SAFTA Copper Project

Pre-Feasibility Study Report for the Mine Residue Disposal Facility

epoch resources (pty) ltd

mine residue and environmental engineering consultants

Project No:000-224 Revision: Draft May 2018

Executive Summary

INTRODUCTION

Uhuru International Consulting Ltd (Uhuru) has requested *Epoch Resources (Pty) Ltd (Epoch)* to conduct A Pre-Feasibility Study (*PFS*) of the *Mine Residue Disposal Facility (MRDF)* for the SAFTA copper project. The MRDF is to be capable of containing the tailings stream for the 10 years LoM. The MRDF will consist of:

- A Tailings Storage Facility (*TSF*);
- A Return Water Dam (*RWD*); and
- A Storm Water Dam (*SWD*).

TERMS OF REFERENCE

The terms of reference that Epoch are responsible for comprise:

- Confirming the suitability of the MRDF selected site;
- A preliminary design to a PFS level of the MRDF comprising:
  - A Tailings Storage Facility (TSF) with sufficient storage capacity to contain 4.5 million dry tonnes of tailings over a 10 year LoM;
  - A Return Water Dam and a Storm Water Dam;
  - The associated infrastructure for the MRDF (i.e. perimeter slurry deposition pipeline, storm water diversion trenches, perimeter access road etc.);
- Estimation of the capital costs to an accuracy of ±25 percent and operating costs associated with these facilities to an accuracy of ±25 percent; and
- Estimation of the costs over the life of the facility.

DESIGN CRITERIA

The design criteria for the SAFTA MRDF are listed in Table 1:

Table 1: Design Criteria Associated with the Kipushi TSF

Item No	Description	Value	Unit	Source
1	**Design Life of Facility**	10	Years	Uhuru
2	**Processed Ore**	Copper	-	Uhuru
3	**Tailings deposition rate**	37.5	Kt/month	Uhuru
4	**Particle SG of Tailings product**	2.7	-	Uhuru
5	**In-Situ Void Ratio**	1	-	Epoch – Assumed
6	**Placed Dry Density of Tailings**	1.4	Tonnes/m^3	Epoch – Calculated
7	**Particle Size Distribution of the Tailings Product**	75% Passing 106 μm	-	Uhuru
8	**Safe Rate of Rise**	2.5	m/annum	Epoch – Assumed
9	**A-Pan to Lake Evaporation Depth Factor**	0.75	-	Epoch – Assumed
10	**Minimum Freeboard**	1	m	Epoch

SITE SELECTION

A formal site selection was not undertaken for this phase of the project, but rather selected through a site investigation by representatives from Uhuru and Epoch. A single site was identified as a potential suitable location based on the following:

- Location overlies an existing disturbed location;
- Provides a wide valley in which to establish a depositional basin; and
- The location does not encroach on nearby settlements.

A volumetric analysis was conducted of the selected site to confirm that the tailings stream could be contained within the available footprint. Figure 1 provides an illustration of the selected site location with the LoM tailings footprint area.

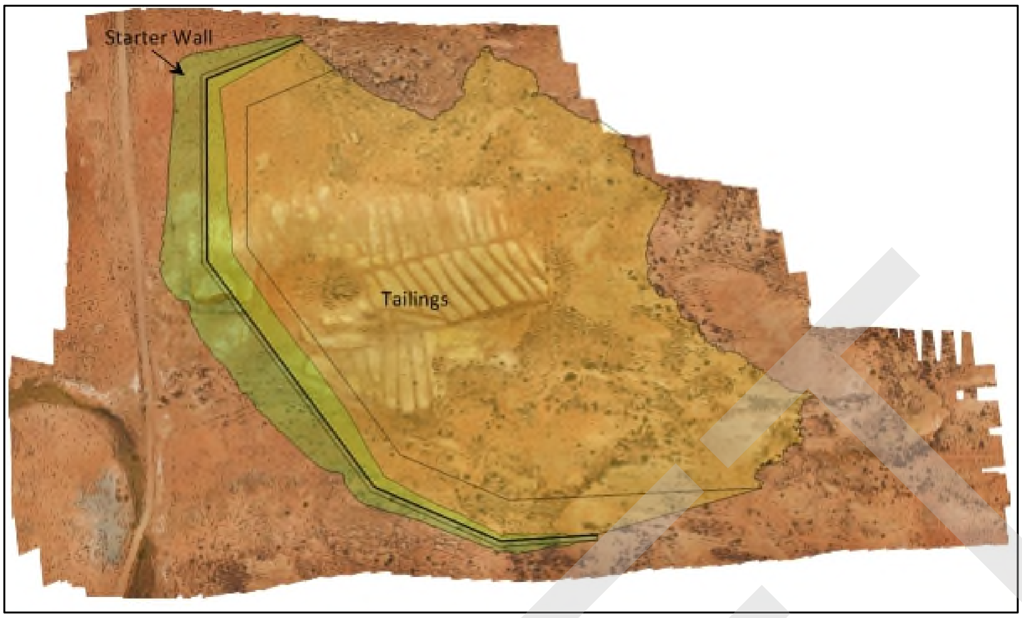

Figure 1: Orthophotograph of the selected site location with the overlaid TSF footprint

In order to optimise the capacity of the selected site a conventional upstream self-raised facility was chosen based on the restricted available footprint area; an anticipated lack of available in-situ borrow material and/or waste rock. The site characteristics are listed in Table 2.

Table 2: Characteristics of the TSF in the selected site

Characteristic	Value	Unit
Type	Valley – Self-Raise	-
Starter Wall Height	17	m
Starter Wall Volume	310 000	m^3
Deposition Height Above Starter Wall	15	m
Final Height	32	m
Volumetric Capacity	3 214 000	m^3
Tonnage Capacity	4 500 000	Tonnes
Footprint Area	32.81	Ha
Lined Area (If required)	24.14	Ha
Catchment Area	309	Ha

Mine Residue Disposal Facility Design

The key design features of the MRDF are as follows:

- The TSF will be constructed as an upstream facility spigotting facility with the following features:
    - The starter embankment will be constructed to elevation 777 mamsl to correlate with the safe Rate of Rise of <2.5m/annum and provide the required minimum freeboard;
    - Deposition will comprise of tailings deposited behind the starter embankment until the Rate of Rise decreases to <2.5 m/annum and then self-raised to a final elevation of 792 mamsl with a terminal Rate of Rise of 1.64 m/annum;

- ➢ The TSF has a total footprint area of 32.81 Ha, a maximum height of 32 m;
- ➢ A slurry spigot pipeline along the crest of the TSF starter embankment;
- ➢ An elevated and a natural ground level (NGL) toe drain and associated drain outlets;
- ➢ A blanket drain and associated outlets
- ➢ A solution trench;
- ➢ Run-off catchment paddocks;
- ➢ A penstock decant system with an intermediate intake and a final intake;
- ➢ An energy dissipator and a dual chamber silt trap with associated outfall trench;
- ➢ An access road;
- ➢ A perimeter fence; and
- ➢ Storm water diversion trenches and berms.

- A RWD with the following features:
    - ➢ A compacted earth containment wall raised to elevation 762 mamsl;
    - ➢ A lined basin with 1.5 mm HDPE with an associated geofabric protection layer;
    - ➢ A return water collection manhole;
    - ➢ A storage capacity of 6 000 m^3 providing approximately 5 days of slurry water; and
    - ➢ A spillway at elevation 761 mamsl.
- A SWD with the following features:
    - ➢ A compacted earth containment wall raised to elevation 762 mamsl;
    - ➢ A lined basin with 1.5 mm HDPE with an associated geofabric protection layer;
    - ➢ A return water collection manhole
    - ➢ A storage capacity of 41 000 m3 providing adequate storage to prevent spillage of dirty water more than once in a 50 year period;
    - ➢ An emergency spillway at elevation 761.2 mamsl; and
    - ➢ A spillway diversion trench and berm.

WATER BALANCE

The average monthly water balance has been determined for a lined and an unlined facility. A water balance for a lined facility would expect greater water returns as the seepage from the supernatant pond into the in-situ soils is nil, provided the liner remains fully operational.

The results of the average monthly water balance are illustrated in Figure 2 for both a lined and unlined facility. The available water for return as a percentage of the slurry water are expected to be:

- Between 20% - 40% for an unlined facility; and
- Between 40% - 60% return for a lined facility.

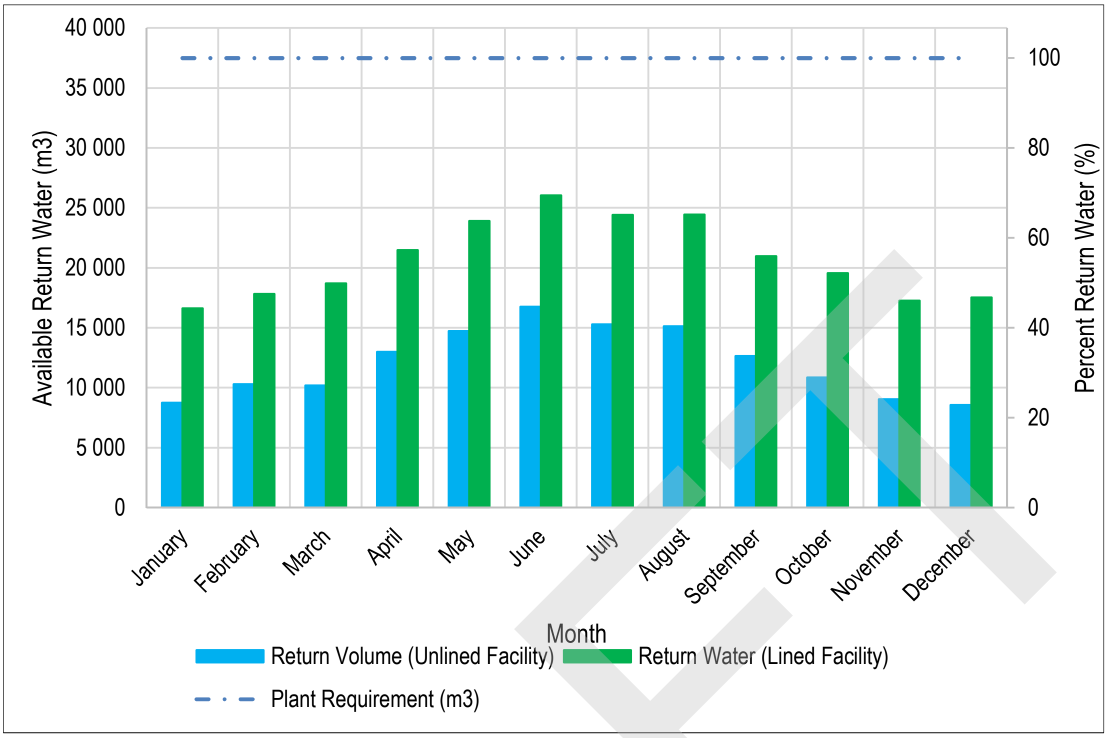

Figure 2: Average monthly water returns for a lined and unlined facility

CAPITAL COST ESTIMATE

The CapEx for the MRDF was determined by quantifying the construction items required, in the form of a Bill of Quantities (BOQ). The BOQ was provided to FAC, who provided rates for each item. (FAC has significant experience constructing Tailings Dams).

The total cost to construct the unlined MRDF totalled R36.08 million. An additional R40.34 million would be required for the installation of a Class C liner totalling R76.37 million. The CapEx for the MRDF has been determined to an accuracy of ±25%. A summary of the costs for an unlined facility is listed in Table 3.

Table 3: Summary of estimated CapEx for an unlined facility

Tailings Storage Facility	**Amount (ZAR)**
Site Clearance	2 819 194.92
Earthworks and Excavations	12 559 291.73
Drainage	2 259 495.87
Concrete Structures	1 212 341.14
Pipework	741 855.00
Catwalk	604 160.00
Miscellaneous	148 532.50
Tailings Storage Facility Sub-Total	**20 344 871.17**
Energy Dissipator and Silt Trap	**Amount (ZAR)**
Earthworks and Excavations	15 648.46
Concrete Structures	1 159 704.15
Energy Dissipator and Silt Trap Sub-Total	**1 175 352.61**
RWD and SWD (Lined)	**Amount (ZAR)**
Earthworks and Excavations	4 262 305.86
Liner and Drainage	1 661 140.28
Concrete Structures	306 979.93.87
RWD and SWD Sub-Total	**6 230 426.07**
Measured Works	**27 750 649.85**
Preliminary and General (@ 30% Of Total Works)	**8 325 194.96**
TOTAL CAPITAL COST	**36 075 844.53**

OPERATING COST ESTIMATE

The OpEx associated with operating the MRDF, provided by Paragon Tailings (Pty) Ltd (Paragon) to an accuracy of ±25%, is estimated at R2.51 million/annum and comprises:

- R0.62 million/annum for managerial salaries;
- R0.19 million/annum for site vehicles;
- R1.49 million/annum for labour wages;
- R0.03 million/annum for safety equipment;
- R0.08 million/annum for safety officer; and
- R0.07 million/annum for store rental.

A once off site establishment and disestablishment charge of:

- R0.119 million; and
- R0.115 million respectively.

Allowance was made for maintenance of infrastructure, and replacement of parts for R0.02 million/annum.

A self-raised facility, as proposed by this PFS, carries more risk than a typical full containment facility, and as such it is recommended that it is operated by a reputable operator, and the mine allows a consulting engineer to conduct quarterly inspections of the MRDF and undertake annual reviews. An allowance of R0.4 million/annum for such engineering consulting services was allocated.

The total estimated total OpEx is R2.92 million per annum and over the LoM totals R29.52 million determined to an accuracy of ±25%.

CLOSURE, REHABILITATION AND AFTERCARE COST ESTIMATE

A high level estimate, to an accuracy of ±50%, has been determined for the costs associated with closure, rehabilitation, and aftercare of the SAFTA MRDF which amounts to:

- Closure and Rehabilitation – R2.88 million; and
- Aftercare – R0.24 million.

TOTAL COST ESTIMATE FOR THE LIFE OF MINE

The total LoM cost associated with the SAFTA MRDF over the duration of the project life (Feasibility Study to the end of the Operational Phase) is estimated at R75.72 million, as shown in Table 4.

Table 4: Summary of Cash Flow over the Life of the Facility

Item	Description	Total (million US$)
1.0	MRDF Capital Cost	36.08
2.0	TSF Consulting/Design Costs	7.00
3.0	TSF Operating Costs	29.52
4.0	Closure and Rehabilitation Costs	2.88
5.0	Aftercare Costs	0.24
	Total	75.72

RISKS

In terms of the PFS for the SAFTA MRDF, the following risks have been identified:

- The CapEx is sensitive to the availability of borrow material within the free haul distance of 2 km. Rates provided by FAC imply CapEx increases by approximately:
- R12 million for 3 km, and
- R15.5 million for 4 km; depending on the distance to the borrow area;

- A full geotechnical investigation must be conducted to determine the suitability of the available in-situ materials for use as construction materials, and the volumes of material available and where borrow pits may be instated;
- The sizing of the SWD is to be confirmed by a detailed water balance which must be conducted in a later stage of study;
- A seepage assessment and slope stability analysis must be conducted to confirm the geometry and drainage requirement of the TSF, RWD, and SWD and must be conducted in further study;
- The Zone of Influence should be determined to establish the potential hazard posed to nearby water resources, settlements, and sensitive flora and fauna;
- The potential of lining would be dependent on the geochemistry of the tailings and poses significant exposure to the CapEx of the project; and
- Lower volumes of available return water will increase the volume of required make-up water and may pose a financial risk.

Opportunities

The opportunities that may be present to reduce CapEx:

- *Cycloning* the slurry to separate the coarse tailings from the fine to be used as an outer wall may be conducted if > 25% of the tailings passes the 75 μm sieve, based on preliminary assessments. This may reduce the CapEx associated with construction of the TSF, but result in an increase in the OpEx;
- Competitive rates may be sourced from other construction contractors to determine the CapEx sensitivity; and
- Less make-up water will be required should the facility be lined which may provide savings in purchasing of raw water.

Recommendations

For the Definitive Feasibility stage of the project, it is recommended the following be undertaken:

- The geochemical properties of a representative sample of the tailings must be determined by an accredited laboratory to determine the Waste Classification according to NEMWA and the corresponding Liner requirement;
- The geotechnical parameters of a representative sample of the tailings must be determined by an accredited laboratory to determine strength and seepage parameters;
- To determine the viability of cyclone deposition, a minimum of 200 kg of sample must be acquired to determine the possible coarse/fine split and the corresponding densities and gradings;
- A detailed geotechnical investigation must be conducted of the site footprint and include:

- ➢ Depth of soil to bedrock/refusal;
- ➢ Depth of in-situ soil layers;
- ➢ Foundation indicators of the in-situ soils;
- ➢ Shear strength parameters of the in-situ soils;
- ➢ Permeability/hydraulic conductivity of the in-situ soils;
- ➢ Identification of any natural fault lines.

- Accurate rainfall and evaporation data must be acquired for the site, as well as confirmation of the design flood depths to complete a detailed water balance of the MRDF;
- Seepage and stability analyses, dependent on the MRDF geometry and material properties, must be conducted;
- The Zone of Influence of the TSF to be determined;
- Proximity of the MRDF to sensitive flora and fauna in accordance with an Environmental Impact Assessment, as well as its impact on local communities;
- An extension to the existing topographical survey would be required; and

The GA may be further optimised and the potential of phasing the preparatory works may be assessed in further studies.

