sample and record on worksheet.
- The sample mass retained (g) on each sieve is calculated as the difference in post mass (g) – pre mass (g).
- Size distribution is calculated as the % fraction sample mass retained: total mass recovered.

* Environmental Mapping & Surveying, P.O. Box 201155, Durban North, KwaZulu-Natal, 4016

11 SEAWATER ELUTRIATION TESTING

11.1 EQUIPMENT & CHEMICALS

- Plastic bucket
- Plastic jar
- Calibrated & verified top loader balance
- Filtered seawater
- Horizontal industrial paint shaker
- 50 mℓ plastic syringe
- 0.45 µm syringe filters
- 70% Ultra-pure nitric acid
- Agilent 4500Cx Inductively Coupled Plasma Mass Spectrometer

11.2 PROCEDURE

- A composite from sections A and B with an approximate mass of 1-2 kg is thoroughly mixed in a clean plastic bucket.
- 400 g of the homogenised sediment sample is weighed into a second clean plastic jar and 600 mℓ of filtered seawater is added to the bucket and sealed.
- The sample is then vigorously shaken for 15 minutes on a horizontal industrial paint shaker.
- After removing the jar from the shaker it is allowed to settle for 30 seconds before extracting the supernatant seawater with a 50 mℓ syringe.
- A 0.45 µm syringe filter is attached to the tip of the syringe and the eluent filtered into a pre-labelled ICP sample cup.
- The extract is acidified with HNO₃ before it is analysed by inductively coupled plasma mass spectroscopy (ICP MS) for trace metals leached into the filtered seawater.
- The background trace metal concentrations of the filtered seawater was also analysed by ICP MS.
- Quality control on seawater analysis includes internal quality control (QC) –solutions and spiked seawater samples with laboratory criteria set at 90% - 110% recovery range.

12 LABORATORY ACCREDITATION



CERTIFICATE OF ACCREDITATION

In terms of section 22(2) (b) of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 (Act 19 of 2006), read with sections 23(1), (2) and (3) of the said Act, I hereby certify that:-

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH ANALYTICAL LABORATORY

STELLENBOSCH

Facility Accreditation Number: **T0093**

is a South African National Accreditation System accredited Testing laboratory
provided that all SANAS conditions and requirements are complied with

This certificate is valid as per the scope as stated in the accompanying schedule of accreditation
Annexure "A", bearing the above accreditation number for


CHEMICAL ANALYSIS

The facility is accredited in accordance with the recognised International Standard

ISO/IEC 17025:2005

The accreditation demonstrates technical competency for a defined scope and the operation of a
laboratory quality management system

While this certificate remains valid, the Accredited Facility named above is authorised to use the
relevant SANAS accreditation symbol to issue facility reports and/or certificates


Mr R. Josias
Chief Executive Officer

Effective Date: 01 August 2013
Certificate Expires: 31 July 2018

SECTION D, APPENDIX 1 - WATER COLUMN AND SEDIMENTARY ENVIRONMENT
1.10 Chemical Analysis Method Statement

ANNEXURE A

SCHEDULE OF ACCREDITATION

Facility Number: T0093

Permanent Address of Laboratory: CSIR Analytical Services Stellenbosch Jan Celliers Street Stellenbosch 7600 Tel: (021) 885-2400/2433 Fax: (021) 885-2630 E-mail: stbrown@csir.co.za	Management Signatory: Mr A Pascall	
	Technical Signatories: Mr S Brown Ms C Anderson Mr E Fieland Nominated Representative: Mr S Brown	
	Issue No.: 13 Date of Issue: 21 June 2013 Expiry Date: 31 July 2018	
Materials / Products Tested	Type of Tests / Properties Measured, Range of Measurement	Standard Specifications, Equipment / Technique Used
Sediment & Soils (dry mass basis)	Cadmium as Cd, Cobalt as Co, Copper as Cu, Manganese as Mn, Nickel as Ni, Zinc as Zn, 0.5 -> 500mg/kg Arsenic as As, Lead as Pb 1.0 ->500mg/kg Iron as Fe in mg/kg 50 -> 100 000mg/kg	Microwave Digestion & ICP OES Detection MALS 4.5 & MALS 6.2 A
Aquatic Biota (dry mass basis)	Cobalt as Co, Nickel as Ni, Manganese as Mn, Zinc as Zn, 0.1 -> 500mg/kg Arsenic as As, Cadmium as Cd 0.25 ->500mg/kg Copper as Cu, Iron as Fe, Selenium as Se, Vanadium as V, 0.5->500mg/kg	Microwave Digestion & ICP OES Detection MALS 4.7 & MALS 6.3 A
Potable Ground & Wastewater (Dissolved)	Aluminium as Al, Antimony as Sb, Arsenic as As, Barium as Ba, Beryllium as Be, Cadmium as Cd, Chromium as Cr, Cobalt as Co, Copper as Cu, Iron as Fe, Lead as Pb, Manganese as Mn, Molybdenum as Mo, Nickel as Ni, Strontium as Sr, Selenium as Se, Vanadium as V, Zinc as Zn 0.105 ->100mg Boron as B, 0.02->100mg/L Calcium as Ca, Sodium as Na, Potassium as K, Magnesium as Mg, Sulphate as SO ₄ in mg/L 0.1 ->100000	ICP OES Detection MALS 64.A ICP OES Detection MALS 4.A ICP OES Detection MALS 5A.4

Original Date of Accreditation: 01 August 1998

Page 1 of 2


Field Manager

SECTION D, APPENDIX 1 - WATER COLUMN AND SEDIMENTARY ENVIRONMENT
1.10 Chemical Analysis Method Statement

ANNEXURE A

Facility No.: T0093
Date of Issue: 21 June 2013
Expiry Date: 31 July 2018

Materials / Products Tested	Type of Tests / Properties Measured, Range of Measurement	Standard Specifications, Equipment / Technique Used
Potable, Ground & Wastewater (Dissolved)	Chloride as Cl in mg/L 0.5 - >300mg/L	SALM.1.0 Flow Injection Colorimetry
Potable Ground & Wastewater	pH 2 - 12	SALM.2.0 Electrometric
	Alkalinity as CaCO ₃ If pH > 4.5 : 0.5 -> 100mg/L	SALM.5.0 Potentiometric
	Electrical Conductivity in mS/m 1 - >5000 mS/m	SALM.3.0 Electrometric
Potable Ground & Wastewater (Dissolved)	Ammonia as NH ₄ -N, OrthoPhosphate as PO ₄ -P 0.05mg/L -> 5mg/L	SALM 6.0 Flow Injection Colorimetry
Potable Ground & Wastewater	Dissolved and Total Organic Carbon 0.5-> 100mg/L	SALM 26 Thermocatalytic Oxidation + Combustion
Potable Ground & Wastewater (Dissolved)	Arsenic as As, Cadmium as Cd, Cobalt as Co, Antimony as Sb, Beryllium as Be, Selenium as Se, Lead as Pb, Manganese as Mn, Nickel Ni, Vanadium as V, Uranium as U 0.5->100ug/L Copper as Cu, Mercury as Hg1.0ug/L-> 100-ug/L Zinc as Zn 2.0ug/L -> 100-ug/L	ICPMS Detection SALM 2.0

Original Date of Accreditation: 01 August 1996

Page 2 of 2

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