Uhuru Consulting Services

SAFTA Copper Project

Pre-Feasibility Study Report for the Mine Residue Disposal Facility

Project No: 000-224

May 2018

Report Status: Draft

Revision	Date	Issued to	Issued by
Draft	May 2018	Adrian Fitz-Gerald	Richard Mallory, Ryan O'Toole

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SAFTA Copper Project

Pre-Feasibility Study Report for the Mine Residue Disposal Facility

1. Introduction

Uhuru International Consulting Ltd (Uhuru) has requested *Epoch Resources (Pty) Ltd (Epoch)* to conduct A Pre-Feasibility Study (*PFS*) of the *Mine Residue Disposal Facility (MRDF)* for the SAFTA copper project. The MRDF is to be capable of containing the tailings stream for the 10 years Life of Mine (*LoM*). The MRDF will consist of:

- A Tailings Storage Facility (*TSF*);
- A Return Water Dam (*RWD*); and
- A Storm Water Dam (*SWD*).

This report serves to provide a PFS level study and will include:

- Design/Study report;
- Bill of Quantities including:
  - Capital Expenditure (CapEx) to an accuracy of ±25%; and
  - Operating Expenditure (OpEx) to an accuracy of ±25%.
- LoM costing; and
- Drawings of the layout and typical cross-sections of the bulk earthworks pertaining to the MRDF.

Costing of the MRDF will consider both a lined and unlined option to provide indicative cost estimate should the MRDF require protective lining in terms of South African legislation pertaining to mine waste management.

2. Project Location

The SAFTA project is located in the Northern Cape Province of South Africa, as shown in Figure 2-1 approximately 5 km north of the town Nababeep and 17 km North West of the town Springbok. The project is located within the F30E quaternary catchment along a non-perennial tributary of the Skaap River, as illustrated in Figure 2-2.

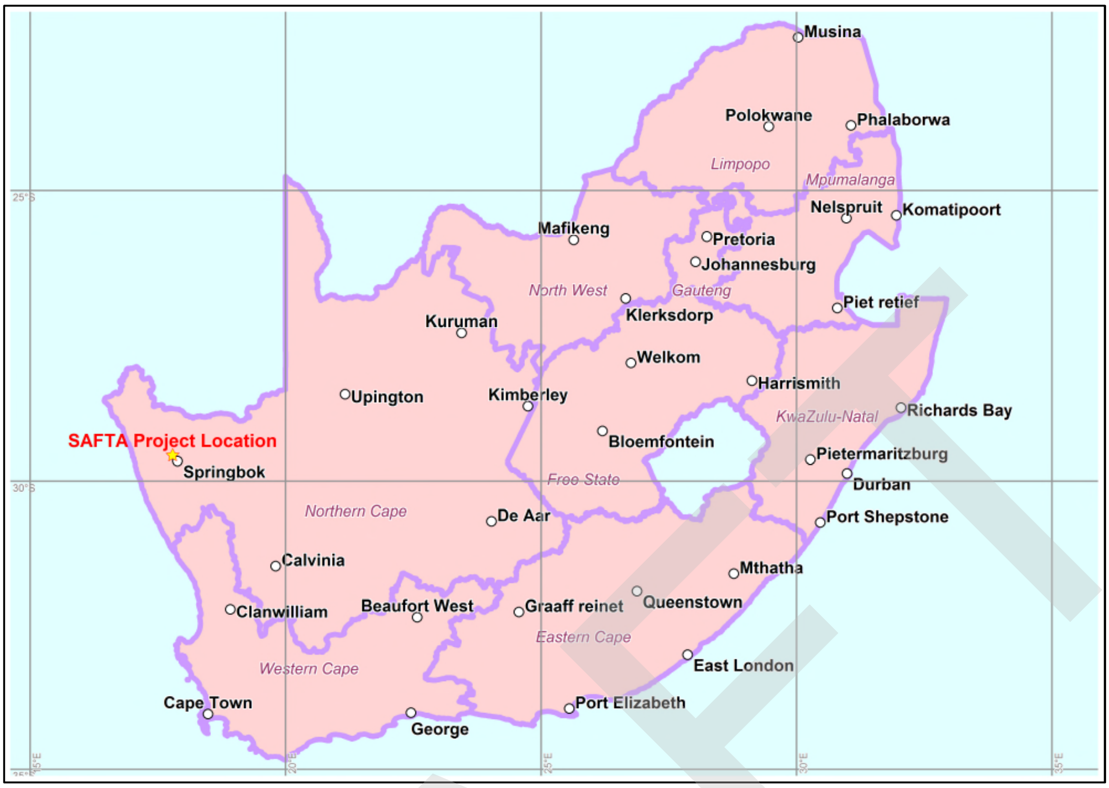


Figure 2-1: Location of the SAFTA project in South Africa

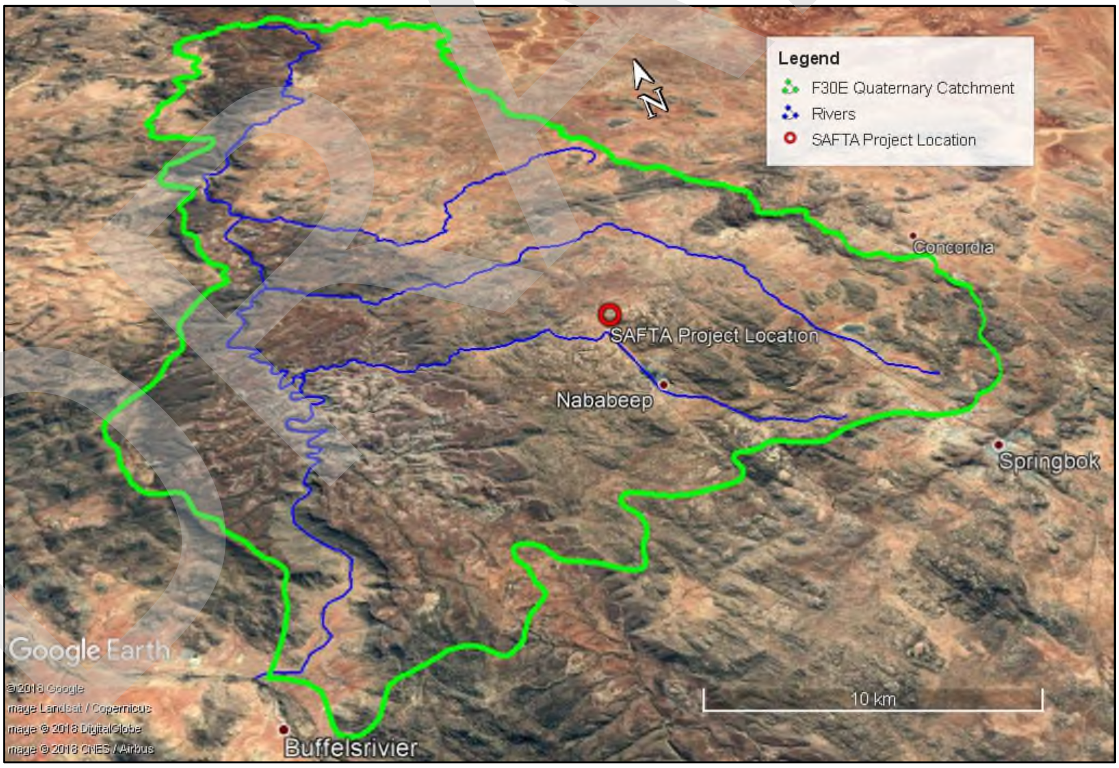


Figure 2-2: The SAFTA project located in the F30E quaternary catchment

3. Terms of Reference

The terms of reference that Epoch are responsible for comprise:

- Confirming the suitability of the MRDF selected site;
- A preliminary design to a PFS level of the MRDF comprising:
  - A Tailings Storage Facility (*TSF*) with sufficient storage capacity to contain 4.5 million dry tonnes of tailings over a 10 year LoM;
  - A Return Water Dam and a Storm Water Dam;
  - The associated infrastructure for the MRDF (i.e. perimeter slurry deposition pipeline, storm water diversion trenches, perimeter access road etc.);
- Estimation of the capital costs to an accuracy of ±25 percent and operating costs associated with these facilities to an accuracy of ±25 percent; and
- Estimation of the costs over the life of the facility.

3.1. Battery Limits

The battery limits for the Feasibility Study are as follows:

- Downstream of the point where the slurry delivery pipeline intersects the TSF starter embankment; and
- Upstream of the first flange exiting the RWD and SWD outlet pipe, prior to the pump station.

3.2. Design Criteria and Constraints/Assumptions

The design of the MRDF was based on the design criteria shown in Table 3-1.

Table 3-1: Design Criteria Associated with the SAFTA MRDF

Item No	Description	Value	Unit	Source
1	**Design Life of Facility**	10	Years	Uhuru
2	**Processed Ore**	Copper	-	Uhuru
3	**Tailings deposition rate**	37.5	Kt/month	Uhuru
4	**Particle SG of Tailings product**	2.7	-	Uhuru
5	**In-Situ Void Ratio**	1	-	Epoch – Assumed
6	**Placed Dry Density of Tailings**	1.4	Tonnes/m^3	Epoch – Calculated
7	**Particle Size Distribution of the Tailings Product**	75% Passing 106 μm	-	Uhuru
8	**Safe Rate of Rise**	2.5	m/annum	Epoch – Assumed
9	**A-Pan to Lake Evaporation Depth Factor**	0.75	-	Epoch – Assumed
10	**Minimum Freeboard**	1	m	Epoch
11				

3.3. Assumptions

The assumptions adopted for the SAFTA MRDF are the following:

- The RWD and SWD will require a liner as the in-situ soils is not expected to be suitable for containing water;
- An allowable Rate of Rise of 2.5m/annum for the TSF was assumed based on the relatively coarse grading of the tailings (75% mass passing 106 µm) and the high net evaporation of the location;
- The legislation that has been adopted for the purpose of this study is "Appropriate Best Practise Measures". "Appropriate Best Practise Measures", in this case, implies the use of the South African Residue Disposal Facility Design Standards and Codes (i.e. SANS 0286:1998 – "Code of Practise for Mine Residue") amongst others;
- It has been assumed that the tailings does not produce leachate in concentrations significant enough to require lining, however for indicative purposes, the cost implication of applying a lining system will be assessed; and
- Sufficient and suitable construction materials for the preparatory earthworks associated with the TSF can be sourced from the TSF basin and nearby borrow pits.

3.4. Available Information

The following information was made available to Epoch to undertake the PFS:

- A 1 m contour interval digital terrain model covering the majority of the selected MRDF location (model did not provide sufficient easterly coverage);
- The preferred site for the MRDF;
- Tailings production rates; and
- Particle Specific Gravity (SG) of the tailings product.

3.5. Climatic Data

The SAFTA project is located within the lower orange catchment in the F30E Quaternary catchment with the Skaap River being the most significant watercourse within the catchment area.

3.5.1. Rainfall and Evaporation

The catchment exhibits a winter rainfall pattern with the majority of rainfall occurring in the months from April to August. The nearby *O'Kiep weather station (0214636 W, elevation 930 mamsl)* provides monthly rainfall records from 1956 to 1985 from which the following was determined:

- Mean Annual Precipitation (MAP) at the station - 165.4 mm;
- Wettest year on record - 377.8 mm (1959/60); and
- Driest year on record – 57.1 mm (1968/69).

The average A-Pan evaporation determined from the O'Kiep weather station is 2 917.5 mm per annum. A coefficient of 0.75 was assumed to yield Lake Evaporation from the A-Pan depths, and equates to 2 188.1 mm.

The average monthly rainfall, A-Pan and Lake evaporation is listed in Table 3-2 as well as the variance between the two, indicating that annual evaporation exceeds the annual rainfall depth by over 2 000 mm (2 m).

Table 3-2: Mean monthly rainfall and evaporation values for the project location

Month	Mean Monthly Rainfall (mm)	Mean Monthly Evaporation – A-Pan (mm)	Mean Monthly Evaporation – Lake (mm)	Variance (Rainfall – Evaporation) (mm)
October	10.3	257.9	193.4	-183.125
November	5.3	316.7	237.5	-232.225
December	13.6	365.8	274.4	-260.75
January	4.5	367.4	275.6	-271.05
February	6.8	321.7	241.3	-234.475
March	9.2	294.2	220.7	-211.45
April	13	200.7	150.5	-137.525
May	20.8	154.7	116.0	-95.225
June	29.3	126.6	95.0	-65.65
July	20.9	131.2	98.4	-77.5
August	23.8	151.3	113.5	-89.675
September	9.5	191.1	143.3	-133.825
Total	165.4	2917.5	2188.125	-2022.725

3.5.2. Design Storm Events

The storm event depths were determined by utilising the inverse distance weighting method based on the design flood depths from surrounding weather stations listed in Table 3-3.

Table 3-3: List of weather stations used to determined design flood depths for the SAFTA project

Town Name	Station Number	Station Elevation (mamsl)	Distance from Project (km)
Nababeep	0214485 W	1 007	5.1
O'Kiep	0214636 W	930	10.8
Concordia	0214752 W	1 043	15.5
Springbok	021467 W	1 007	16.2
Steinkopf	0244405 W	661	32.2

The weighed design floods are listed in Table 3-4 for duration of days 1 to 7 for recurrence intervals from 2 to 200 years.

Table 3-4: Design floods determined for the SAFTA MRDF project

Duration (Days)	Rainfall Depth (mm) for each Recurrence Interval						
	2 Years	5 Years	10 Years	20 Years	50 Years	100 Years	200 Years
1	33	49	61	73	90	105	120
3	43	64	79	95	117	135	154
5	45	67	83	99	122	140	158
7	48	71	87	103	125	142	159

3.6. Exclusions

The following were excluded from Epoch's scope of work:

- Ground survey work;
- Trade off studies of various depositional strategies e.g. paste versus conventional;
- Hydrological, geo-hydrological, geochemical, mineralogical and other environmental investigations or studies required for the EIA or for engineering design purposes;
- Static and kinematic geochemical testing;
- Geotechnical investigations;
- Seepage and slope stability assessments of the MRDF;
- The design and costing of:
  - Mechanical works e.g. pumps, electrics, process controls and instrumentation;
  - The slurry delivery pump station at the plant including pumps motors, electrics, process control, instrumentation etc.;
  - The slurry delivery pipeline from the plant to the TSF and the associated slurry pumps etc.; and
  - The return water pipeline from the barge/manholes to the plant/treatment facilities and the associated pumps.
- Liaising or obtaining permission from various government authorities e.g. licences, permits, relocation of major services etc.;
- Determination of flood lines along water courses;
- Generating tender or enquiry documentation and/or specifications of the construction works; and
- Obtaining priced quotes on a competitive bid bases from a number of potential contractors.

3.7. Regulations pertaining to Tailings Storage Facilities

The National Environmental Management: Waste Act (NEMWA) of 2008 GN.R634-634 provides the legislation pertinent to the waste classification of the tailings stream, and the requirement for lining the MRDF thereof. It has been assumed that no liner is required at this phase of study, however, in the absence of waste classification through geochemical testing of the tailings product, the costs pertaining to installation of a Class-C liner has been included for indicative purposes. A Class C liner typically consists of:

- 1.5 mm HDPE geomembrane;
- 300 mm compacted clay layer;
- Leakage Detection systems; and
- A protection layer (fill material, or geotextile).

A typical cross-section of a Class-C liner is illustrated in Figure 3-1.

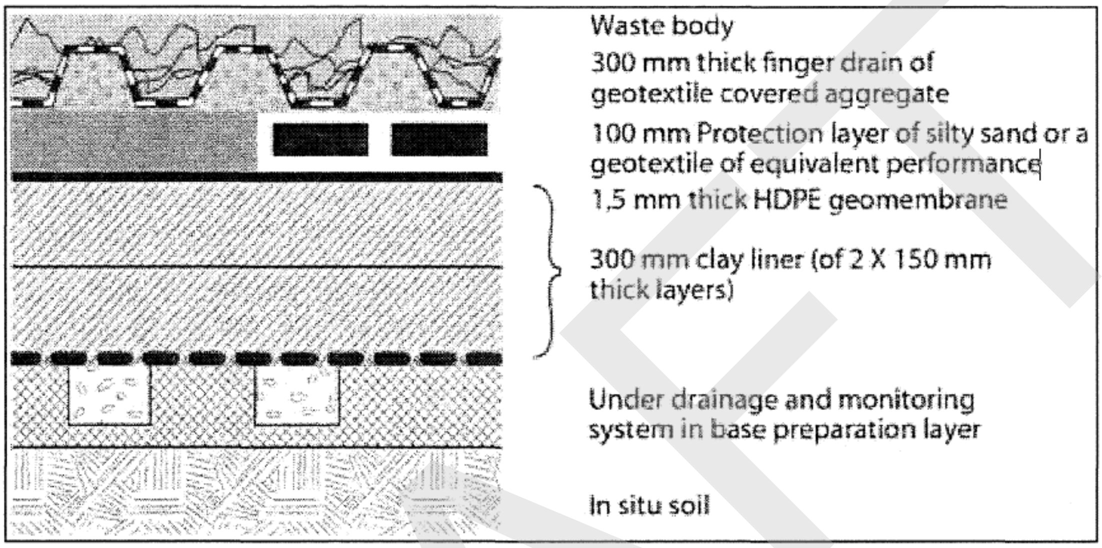


Figure 3-1: Class-C Liner System as per NEMWA GN. R636

Based on site visits conducted to the SAFTA project location, it is understood that there is no available material that may pass as clay, and as such, it has been assumed that a Geosynthetic Clay Liner (GCL) may be utilised to replace:

- The 300 mm clay layer; and the
- Protection layer.

The leakage detection, as part of the Class-C liner, will comprise:

- A Network on under basin collection trenches with:
  - 160 mm perforated HDPE pipes;
  - Backfilled with 19 mm (coarse) stone; and
  - Covered/Wrapped in A6 or equivalent specification geofabric.
- Outlets comprising:
  - 160 mm non-perforated HDPE pipes;
  - Backfilled with 19 mm (coarse) stone; and
  - Covered/Wrapped in A6 or equivalent specification geofabric.
- Leakage Collection manholes.

4. Scope of Work

The scope of work for the SAFTA PFS comprises the following:

- Collecting and reviewing all available information pertinent to the design of the MRDF i.e. survey, design criteria such as production rates, mine schedule, base line climatic data, local site conditions etc.;
- Undertake a PFS design of the selected MRDF site comprising:
  - A TSF impoundment;
  - A RWD and SWD;
  - The associated infrastructure for the MRDF (i.e. perimeter slurry deposition pipeline, storm water diversion trenches, perimeter access road etc.);
- Undertake a high level water balance to determine the average monthly water returns form the MRDF.
- Preparation of general layout drawings and typical details for the abovementioned components;
- Compilation of a preliminary bill of quantities (BoQ) for the MRDF to determine CapEx and OpEx (±25%cost accuracy);
- An annualised cash flow associated with the MRDF over the LoM for incorporation into the overall financial model for the PFS; and
- Compilation and documenting of the above for inclusion into the overall PFS report.

5. Selected TSF Site Description and Optimisation

5.1. Selected TSF Site

A formal site selection was not undertaken for this phase of the project. During a site investigation a site investigation with representatives from Uhuru and Epoch a single site was identified as a potential suitable location based on the following:

- Location overlies an existing environmentally disturbed location;
- The site is positioned over a wide valley in which it is possible to establish a large depositional basin reducing the volume requirement for a starter embankment; and
- The location does not encroach on nearby settlements.

A volumetric analysis was conducted of the selected site to confirm that the tailings stream could be contained within the available footprint. Figure 5-1 provides an illustration of the selected site location with the LoM tailings footprint area.

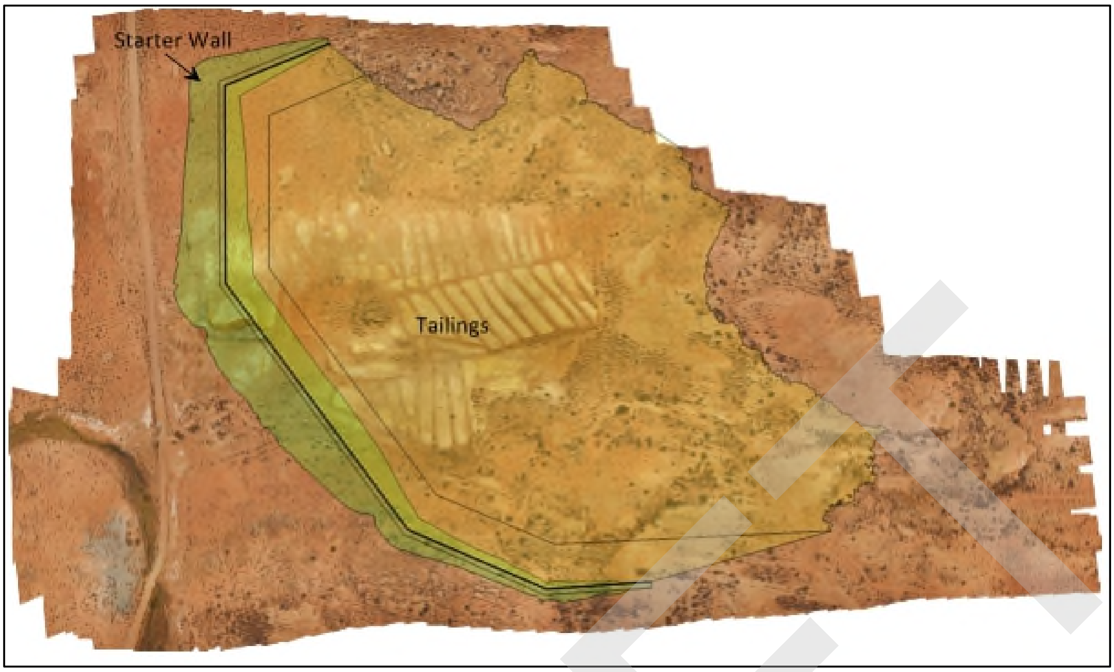


Figure 5-1: Orthophotograph of the selected site location with the overlaid TSF footprint

In order to optimise the capacity of the selected site a conventional upstream self-raised facility was chosen based on the restricted available footprint area; an anticipated lack of available in-situ borrow material and/or waste rock.

Listed in Table 5-1 are the characteristics of an upstream self-raised spigotted TSF. The TSF footprint with its associated catchment area illustrated in Figure 5-2.

Table 5-1: Characteristics of the TSF in the selected site

Characteristic	Value	Unit
Type	Valley – Self-Raise	-
Starter Wall Height	17	m
Starter Wall Volume	310 000	m³
Deposition Height Above Starter Wall	15	m
Final Height	32	m
Volumetric Capacity	3 214 000	m³
Tonnage Capacity	4 500 000	Tonnes
Footprint Area	32.81	Ha
Lined Area (if required)	24.14	Ha
Catchment Area	309	Ha

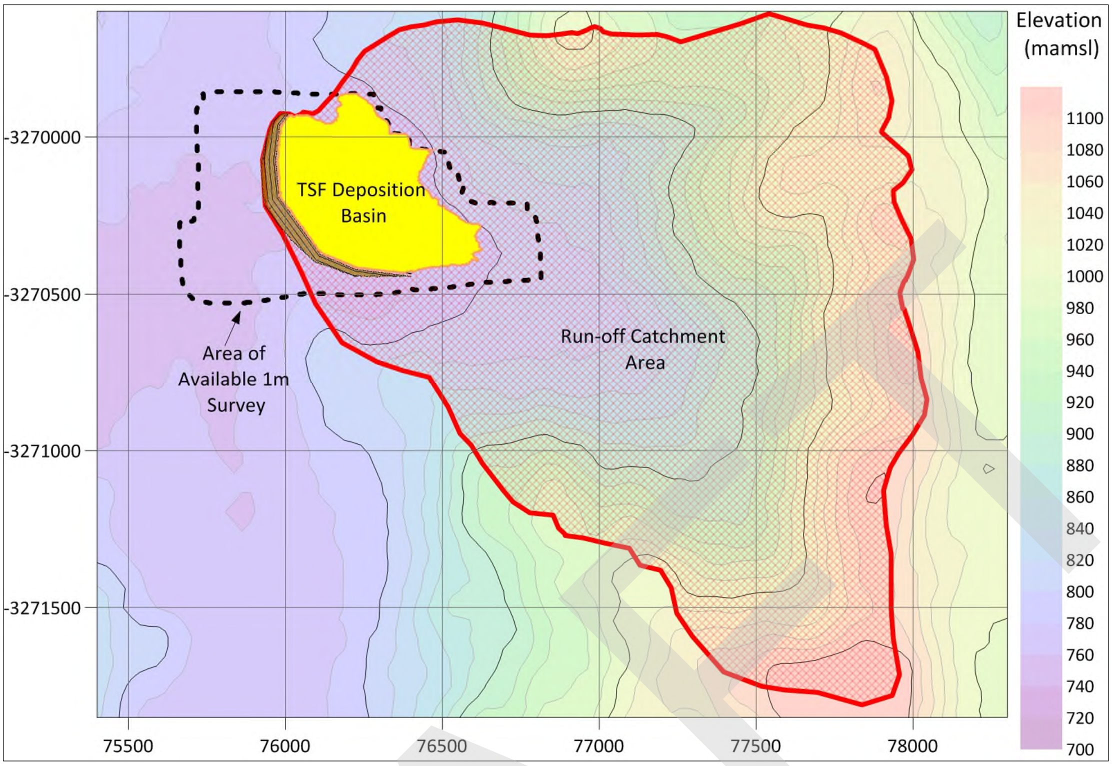


Figure 5-2: Selected MRDF site and its associated catchment area

6. Mine Residue Disposal Facility Design

The MRDF has been designed to contain a volumetric storage capacity of 4 500 000 dry tonnes over a 10 year LoM. The MRDF comprises the following facilities:

- A self-raised TSF;
- A RWD;
- A SWD;
- Associated infrastructure (i.e. slurry delivery infrastructure, storm water diversion trenches, energy dissipaters, silt traps etc.).

The general arrangement of the proposed MRDF is illustrated on Drawing Number 000-224-900, included in Appendix 2. The key design features of the MRDF are as follows:

- The TSF will be constructed as an upstream facility spigotting facility with the following features:
  - ➢ The starter embankment will be constructed to elevation 777 mamsl to correlate with the safe Rate of Rise of <2.5m/annum and provide the required minimum freeboard;
  - ➢ Deposition will comprise of tailings deposited behind the starter embankment until the Rate of Rise decreases to <2.5 m/annum and then self-raised to a final elevation of 792 mamsl with a terminal Rate of Rise of 1.64 m/annum;
  - ➢ The TSF has a total footprint area of 32.81 Ha, a maximum height of 32 m;

- A slurry spigot pipeline along the crest of the TSF starter embankment;
- An elevated and a natural ground level (NGL) toe drain and associated drain outlets;
- A blanket drain and associated outlets
- A solution trench;
- Run-off catchment paddocks;
- A penstock decant system with an intermediate intake and a final intake;
- An energy dissipator and a dual chamber silt trap with associated outfall trench;
- An access road;
- A perimeter fence; and
- Storm water diversion trenches and berms.

- A RWD with the following features:
  - A compacted earth containment wall raised to elevation 762 mamsl;
  - A lined basin with 1.5 mm HDPE with an associated geofabric protection layer;
  - A return water collection manhole;
  - A storage capacity of 6 000 m^3 providing approximately 5 days of slurry water; and
  - A spillway at elevation 761 mamsl.
- A SWD with the following features:
  - A compacted earth containment wall raised to elevation 762 mamsl;
  - A lined basin with 1.5 mm HDPE with an associated geofabric protection layer;
  - A return water collection manhole
  - A storage capacity of 41 000 m3 providing adequate storage to prevent spillage of dirty water more than once in a 50 year period;
  - An emergency spillway at elevation 761.2 mamsl; and
  - A spillway diversion trench and berm.

6.1. Tailings Storage Facility

6.1.1. Stage Capacity and Site Development Strategy

The stage capacity curve for the TSF, reflecting the relationship between tailings elevation, Rate of Rise (RoR), storage volume, footprint area, cumulative tonnage, elevation and time is included in Appendix 1.

This facility will be constructed as an upstream deposition self-raised TSF and requires that the RoR always remains within the limits, which are dependent on a number of factors, such as: tailings characteristics, climate, etc. For SAFTA a RoR of <2.5 m/year must be adhered to.

An initial 17 m high compacted earth starter embankment corresponding to a crest wall elevation of 777 m.a.m.s.l., which will provide approximately 2.5 years of tailings capacity and provide at least 1 m of freeboard, as indicated in Appendix 1. Thereafter there will be sufficient depositional area to self-raise the tailings within the confines of the safe RoR until the termination of operations. Illustrated in Figure 6-1 is the deposition basin until the crest of the starter embankment and to final elevation illustrated in Figure 6-2.

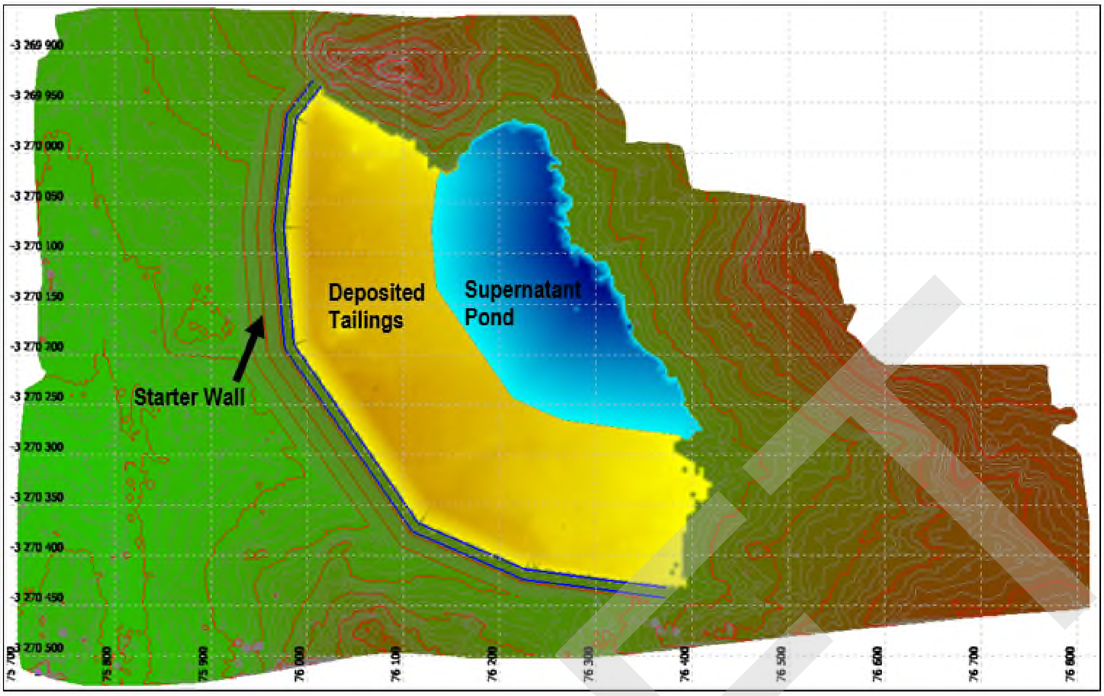


Figure 6-1: Deposition surface at the crest of the starter embankment

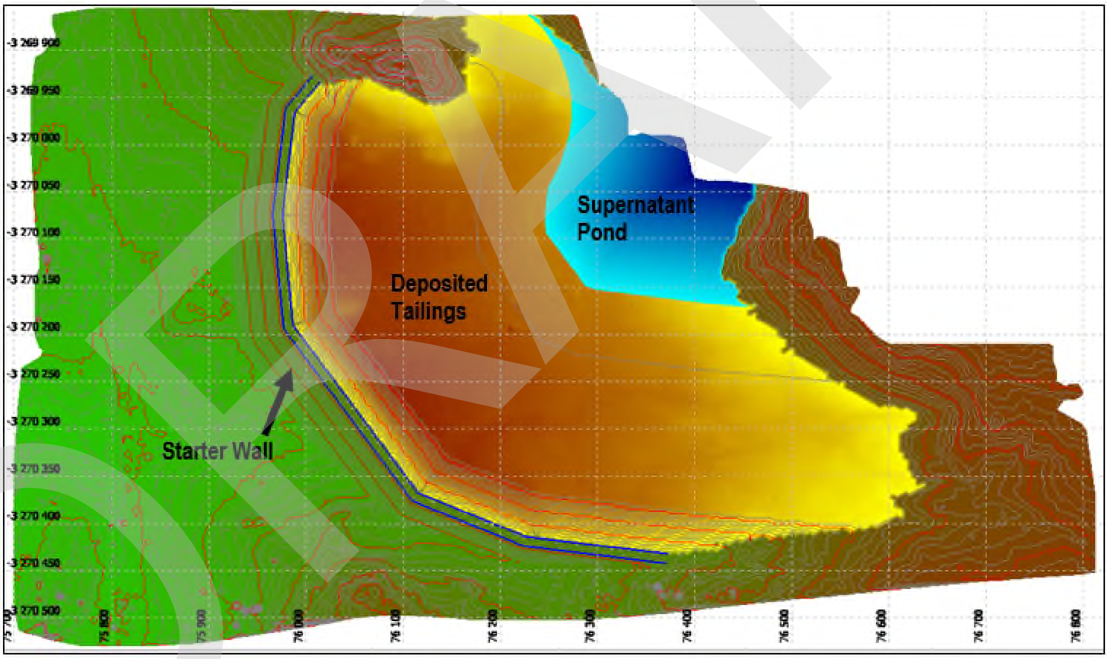


Figure 6-2: Depositional surface at final elevation

6.1.2. Tailings Storage Facility Preparatory Works

The preparatory works associated with the TSF are shown on Drawings 000-224-901 to 906, included in Appendix 2 and comprises of the following:

- Topsoil stripping to a depth of up to 200 mm beneath the TSF footprint;
- A box cut to a depth of 500 mm beneath the starter embankment;

- A compacted earth starter embankment with the following dimensions:
  - 17 m high (i.e. crest elevation of 777 m.a.m.s.l.);
  - 10 m crest width;
  - 1V:2H internal side slope; and
  - 1V:3H external side slope.
- An elevated Toe Drain at the upstream toe of the starter embankment, to reduce the level of the phreatic surface. This will comprise the following:
  - Suitable graded filter sand, 6.7 mm and 19 mm stone (intermediate and coarse stone);
  - A 160 mm perforated seepage collection pipe;
  - A 160 mm non-perforated outlet pipe;
  - Wrapped in A6 or similar approved geofabric.
- An NGL Toe Drain at the upstream toe of the starter embankment, to reduce the level of the phreatic surface. This will comprise the following:
  - Suitable graded filter sand, 6.7 mm and 19 mm stone (intermediate and coarse stone);
  - A 160 mm perforated seepage collection pipe;
  - A 160 mm non-perforated outlet pipe;
  - Wrapped in A6 or similar approved geofabric.
- An elevated Blanket Drain at the upstream toe of the starter embankment, to reduce the level of the phreatic surface. This will comprise the following:
  - Suitable graded filter sand, 6.7 mm and 19 mm (intermediate and coarse stone);
  - A 160 mm perforated seepage collection pipe;
  - A 160 mm non-perforated outlet pipe;
  - Wrapped in A6 or similar approved geofabric.
- A solution trench around the TSF to collect run-off and drain outlet water and direct it to the RWD. The trapezoidal solution trench has the following dimensions:
  - 0.5 m deep;
  - 4 m wide; and
  - 1V:1.5H side slopes.
- A storm water diversion channel with its associated cut-to-fill berm with the following dimensions:
  - 1 m deep;
  - 2.5 m wide; and
  - 1V:2H side slopes.
- A 120 ND slurry spigot pipeline along the length of the TSF along the length of the starter embankment;
- A buried penstock decanting system comprising:
  - 375 ND Class 100D spigot-socket precast concrete penstock pipeline;
  - A single intermediate intake;
  - A double final vertical intake;
  - 510 DN pre-cast penstock rings;

- A penstock catwalk; and
- Penstock intake platforms.

- A reinforced concrete energy dissipator;
- A two-compartment reinforced concrete silt trap; and
- A Class C liner system (to be included if required by the geochemical classification of the tailings), comprising:
  - A 1.5 mm HDPE liner;
  - Geosynthetic clay liner (GCL) and
  - A leakage detection system.

The specified size of the penstock pipeline and the slurry delivery pipeline has been based on preliminary design calculations and should be re-evaluated during the detailed design phase of the project.

6.1.3. Tailings Storage Facility Depositional and Operational Methodology

The depositional technique selected for this project will be a self-raised, hydraulically deposited spigot facility. The starter embankment will be constructed using imported fill or borrow material and tailings will initially be deposited behind the wall and thereafter packed on itself. This design is a common construction technique used in the tailings industry. The three principal designs are downstream, upstream and centreline structures, which designate the direction in which the embankment crest moves in relation to the starter embankment at the base of the embankment wall. The SAFTA TSF is an upstream structure. The method of spigotting is illustrated in Figure 6-3.

The tailings are usually discharged from the top of the dam crest using multiple outlets called spigots. A beach and resulting supernatant pool develops as far away from the crest as possible. Spigots break up the stream into smaller streams, thus causing a drop in stream velocity. Where the tailings properties are suitable, natural segregation of coarse material settles closest to the spigot and the fines furthest away.

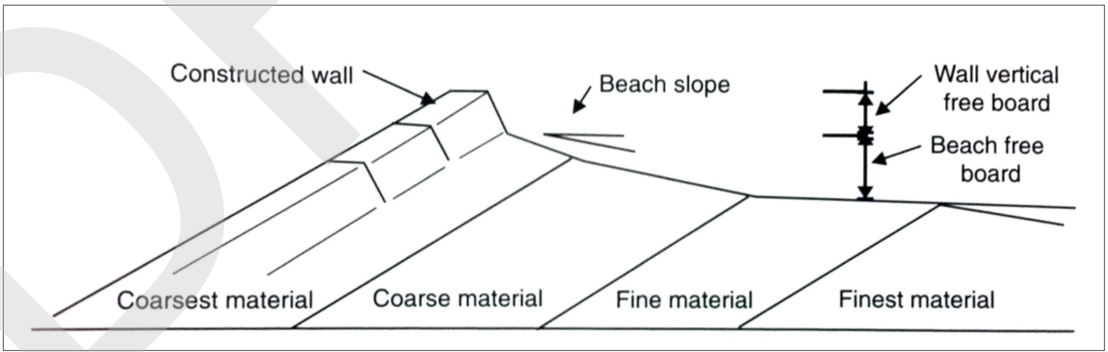


Figure 6-3: Upstream Spigot method of construction (Chamber Of Mines Of South Africa: Guidelines For Environmental Protection)

Based on the physical characteristics and actual particle size distribution of the tailings, the following depositional characteristics are affected:

- Tailings behaviour on deposition;
- Beach formation and profile;

- Rate of drying out and desiccation/consolidation and associated strength gain;
- Particle segregation along the beach;
- Pool control; and
- General TSF operation and deposition practices.

For the selected depositional methodology, tailings are deposited into the TSF basin via a spigot pipeline located on the inner crest of the starter embankment as shown in Figure 6-4. During commissioning, deposition of the tailings behind the starter embankment is directed to the base of the inner toe of the starter embankment by flexible hoses. Temporary spigots are also installed to cover the blanket drain situated approximately 50 m from the inner toe of the starter embankment. Deposition during this stage is to be carefully controlled, monitored and intensely managed to ensure that the liner is not damaged (if present) and the drains are not operationally impaired by poor depositional practices. A typical spigot deposition operation is illustrated in

Once the tailings have reached the starter embankment crest elevation, the tailings are deposited into mechanically placed or constructed *day paddocks*. These paddocks are constructed with tailings that have settled and consolidated, and provide freeboard for ongoing operations. Fresh tailings are then deposited into the day paddocks in layers of approximately 150 mm and allowed to settle. Once the tailings have settled, the supernatant water is drained off towards the TSF pool. The balance of the tailings not used for wall construction of the day paddocks are deposited into the TSF basin. After a period of drying, the paddock walls are raised and a successive cycle of deposition is repeated. The upstream method day paddocking is illustrated in Figure 6-5.

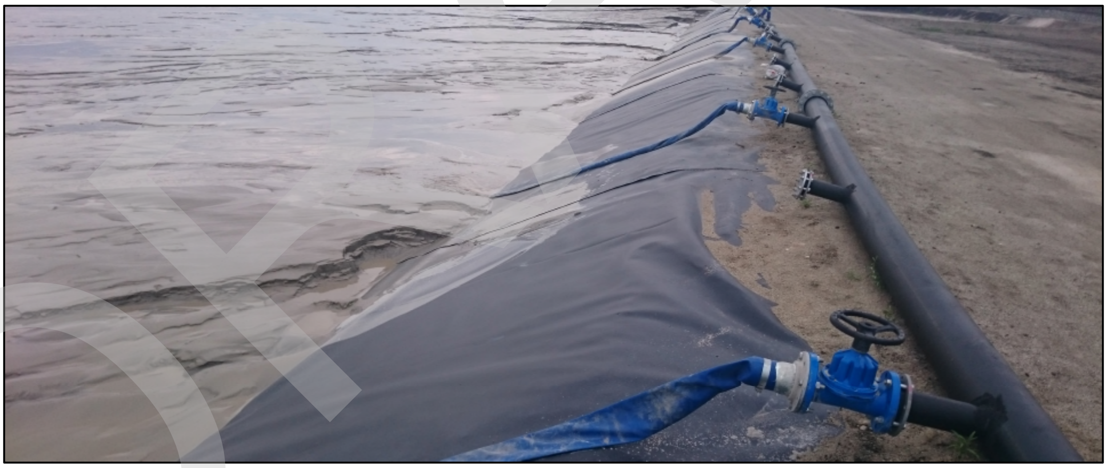


Figure 6-4: Multiple Spigot Discharge (Maseve Platinum Mine, South Africa)

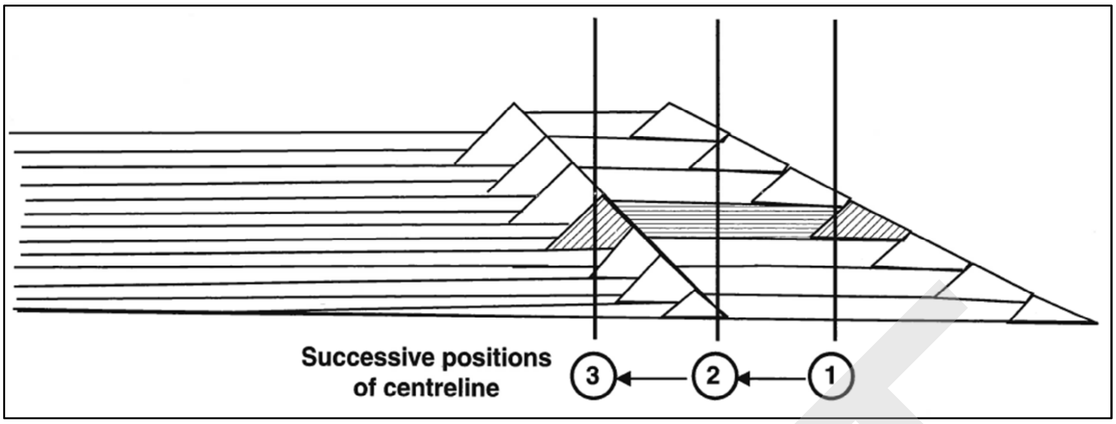


Figure 6-5: Construction of day paddocks for upstream deposition method (Chamber Of Mines Of South Africa: Guidelines For Environmental Protection)

6.1.4. MRDF Decant and Return Water System

Supernatant water on the TSF accumulates in a pool as a result of beaching and deposition control. This supernatant water, predominantly derived from the process, but also from rainfall, must be decanted from the surface of the TSF. A self-raised TSF cannot store water, for the following reasons:

- To prevent accumulation and eventually overtopping the sides of the TSF. For a self-raised facility, overtopping can lead to erosion of the tailings, which may lead to a breach, therefore water on the dam must be controlled;
- To return water to the process plant circuit, before significant evaporation occurs;
- To reduce the potential development of a high phreatic surface with consequent stability problems;
- To allow the tailings to consolidate and dry; and
- Reduce the potential for infiltration of water into the sub-surface causing potentially contaminating the ground water in the case of unlined facilities.

6.1.4.1. Return and Storm Water Dams

Supernatant and storm water is decanted via a vertical penstock intake and a buried penstock pipeline to the Energy Dissipater, RWD and SWD. During commissioning and the initial stages of the TSF development, decanting occurs via a trench cut into the basin of the TSF directing water to the penstock. The penstock outfall pipe comprises a spigot and socket concrete pipe, half-haunched in concrete. This pipe routes the supernatant water by gravity to a concrete lined energy dissipater structure and then through a silt trap to encourage settling of the suspended solids. The water is then gravitated to the RWD from where it may be returned to the process plant. In the event of rainfall, water may spill from the RWD to be captured and stored in the SWD. Water stored in the SWD may be returned to the process plant via a collection manhole.

The Return Water Dam (RWD) and the Storm Water Dam (SWD) have been designed to contain decant water from the TSF and runoff water arising from the MRDF footprint area with the philosophy that “dirty water” storage dams are:

- Designed, constructed, maintained and operated so as to not release any water more than once over a 50 year period; and
- Designed, constructed, maintained and operated to have a minimum freeboard of 1 m above full supply level.

The RWD and SWD are lined due to the pervious nature of the presiding in-situ material. During high rainfall/storm events, excess decant water that cannot be contained in the RWD or returned back to the process plant overflows into the SWD area, for storage and re-use at a later stage as process water. Water from the SWD may be returned via a return water manhole into which a submersible pump may be installed or lowered. In extreme rainfall events, water may be discharged from the SWD via an emergency spillway into the downstream environment.

The RWD and SWD have been respectively designed to contain:

- 5 days of slurry water, or approximately 6 000 m^3; and
- The 7 day 1:50 year design flood across the MRDF footprint, or 41 000 m^3.

The capacity of the SWD must be confirmed with a detailed water balance at a later phase of study.

6.1.4.2. Return and Storm Water Dam Details and Preparatory Works

The preparatory works associated with the RWD & SWD are shown on Drawings Number 000-224-908, included in Appendix 2 of this report and comprise the following:

- Topsoil stripping to a depth of up to 200 mm beneath the RWD and SWD wall footprint;
- A box cut to a depth of 500 mm beneath the starter embankment;
- A compacted earth starter embankment with the following dimensions:
  - 7 m high (i.e. crest elevation of 762 m.a.m.s.l.);
  - 5 m crest width;
  - 1V:2H internal side slope; and
  - 1V:3H external side slope.
- A liner system comprising of:
  - A 1.5 mm HDPE geomembrane; and
  - A geofabric protection layer of class A6 or similar specification.
- A return water collection system for the RWD and the SWD comprising of:
  - An inlet sump
  - An outlet pipe; and
  - A collection manhole;
- A RWD spillway at 761 mamsl;
- A RWD emergency spillway at 761.2 mamsl; and
- A SWD emergency spillway at 761.2 mamsl

6.1.5. Rainfall Run-off Management

To limit contamination of clean water run-off brought on by rainfall events, a clean-water, or storm-water diversion trench and berm has been included to reduce the size of the effective catchment area of run-off reporting towards the TSF basin. This will in effect divert the clean water around and away from the MRDF.

To limit the volume of run-off that would be subjected to contamination, two diversion trenches have been sized to deal with anticipated run-off, namely:

- Northern diversion trench, and the
- Southern diversion trench.

The storm water diversion will assist in minimizing the impact on clean water run-off from the remaining catchment as it is diverted away for the MRDF back towards its natural flow course. Run-off originating from the MRDF footprint is captured by the Storm Water Dam as temporal *contaminated* water storage which may be returned to plant as process water. The proposed location of the northern and storm water diversion trenches is illustrated in Figure 6-6.

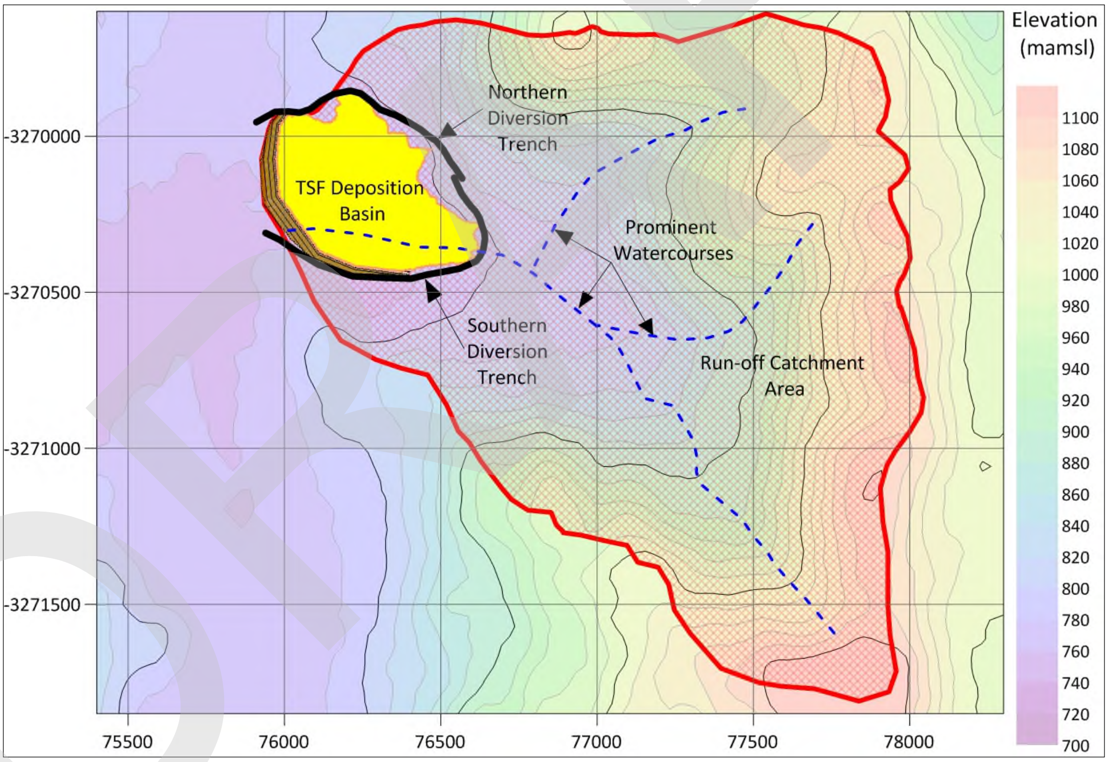


Figure 6-6: Position of the northern and southern storm water diversion trenches to limit clean water contamination

7. Water Balance

An average water balance was undertaken for the TSF based on available rainfall and evaporation data. The model inputs and dependants are:

- Average monthly rainfall;
- Average monthly evaporation;

- Composition of the tailings slurry (solids to liquid ratio);
- Void ratio of the tailings;
- Supernatant pond size; and
- Permeability of the tailings and in-situ material (only relevant for unlined facilities).

The above are just a few of the variables that influence the accuracy of a water balance. This is further affected by the deposition method, the wetted beach area, and stage of deposition to name a few parameters.

As such, a deterministic approach presented by Wels and Robertson (2003) was utilised for the water balance model to determine the available volume of return water.

This approach may be simplified as follows:

Available Return Water = Input Water – Losses;

Whereby input water include:

- Rainfall Recharge; and
- Slurry delivery water.

And output water (losses) include:

- Evaporation;
- Seepage losses; and
- Interstitial lock-up.

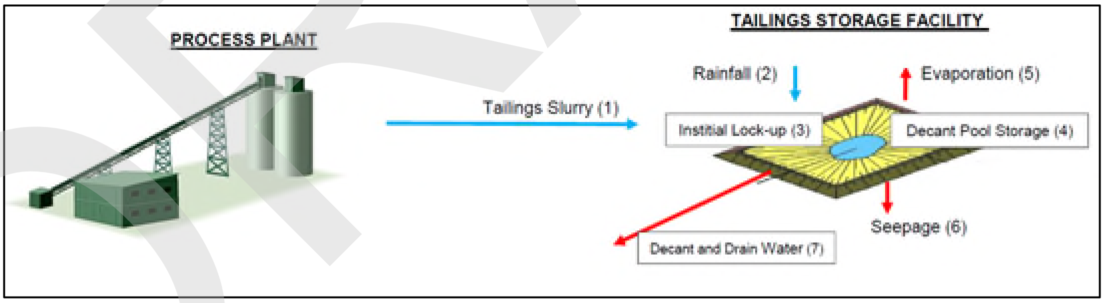


Figure 7-1: Graphical presentation of the inflows and outflows

7.1. Water Inflows

It was assumed that there is no ramp-up in tailings deposition shall occur during the design life of the MRDF, as such, no variance in the slurry water quantity is expected over the LoM.

Input of water to the MRDF include:

- Run-off water from precipitation; and
- Slurry delivery water.

The tailings depositional area is sub-divided into three categories:

- Dry Beach
- Wet Beach; and
- Supernatant Pond.

Run-off coefficients of the wet beach and dry beach varies based on the monthly rainfall depth, as listed in Table 7-1 for a wet beach profile and

Table 7-2 for a dry beach profile. A run-off coefficient of 1.0 being implemented for the supernatant pond area.

Table 7-1: Wet Beach run-off coefficients based on rainfall depths

Minimum Rainfall Depth (mm)	Maximum Rainfall Depth (mm)	Wet Beach Run-off Coefficient
0	< 10	0.3
10	< 50	0.5
50	> 50	0.8

Table 7-2: Dry Beach run-off coefficients based on rainfall depths

Minimum Rainfall Depth (mm)	Maximum Rainfall Depth (mm)	Dry Beach Run-off Coefficient
0	< 50	0
50	< 100	0.5
100	< 150	0.5
150	< 180	0.5
180	>180	0.5

7.2. Water Losses

Outflows will include:

- Seepage losses from the basin (assumed to be null in a lined facility);
- Evaporation;
- Re-saturation of the beach; and
- Interstitial lock-up.

Lock-up is a phenomenon whereby water is held up in the voids of the tailings material. This water is considered lost after the tailings have settled. The following material parameters were utilised in the water balance model:

- Final Void Ratio – 1.0 (Assumed);
- Specific Gravity of Tailings: 2.7; and
- Interstitial Lock-up: 37% (i.e. 37% of the slurry water is "lost" to the interstitial lock-up in the voids between the tailings particles).

The lock-up percentage stated is based on the assumption that 50% of the mass of the tailings slurry is constituted by the solid particulate and the remaining mass occupied by water.

7.3. Average Monthly Water Balance

The average monthly water balance has been determined for a lined and an unlined facility. A water balance for a lined facility would expect greater water returns as the seepage from the supernatant pond into the in-situ soils is nil, provided the liner remains fully operational.

The results of the average monthly water balance are illustrated in Figure 7-2 for both a lined and unlined facility. The available water for return as a percentage of the slurry water are expected to be:

- Between 20% - 40% for an unlined facility; and
- Between 40% - 60% return for a lined facility.

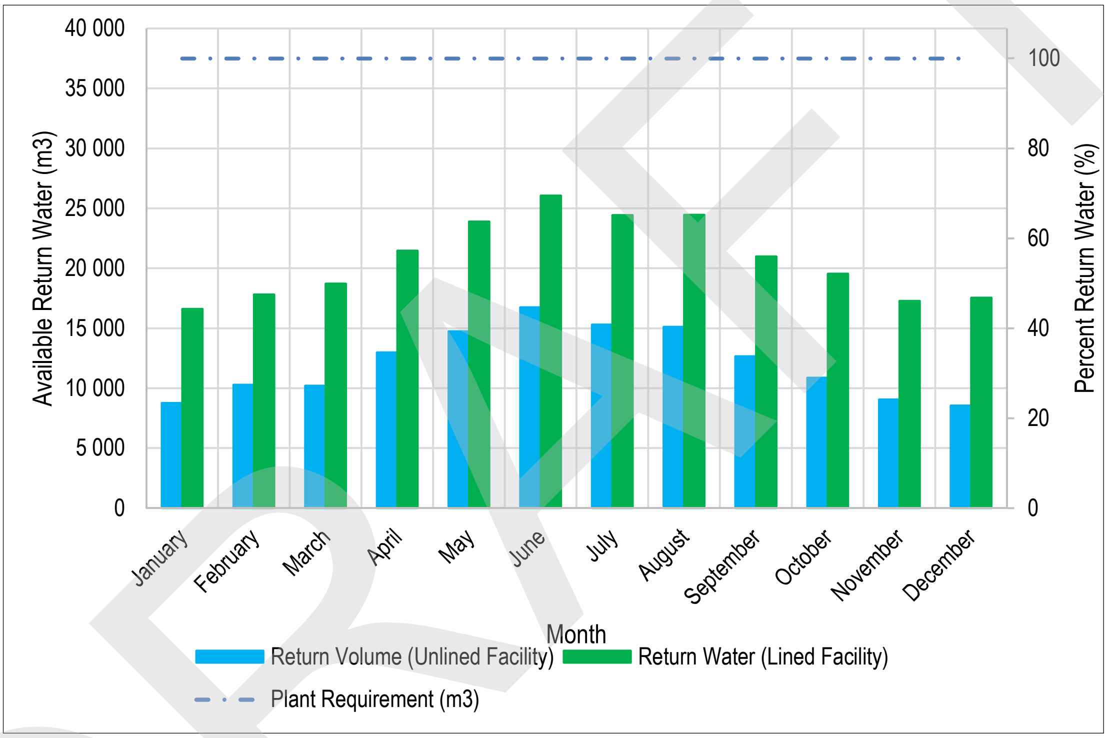


Figure 7-2: Average monthly water returns for a lined and unlined facility

It is recommended that a detailed daily water balance be undertaken in later studies of the project.

8. TSF Capital and Operating Cost Estimate

The SAFTA MRDF cost estimate has been conducted assuming that the MRDF will not be lined, however, the cost implication of the addition of a Class C liner has been assessed.

Fraser Alexander Construction (FAC) and Paragon Tailings were approached to provide construction and operation rates for the CapEx and OpEx estimates respectively.

8.1. Capital Cost Estimate

The CapEx for the MRDF was determined by quantifying the construction items required, in the form of a Bill of Quantities (BOQ). The BOQ was provided to FAC, who provided rates for each item. (FAC has significant experience constructing Tailings Dams).

The total cost to construct the unlined MRDF totalled R36.08 million. An additional R40.34 million would be required for the installation of a Class C liner totalling R76.42 million. The CapEx for the MRDF has been determined to an accuracy of ±25%.

The complete Bill of Quantities has been included in Appendix 3 and a summary of costs for an unlined MRDF is shown in Table 8-1.

Table 8-1: Summary of estimated CapEx for an unlined facility

Tailings Storage Facility	**Amount (ZAR)**
Site Clearance	2 819 194.92
Earthworks and Excavations	12 559 291.73
Drainage	2 259 495.87
Concrete Structures	1 212 341.14
Pipework	741 855.00
Catwalk	604 160.00
Miscellaneous	148 532.50
Tailings Storage Facility Sub-Total	**20 344 871.17**
Energy Dissipator and Silt Trap	**Amount (ZAR)**
Earthworks and Excavations	15 648.46
Concrete Structures	1 159 704.15
Energy Dissipator and Silt Trap Sub-Total	**1 175 352.61**
RWD and SWD (Lined)	**Amount (ZAR)**
Earthworks and Excavations	4 262 305.86
Liner and Drainage	1 661 140.28
Concrete Structures	306 979.93.87
RWD and SWD Sub-Total	**6 230 426.07**
Measured Works	**27 750 649.85**
Preliminary and General (@ 30% Of Total Works)	**8 325 194.96**
TOTAL CAPITAL COST	**36 075 844.53**

The following qualifications have been made with regards to the CapEx associated with the SAFTA MRDF:

- No allowance for escalation has been made – rates quoted as at May 2018;
- Contingency has not been allocated; and
- Preliminary and Generals have been placed at 30% as provided by FAC.

The CapEx estimation excludes the following:

- Acquisition and installation of pumps;
- All mechanical and electrical components; and
- Slurry and water delivery lines between the MRDF and the plant.

8.2. Operating Cost Estimate

The OpEx associated with operating the MRDF, provided by Paragon Tailings (Pty) Ltd (Paragon) to an accuracy of ±25%, is estimated at R2.51 million/annum and comprises:

- R0.62 million/annum for managerial salaries;
- R0.19 million/annum for site vehicles;
- R1.49 million/annum for labour wages;
- R0.03 million/annum for safety equipment;
- R0.08 million/annum for safety officer; and
- R0.07 million/annum for store rental.

A once off site establishment and disestablishment charge of:

- R0.119 million; and
- R0.115 million respectively.

Allowance was made for maintenance of infrastructure, and replacement of parts for R0.02 million/annum.

A self-raised facility, as proposed by this PFS, carries more risk than a typical full containment facility, and as such it is recommended that it is operated by a reputable operator, and the mine allows a consulting engineer to conduct quarterly inspections of the MRDF and undertake annual reviews. An allowance of R0.4 million/annum for such engineering consulting services was allocated.

The total estimated total OpEx is R2.92 million per annum and over the LoM totals R29.52 million determined to an accuracy of ±25%.

8.3. Closure, Rehabilitation and Aftercare

A high level estimate, to an accuracy of ±50%, has been determined for the costs associated with closure, rehabilitation, and aftercare of the SAFTA MRDF which amounts to:

- Closure and Rehabilitation – R2.88 million; and
- Aftercare – R0.24 million.

The following sections provide a guideline as to the proposed closure, rehabilitation, and aftercare.

8.3.1. Closure Activities at Cessation of Operations

At the cessation of operation of the TSF, the focus will be on the cover and vegetation of the top surface and side slopes of the facility, the decommissioning of facilities associated with the TSF and the construction of storm water control measures as required. Specific activities that will be carried out will include:

- The dismantling and removal from site of all pipes and supports associated with the slurry delivery and return water systems;
- The plugging of penstock inlets;
- The construction of storm water decant points from the TSF basin. The decant points will be located so as to control the rate of decant from the basin and will be constructed along the up-gradient side of the facility to minimize the flow velocities associated with the decanting process. The spillways will be designed to accommodate the peak design flows from the facility area and will be rock and/or concrete lined;
- The stripping of sufficient soil from the footprint of the facility to enable the placement of a soil cover to the outer slopes and cover layer on top of the TSF;
- The placement of a mixture of soils and selected waste materials to the outer slopes of the impoundment and top of the TSF wall in preparation for the establishment of vegetation;
- The supply and hand planting of vegetation to the outer slopes of the impoundment wall and top of the TSF to assist in the prevention of erosion;
- The aftercare and maintenance of the cover layers and vegetation; and
- Minor earthworks to drains, roads, trenches, etc.

The duration of the final closure process may be affected by the length of time required for the basin of the facility to dry sufficiently to enable the placement of cover material in preparation for the vegetation establishment.

The nature of the available soils likely to be stripped from the footprint of the TSF requires that they are protected against erosion. This will be done by a combination of mixing with selected waste material and the establishment of vegetation to the cover. The mixing of soil with material of a gravel/rocky nature has been found to be effective in improving the erosion resistance of cover layers to sloped areas. The establishment of vegetation to the side slopes of the facility could be done by hand planting, seeding or hydro-seeding and should comprise a mixture of grass, shrubs and trees. The most effective method of covering and vegetation establishment will be arrived at during the operational life of the facility by a process of trial and error. The vegetation used in the establishment of the vegetative cover will all be indigenous and should not require irrigation.

8.3.2. Aftercare and Maintenance Requirements

On completion of the final rehabilitation and closure works, an aftercare and maintenance program will be required to assist in ensuring that the closure measures are robust, have performed adequately and that no further liabilities arise. The aftercare period is normally not less than 5 years but can extend into decades depending on the physical and chemical characteristics of the facility. The aftercare and maintenance program for SAFTA is expected to include:

- Periodic inspection of the cover and vegetation for signs of erosion damage and failures of the vegetation establishment process;
- Repairs and amendments to the closure works as necessary;
- Re-planting of areas of vegetation where required;
- Periodic inspection and monitoring to confirm the effectiveness of the closure works in achieving the stated closure objectives, including:
  - Collection and analysis of ground and surface water samples;
  - Measuring of phreatic surfaces within the TSF and assessment of the overall structural stability of the facility; and
  - Inspections of storm water decant facilities for signs of damage.

No allowance has been made for the treatment of water that will need to be discharged into the environment from the MRDF after closure. This water could be released through the TSF drain outlets, which is conveyed RWD and SWD from where it may be collected.

The maintenance requirements for the facility should decrease with time and should be confined to minor earthworks to repair erosion damage and upgrade facilities as required, as well as re-planting of areas of vegetation damaged due to erosion.

9. Annualised Cash Flow Associated with the TSF

The total LoM cost associated with an unlined MRDF over the duration of the project life (Feasibility Study to Post Closure) is estimated at R75.72 million, as shown in Table 9-1, and includes:

- CapEx associated with the preparatory works for the MRDF to an accuracy of ±25%;
- OpEx associated with the operations and consulting services to an accuracy of ±25%;
- Engineering design and consulting services (Feasibility, Detail Design and Construction Supervision); and
- Closure and rehabilitation estimate to an accuracy of ±50%.

The addition of the closure and rehabilitation phase (post closure) are purely indicative and should be addressed with higher degrees of accuracy in further studies.

All costs are listed in terms of their current value.

Table 9-1: Annualised Cash Flow Associated with the SAFTA TSF

Item	Description	NPV	Study/Design Phase		Construction Phase	Operational Phase										Closure	Rehab/Aftercare					Total
			Year																			
		NPV	**-3**	**-2**	**-1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Total**
1.0	**MRDF Capital Cost**																					
1.1	Tailings Storage Facility	20.34			20.34																	20.34
1.2	Return/Storm Water Dam	6.23			6.23																	6.23
1.3	Energy Dissipator & Silt Trap	1.18			1.18																	1.18
1.5	P & G's (30% of total works)	8.33			8.33																	8.33
	Sub-Total	36.08	0.00	0.00	36.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.08
2.0	**MRDF Consulting/Design Costs**																					
2.1	Engineering Feasibility Design	2.00	2.00																			2.00
2.2	Engineering Detail Design	3.00		3.00																		3.00
2.3	Engineering Construction Supervision	2.00			2.00																	2.00
	Sub-Total	7.00	2.00	3.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
3.0	**MRDF Operating Costs**																					
3.1	TSF Deposition Management Costs	25.37				2.71	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.62							25.37
3.2	TSF Operational Costs (i.e. pipeline and valve replacement costs, maintenance, etc.)	0.15				0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02							0.15
3.3	Consulting Services (i.e. Monitoring, quarterly inspections, annual reports, etc.)	4.00				0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40							4.00
	Sub-Total	29.52	0.00	0.00	0.00	3.12	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	3.04	0.00	0.00	0.00	0.00	0.00	0.00	29.52
4.0	**MRDF Closure and Rehabilitation Costs**																					
4.1	Engineering Costs (i.e. design and supervision of closure and rehabilitation measures)	0.90														0.15	0.15	0.15	0.15	0.15	0.15	0.90
4.2	Closure and Rehabilitation Measures undertaken during Operational and Decommissioning Phase (i.e. rock cladding, re-vegetation, sealing of penstocks, etc.)	1.98														0.75	0.75	0.33	0.05	0.05	0.05	1.98
	Sub-Total	2.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.90	0.48	0.20	0.20	0.20	2.88
5.0	**MRDF Aftercare Costs**																					
5.1	Monitoring of Closure Activities	0.04														0.02	0.01	0.00	0.01	0.00	0.01	0.04
5.2	Miscellaneous Works (i.e. post closure remedial measures, etc.)	0.20														0.00	0.10	0.03	0.03	0.03	0.03	0.20
	Sub-Total	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.03	0.03	0.03	0.03	0.24
	Total	**75.72**	**2.00**	**3.00**	**38.08**	**3.12**	**2.92**	**2.92**	**2.92**	**2.92**	**2.92**	**2.92**	**2.92**	**2.92**	**3.04**	**0.92**	**1.01**	**0.51**	**0.23**	**0.23**	**0.23**	**75.72**

10. Conclusions

The PFS of the SAFTA MRDF has been undertaken, and the following was concluded:

- A site has been identified within the available survey capable of containing the tailings stream over the 10 year LoM;
- In the absence of geochemical laboratory testing on a representative tailings sample, the TSF was assessed as both a lined and unlined facility;
- A RWD was sized to contain 5 days of slurry water, or 6 000 m^3;
- A SWD was sized to contain the volume of water that would resulting from a 7 day 1:50 year return period flood over the entire MRDF footprint, or 41 000m^3;
- A high level water balance yielded returns of:
  - Between 20% – 40% for an unlined facility; and
  - Between 40% - 60% for a lined facility.
- CapEx was determined from rates provided by Fraser Alexander Construction to an accuracy of ±25% and was estimated at R36.08 million for an unlined TSF
- An additional cost of R40.34 million to provide a Class C liner totalling R76.42 million;
- OpEx associated with the MRDF was estimated to an accuracy of ±25% and was estimated at R2.92 million per annum over the operational life of the facility;
- Closure and rehabilitation were indicatively provided to an accuracy of ±50% which will be R3.12 million.
- The total LoM cost pertaining to the MRDF is estimated at:
  - R75.72 million for an unlined facility; and
  - R116.56 million for a lined facility.

11. Risks

In terms of the PFS for the SAFTA MRDF, the following risks have been identified:

- The CapEx is sensitive to the availability of borrow material within the free haul distance of 2 km. Rates provided by FAC imply CapEx increases by approximately:
- R12 million for 3 km, and
- R15.5 million for 4 km; depending on the distance to the borrow area;
- A full geotechnical investigation must be conducted to determine the suitability of the available in-situ materials for use as construction materials, and the volumes of material available and where borrow pits may be instated;
- The sizing of the SWD is to be confirmed by a detailed water balance which must be conducted in a later stage of study;
- A seepage assessment and slope stability analysis must be conducted to confirm the geometry and drainage requirement of the TSF, RWD, and SWD and must be conducted in further study;

- The Zone of Influence should be determined to establish the potential hazard posed to nearby water resources, settlements, and sensitive flora and fauna;
- The potential of lining would be dependent on the geochemistry of the tailings and poses significant exposure to the CapEx of the project; and
- Lower volumes of available return water will increase the volume of required make-up water and may pose a financial risk.

12. Opportunities

The opportunities that may be present to reduce CapEx:

- *Cycloning* the slurry to separate the coarse tailings from the fine to be used as an outer wall may be conducted if > 25% of the tailings passes the 75 μm sieve, based on preliminary assessments. This may reduce the CapEx associated with construction of the TSF, but result in an increase in the OpEx;
- Competitive rates may be sourced from other construction contractors to determine the CapEx sensitivity; and
- Less make-up water will be required should the facility be lined which may provide savings in purchasing of raw water.

13. Recommendations

For the Definitive Feasibility stage of the project, it is recommended the following be undertaken:

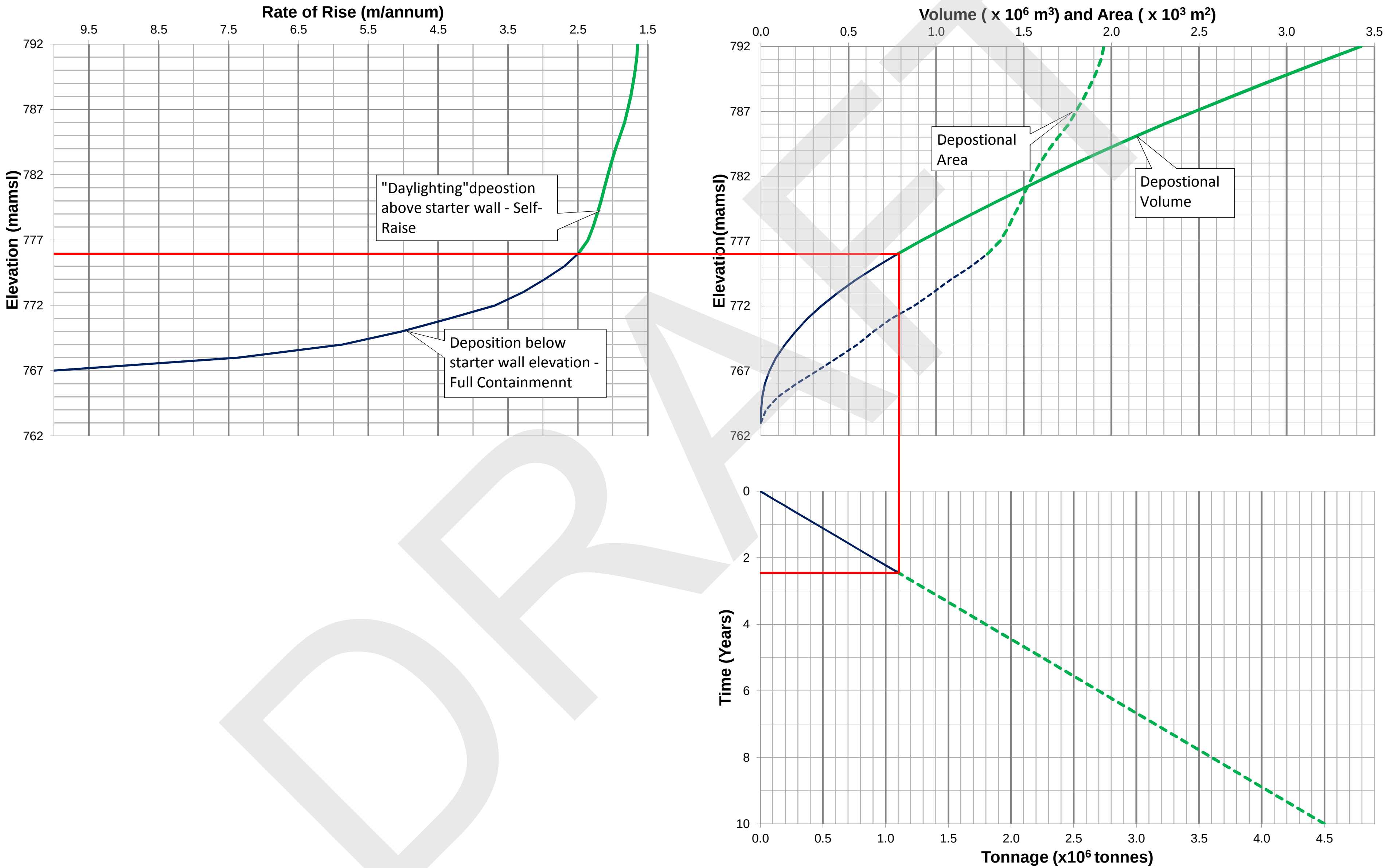
- The geochemical properties of a representative sample of the tailings must be determined by an accredited laboratory to determine the Waste Classification according to NEMWA and the corresponding Liner requirement;
- The geotechnical parameters of a representative sample of the tailings must be determined by an accredited laboratory to determine strength and seepage parameters;
- To determine the viability of cyclone deposition, a minimum of 200 kg of sample must be acquired to determine the possible coarse/fine split and the corresponding densities and gradings;
- A detailed geotechnical investigation must be conducted of the site footprint and include:
  - Depth of soil to bedrock/refusal;
  - Depth of in-situ soil layers;
  - Foundation indicators of the in-situ soils;
  - Shear strength parameters of the in-situ soils;
  - Permeability/hydraulic conductivity of the in-situ soils;
  - Identification of any natural fault lines.
- Accurate rainfall and evaporation data must be acquired for the site, as well as confirmation of the design flood depths to complete a detailed water balance of the MRDF;

- Seepage and stability analyses, dependent on the MRDF geometry and material properties, must be conducted;
- The Zone of Influence of the TSF to be determined;
- Proximity of the MRDF to sensitive flora and fauna in accordance with an Environmental Impact Assessment, as well as its impact on local communities;
- An extension to the existing topographical survey would be required; and
- The GA may be further optimised and the potential of phasing the preparatory works may be assessed in further studies.

Report Author	**Reviewer**	**Project Manager**
Richard Mallory, Ryan O'Toole	**Georgia Wills-Vagis**	**Andrew Savvas**

epoch resources (pty) ltd

Appendix 1 - Stage Capacity Curves


Rate of Rise (m/annum)
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
Elevation (mamsl)
792
787
782
777
772
767
762
"Daylighting"dpeostion above starter wall - Self-Raise
Deposition below starter wall elevation - Full Containmennt
Volume (x 10⁶ m³) and Area (x 10³ m²)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Elevation(mamsl)
Depostional Area
Depostional Volume
Time (Years)
0
2
4
6
8
10
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Tonnage (x10⁶ tonnes)

Appendix 2 - Drawings

FOR INFORMATION

DRAWING No.	DRAWING TITLE
	REFERENCE DRAWINGS

REV	MADE	DATE	APPD	DATE
3				
2				
1				
0				
C				
B				
A	L.S.	30-05-18		

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DRAWN	L. STEINHOBEL
DATE	MAY 2018
CHECKED BY	
DATE	
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DATE	
APPROVED (CLIENT)	
DATE	

PROFESSIONAL REGISTRATION
NAME:
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COMMENT ☐
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DATE:
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CO-ORD SYSTEM: Lo17 HARTTEBEESHOEK94

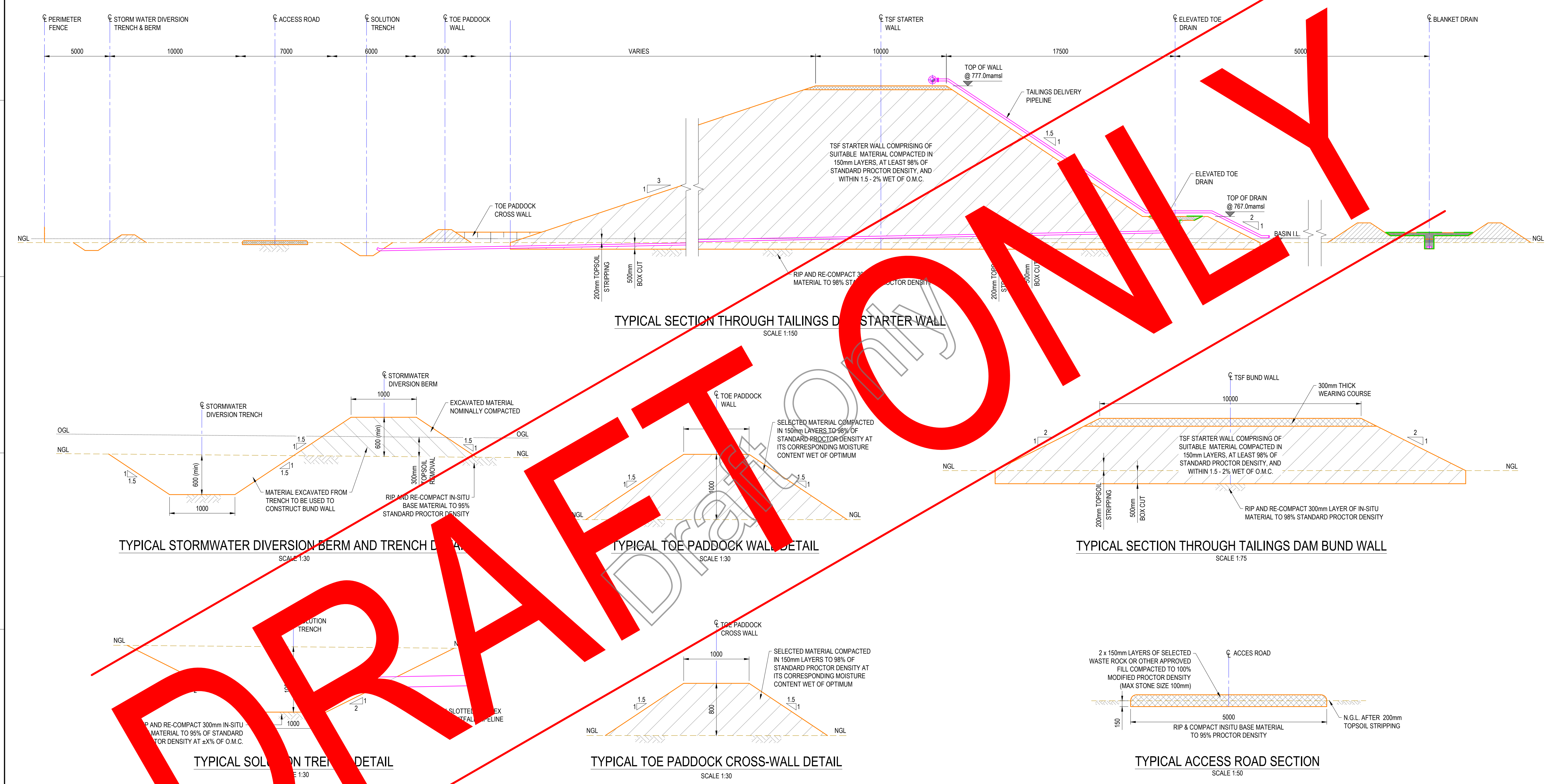
SCALE	
A1	AS SHOWN
A3	AS SHOWN x2

epoch — mine residue and environmental engineering consultants

TITLE
SAFTA COPPER PFS
TAILINGS STORAGE FACILITY
GENERAL ARRANGEMENT

DRG No. 000-224-900 REV. A

A1



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DRAWN	L. STEINHOBEL
DATE	MAY 2018
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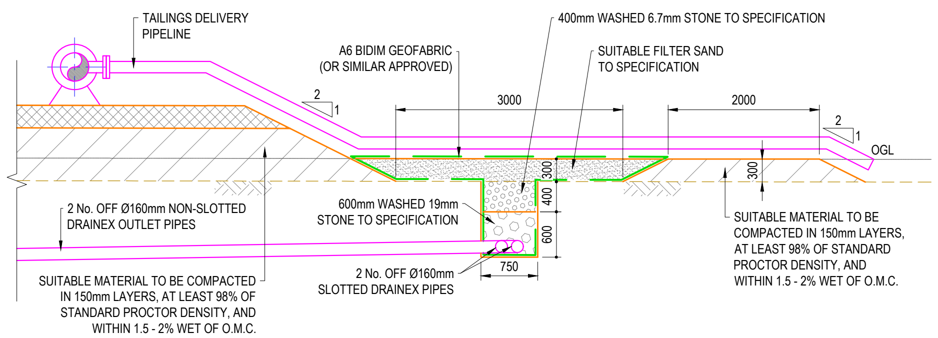
APPROVED (CLIENT)	
DATE	

CO-ORD SYSTEM: Lo17 HARTTEBEESHOEK94
SCALE: A1 AS SHOWN; A3 AS SHOWN x2

epoch — mine residue and environmental engineering consultants

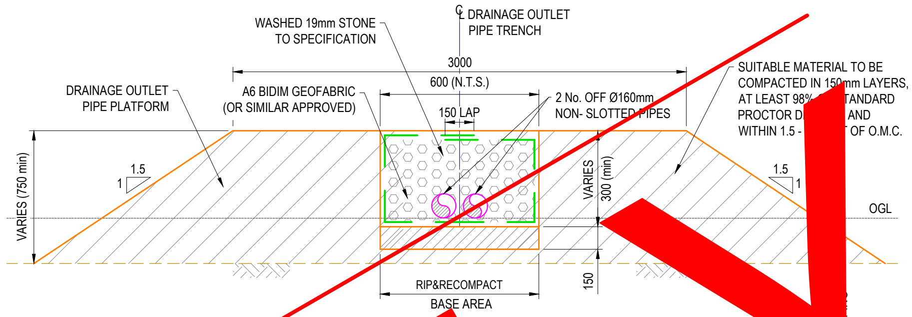
TITLE: SAFTA COPPER PFS
TAILINGS STORAGE FACILITY
TYPICAL CROSS SECTIONS

DRG No. 000-224-901 REV. A

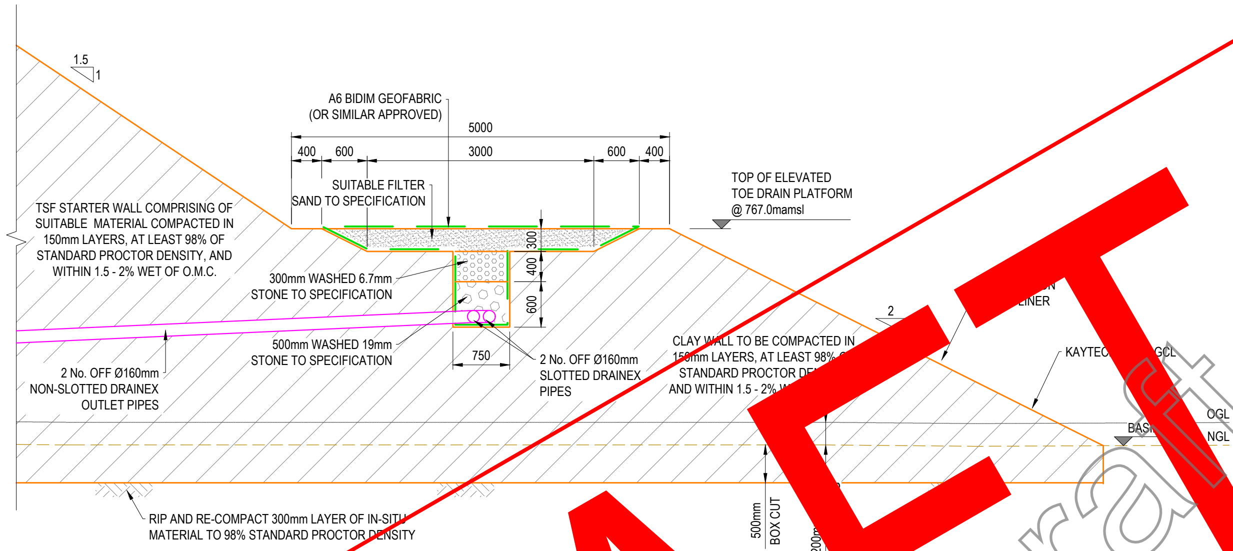


TYPICAL SECTION THROUGH NGL TOE DRAIN

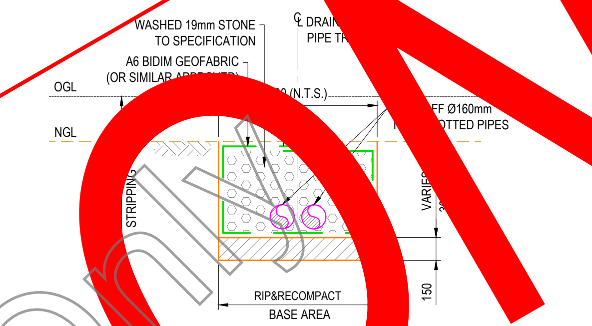
SCALE 1:50



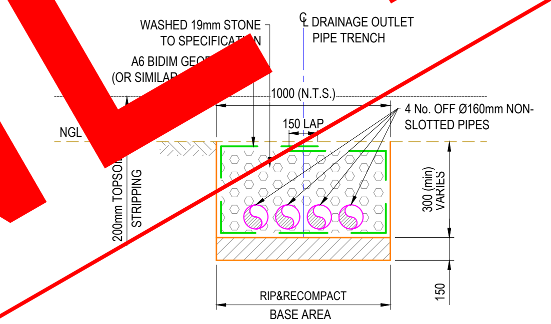
TYPICAL SECTION - DRAINAGE OUTLET PIPES THROUGH PLATFORM



TYPICAL SECTION THROUGH ELEVATED TOE DRAIN



TYPICAL SECTION - DRAINAGE OUTLET PIPES BELOW N.G.L. BEFORE TOE DRAIN OUTLET JOIN



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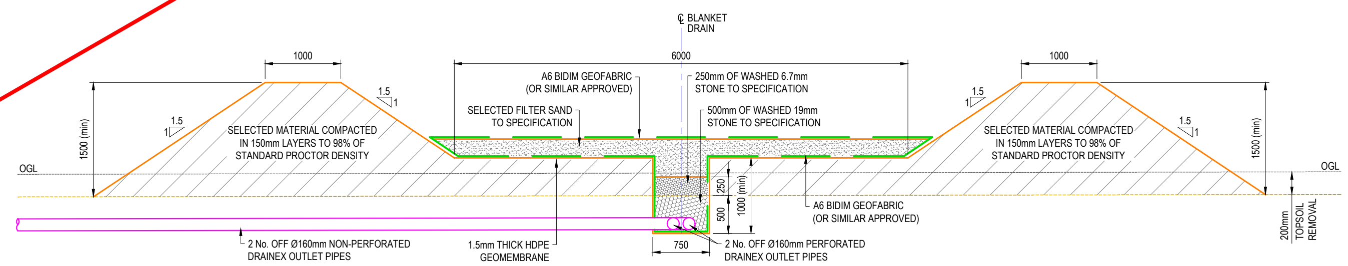
SCALE 1:25



TYPICAL BLANKET DRAIN DETAIL

SCALE 1:40

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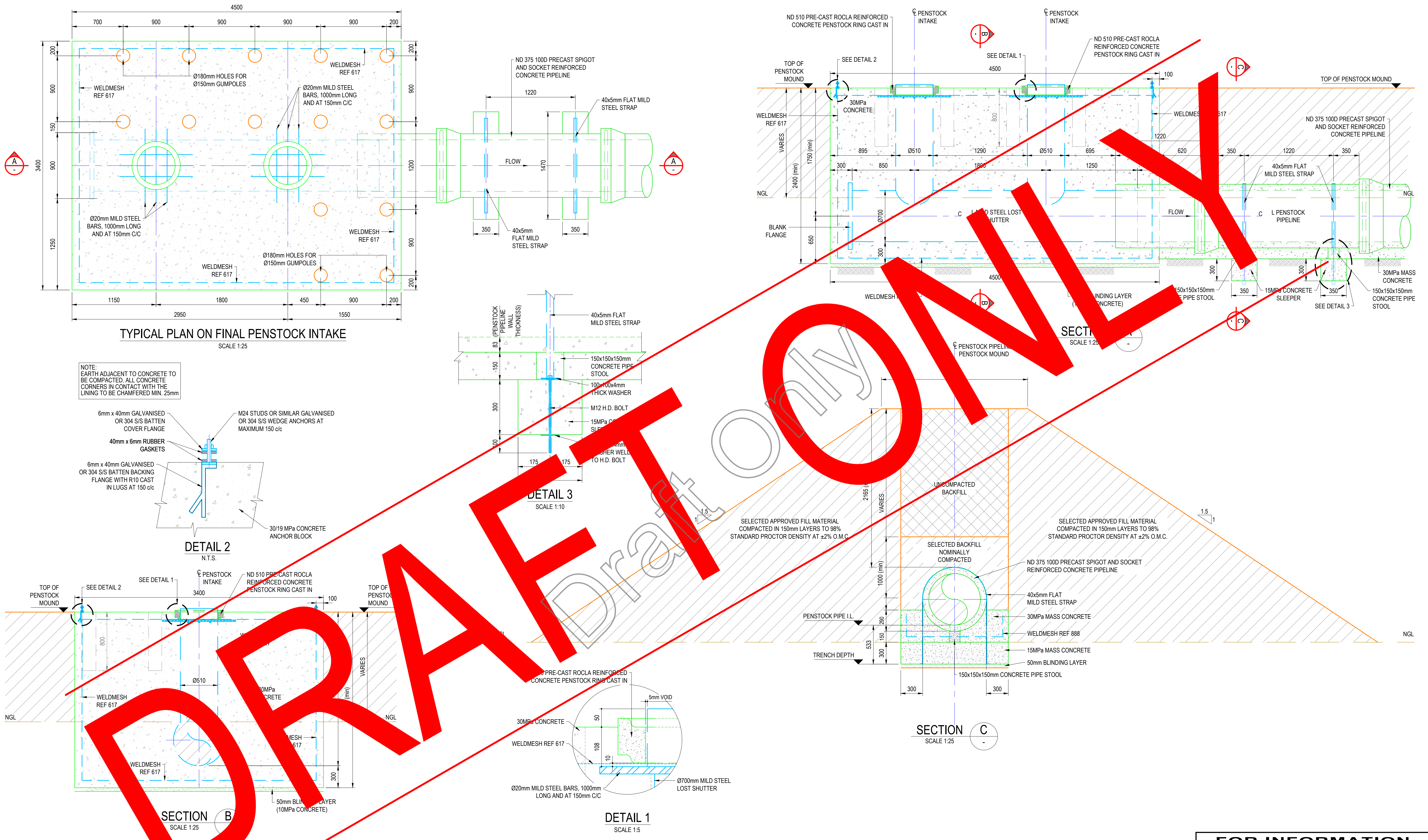
SCALE: A1 AS SHOWN; A3 AS SHOWN x2

FOR INFORMATION

epoch — mine residue and environmental engineering consultants

TITLE: SAFTA COPPER PFS TAILINGS STORAGE FACILITY TYPICAL DRAINAGE CROSS SECTIONS

DRG No. 000-224-902 REV. A



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SCALE: A1 AS SHOWN; A3 AS SHOWN x2

REV. A — MADE L.S. — DATE 30-05-18

epoch
mine residue and environmental engineering consultants

TITLE
SAFTA COPPER PFS
TAILINGS STORAGE FACILITY
FINAL PENSTOCK INTAKE
TYPICAL DETAILS

DRG No. 000-224-903
REV. A

DRAWING No.	DRAWING TITLE
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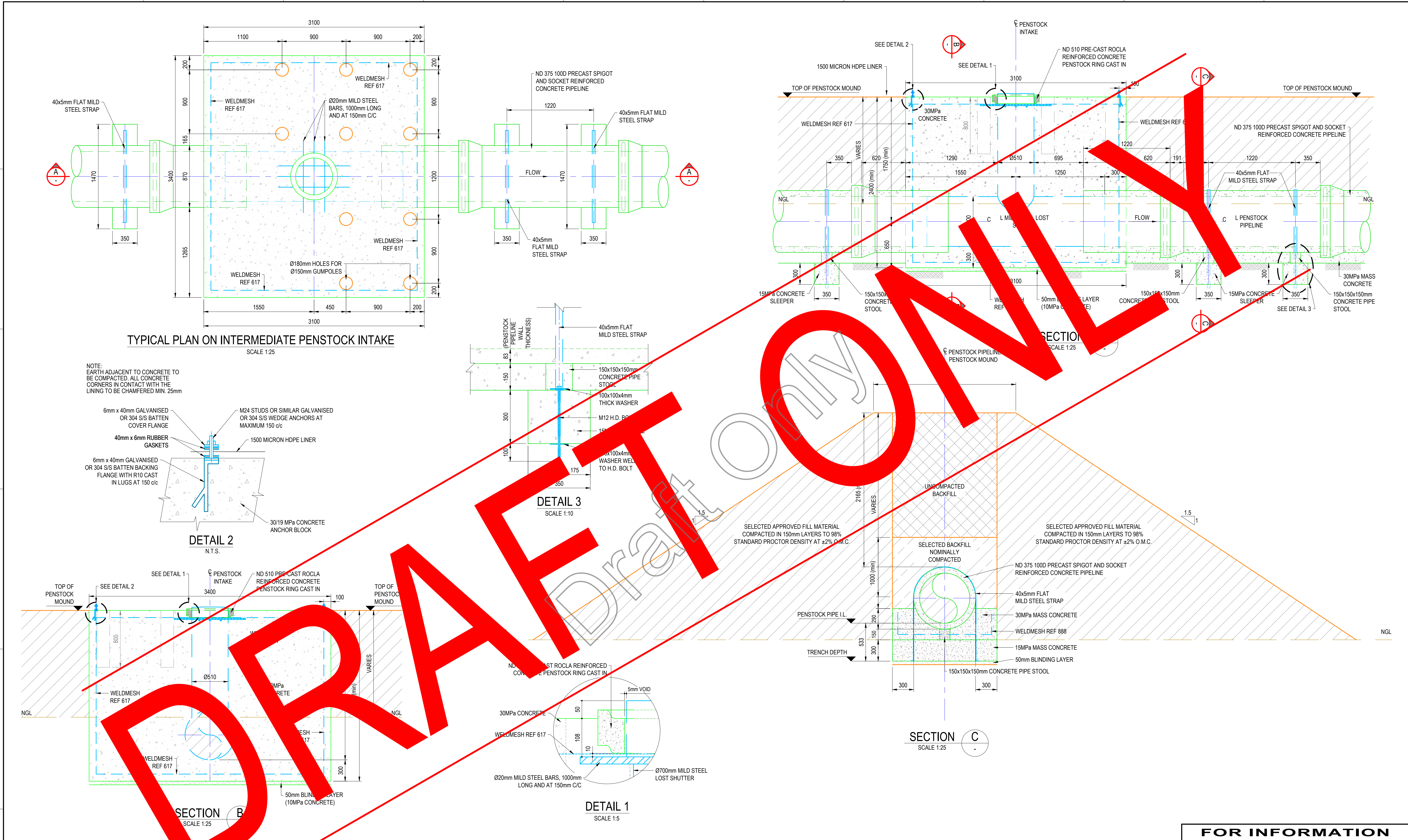

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APPROVED (CLIENT)	
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CO-ORD SYSTEM: Lo17 HARTEBEESHOEK94
SCALE: A1 AS SHOWN; A3 AS SHOWN x2

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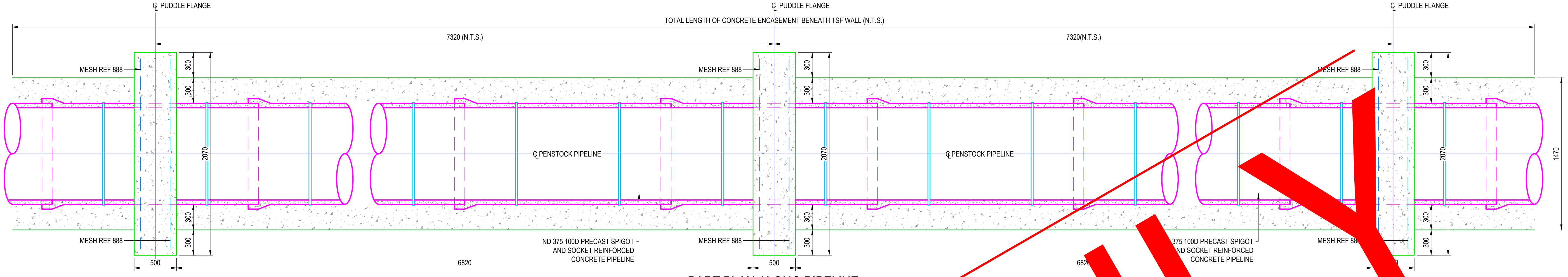
TITLE
SAFTA COPPER PFS
TAILINGS STORAGE FACILITY
INTERMEDIATE PENSTOCK INTAKE
TYPICAL DETAILS

DRG No. 000-224-904
REV. A

A1

PART PLAN ALONG PIPELINE

NOT TO SCALE



TYPICAL LONGITUDINAL SECTION THROUGH PIPEWORK

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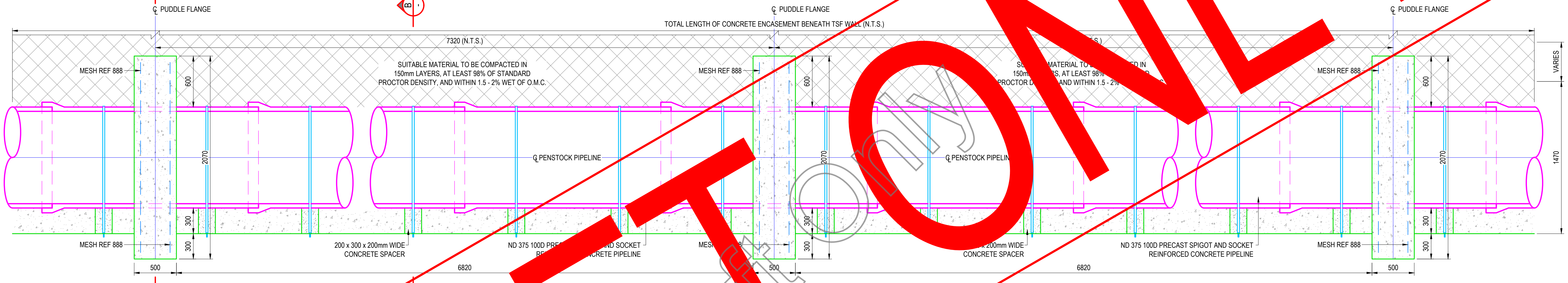

SECTION B

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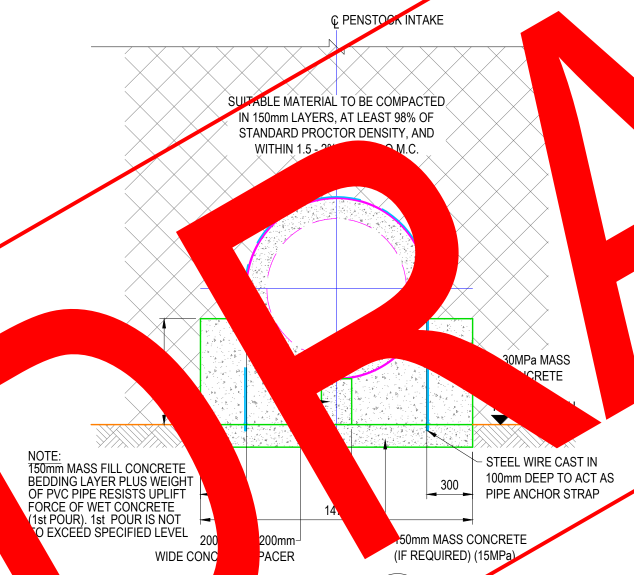

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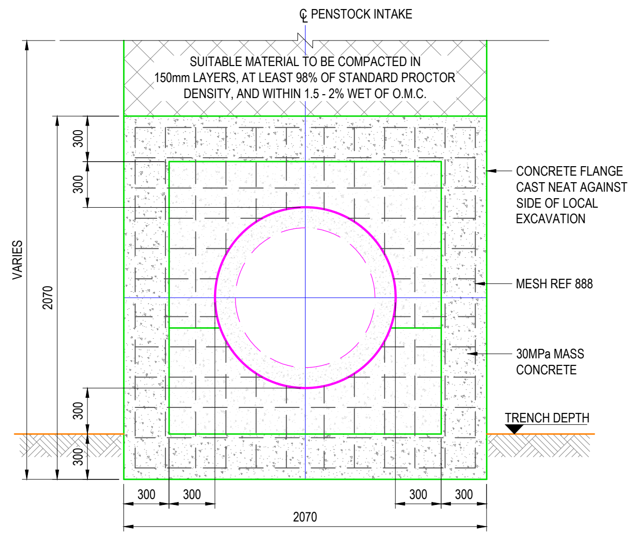

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C	MADE / APPD	DATE / DATE
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A	MADE L.S. / APPD	DATE 30-05-18 / DATE

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CONSTRUCTION ☐
APPROVAL ☐
COMMENT ☐
PRICING ☐
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FOR INFORMATION

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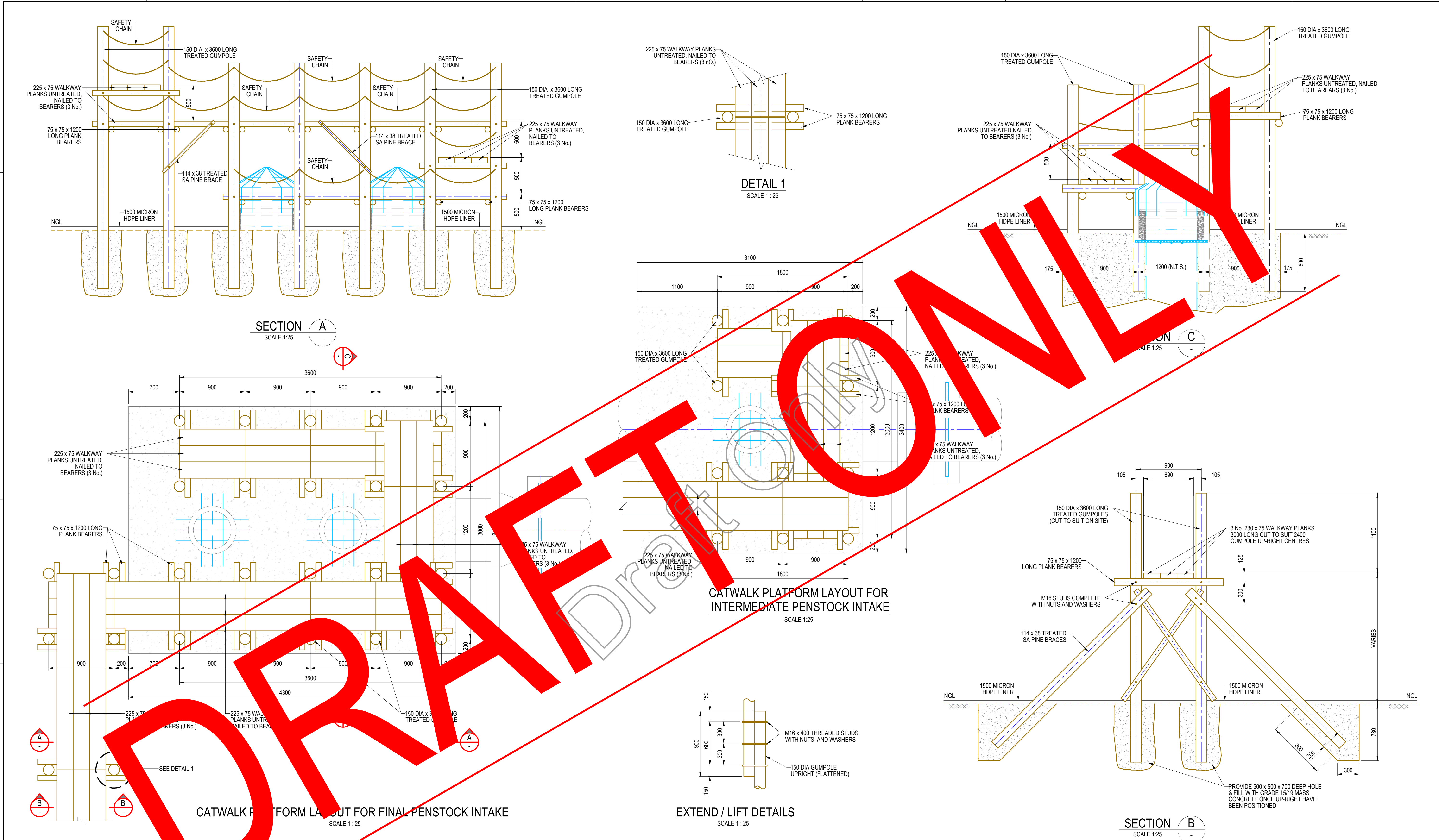
TITLE
SAFTA COPPER PFS
TAILINGS STORAGE FACILITY
PENSTOCK PIPELINE THROUGH STARTER WALL
TYPICAL DETAILS

DRG No. 000-224-905
REV. A

A1



FOR INFORMATION

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MANUFACTURE ☐
CONSTRUCTION ☐
APPROVAL ☐
COMMENT ☐
PRICING ☐
INFORMATION ☒
DATE:
SIGNED:

CO-ORD SYSTEM: Lo17 HARTTEBEESHOEK94

SCALE	
A1	AS SHOWN
A3	AS SHOWN x2

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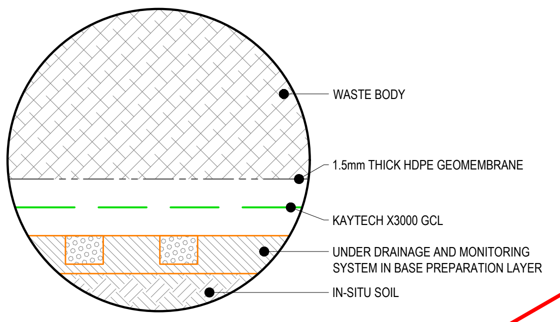
TITLE
SAFTA COPPER PFS
TAILINGS STORAGE FACILITY
TYPICAL PENSTOCK CATWALK DETAILS

DRG No. 000-224-906 REV. A

DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

NOTE:
LINER SYSTEM TO BE
INSTALLED ONLY IF REQUIRED.



CLASS C LINER DETAILS
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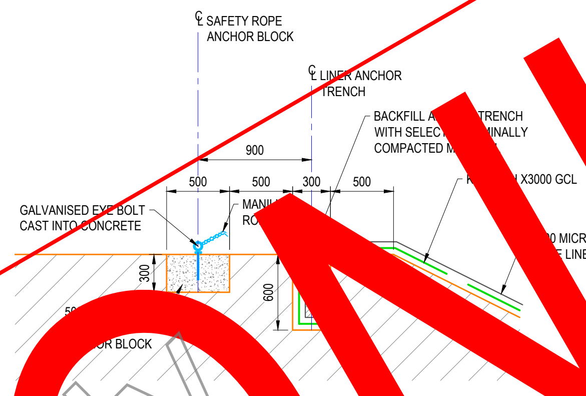
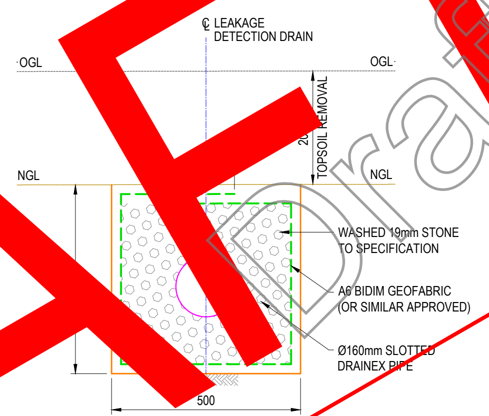


LINER ANCHOR TRENCH DETAIL



TYPICAL LEAKAGE
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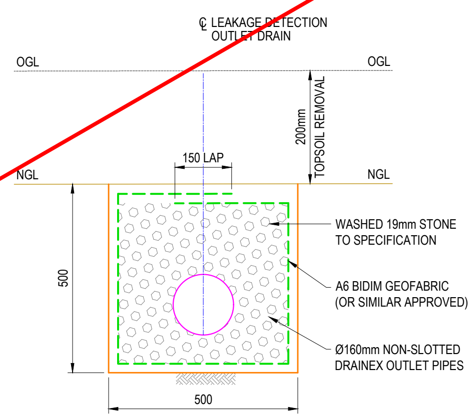

TYPICAL LEAKAGE DETECTION
OUTLET DRAINS DETAIL
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DRAWING No.	DRAWING TITLE
	REFERENCE DRAWINGS

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1				
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MANUFACTURE ☐
CONSTRUCTION ☐
APPROVAL ☐
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PRICING ☐
INFORMATION ☒
DATE:
SIGNED:

DRAWN	L. STEINHOBEL
DATE	MAY 2018
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DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	

CO-ORD SYSTEM: Lo17 HARTTEBEESHOEK94

SCALE	
A1	AS SHOWN
A3	AS SHOWN x2

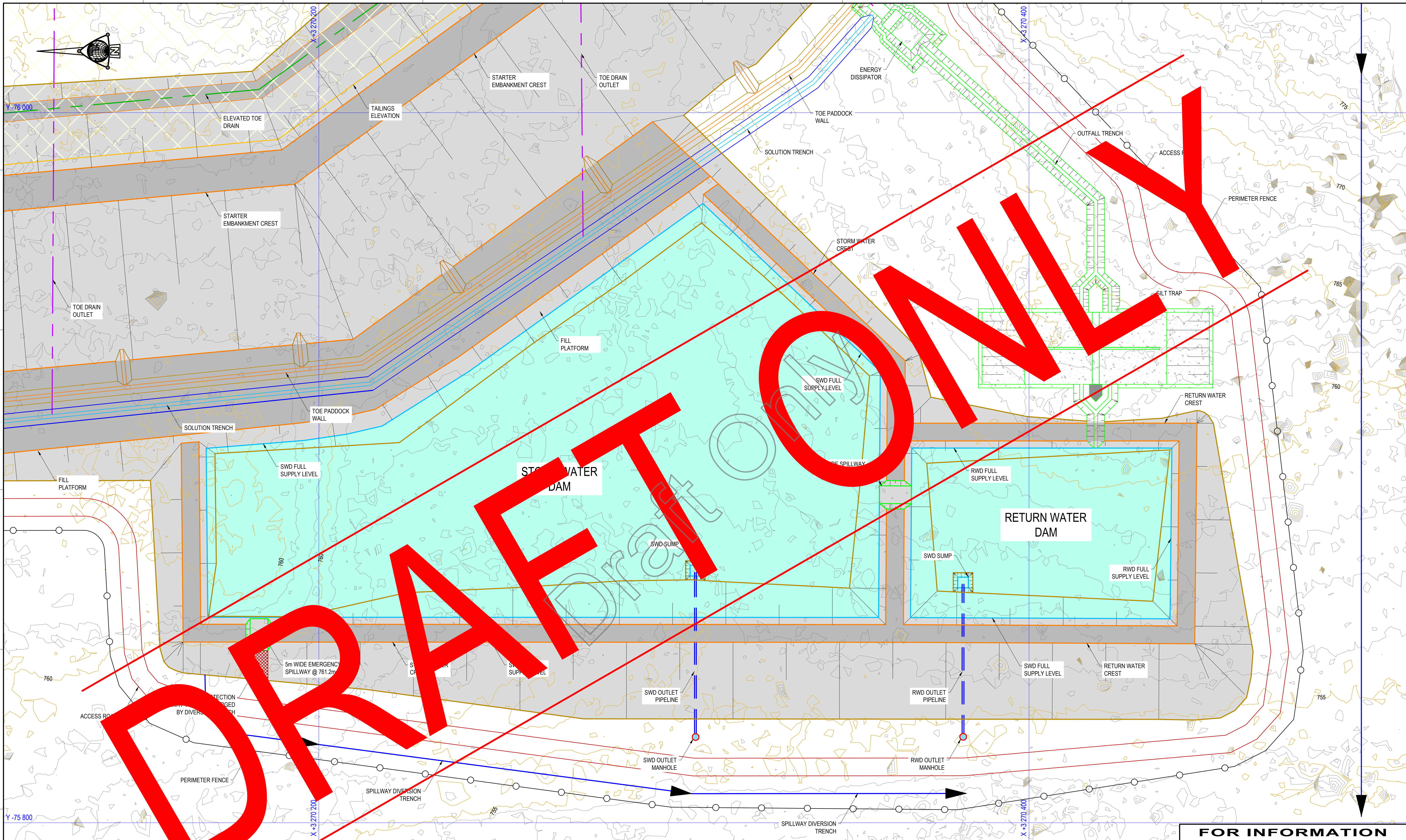
FOR INFORMATION

epoch resources (pty) ltd
mine residue and environmental engineering consultants

TITLE
SAFTA COPPER PFS
TAILINGS STORAGE FACILITY
LINER DETAILS

DRG No. 000-224-907
REV. A

A1



3	MADE / APPD	DATE / DATE	2	MADE / APPD	DATE / DATE	1	MADE / APPD	DATE / DATE	0	MADE / APPD
C	MADE / APPD	DATE / DATE	B	MADE / APPD	DATE / DATE	A	MADE L.S. / APPD	DATE 30-05-18 / DATE	ISSUED FOR INFORMATION	

DRAWING No.	DRAWING TITLE
	REFERENCE DRAWINGS

This drawing is confidential and the property of Epoch Resources (PTY)Limited and is not to be communicated to any third party nor must it be used except in relation to the contract in connection with which it has been supplied.

PROFESSIONAL REGISTRATION
NAME:
PR.ENG.No.
DATE:
SIGNED:

ISSUED FOR:
MANUFACTURE ☐
CONSTRUCTION ☐
APPROVAL ☐
COMMENT ☐
PRICING ☐
INFORMATION ☒
DATE:
SIGNED:

DRAWN	L. STEINHOBEL
DATE	MAY 2018
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	

CO-ORD SYSTEM	SCALE	
Lo17 HARTEBEESHOEK94	A1	AS SHOWN
	A3	AS SHOWN x2

FOR INFORMATION

epoch

mine residue and environmental engineering consultants

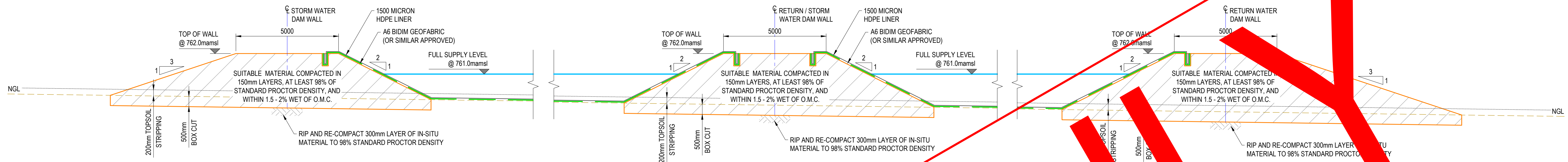
TITLE

SAFTA COPPER PFS
RETURN AND STORM WATER DAM
GENERAL ARRANGEMENT

DRG No. 000-224-908

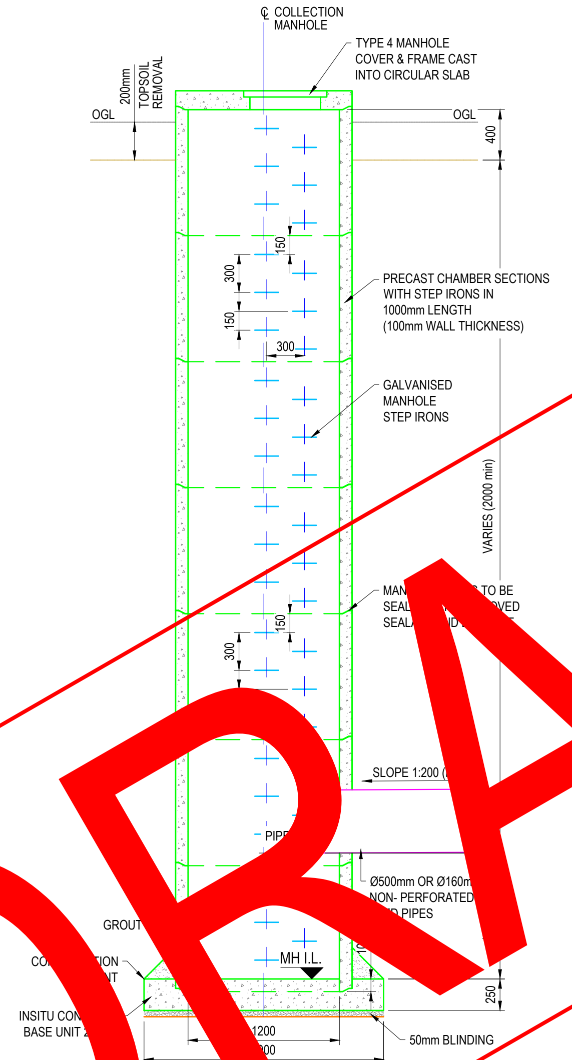
REV. A

A1



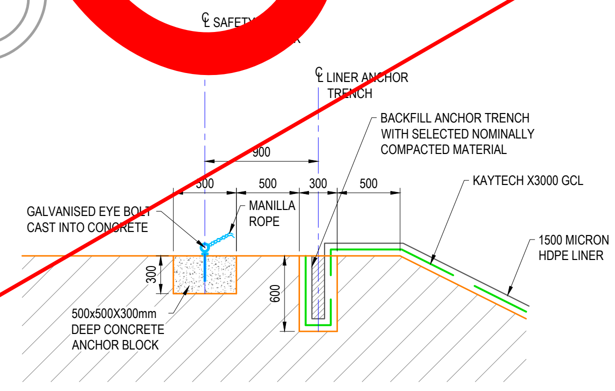
TYPICAL SECTION THROUGH RETURN AND STORM WATER DAM EMBANKMENT

SCALE 1:100



TYPICAL MANHOLE DETAIL

SCALE 1:30



LINER ANCHOR TRENCH DETAIL

SCALE 1:30

FOR INFORMATION

DRAWING No.	DRAWING TITLE
	REFERENCE DRAWINGS

REV	MADE	DATE	APPD	DATE
A	L.S.	30-05-18		

ISSUED FOR INFORMATION

DRAWN	L. STEINHOBEL
DATE	MAY 2018
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	

PROFESSIONAL REGISTRATION

NAME:

PR.ENG.No.

DATE:

SIGNED:

ISSUED FOR: MANUFACTURE ☐ CONSTRUCTION ☐ APPROVAL ☐ COMMENT ☐ PRICING ☐ INFORMATION ☒

DATE:

SIGNED:

CO-ORD SYSTEM: Lo17 HARTTEBEESHOEK94

SCALE: A1 AS SHOWN; A3 AS SHOWN x2

epoch

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TITLE

SAFTA COPPER PFS
RETURN AND STORM WATER DAMS
TYPICAL CROSS SECTIONS

DRG No. 000-224-908

REV. A

A1

Appendix 3 – Bill of Quantities

SAFTA MINE RESIDUE DISPOSAL FACILITY

ENERGY DISSIPATOR AND SILT TRAP

INFORMATION ONLY

SCHEDULE C2: EARTHWORKS AND EXCAVATIONS

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
C2	**EARTHWORKS AND EXCAVATIONS**				
C2 1	*Restricted excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by the Engineer within a 2 km free haul distance (rate to to allow for, sourcing, excavation, loading, shoring, cutting back, dewatering, shaping, trimming, etc.).*				
C2 1.1	Energy dissipator	m^3	50	37.75	1 887.50
C2 1.2	Silt trap & Canal	m^3	75	37.75	2 831.25
C2 2	*Base preparation of insitu material (Rip and recompacted 300mm deep or as specified by the Engineer) to under side of:*				
C2 2.1	Energy dissipator	m^2	113	29.66	3 336.75
C2 2.2	Silt trap & Canal	m^2	256	29.66	7 592.96
	TOTAL CARRIED TO SUMMARY				**15 648.46**

SAFTA MINE RESIDUE DISPOSAL FACILITY

ENERGY DISSIPATOR AND SILT TRAP
INFORMATION ONLY

SCHEDULE D2: CONCRETE STRUCTURES

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
D2	**CONCRETE STRUCTURES**				
D2 1	*Formwork*				
D2 1.1	*Rough shuttering to:*				
D2 1.1.1	Energy dissipator	m^2	115	403.64	46 418.60
D2 1.1.2	Silt trap & Canal	m^2	305	403.64	123 110.20
D2 2	*30MPa/19mm, concrete to:*				
D2 2.1	Energy dissipator	m^3	50	1744.44	87 222.00
D2 2.2	Silt trap & Canal	m^3	173	1744.44	301 788.12
D2 3	*Surface finish with wood float to:*				
D2 3.1	Energy dissipator	m^2	113	12.46	1 401.75
D2 3.2	Silt trap & Canal	m^2	481	12.46	5 987.03
D2 4	*Supply and install mesh REF 888 to:*				
D2 4.1	Energy dissipator	tonne	8	15 523.04	121 855.86
D2 4.2	Silt trap & Canal	tonne	27	15 523.04	421 621.29
D2 5	*Blinding layer 50mm thick Class 10MPa/19mm concrete to:*				
D2 5.1	Energy dissipator	m^2	150	127.34	19 101.00
D2 5.2	Silt trap & canal	m^2	245	127.34	31 198.30
	TOTAL CARRIED TO SUMMARY				**1 159 704.15**

SAFTA MINE RESIDUE DISPOSAL FACILITY

CLASS C LINER (IF REQUIRED)

INFORMATION ONLY

SCHEDULE C4: EARTHWORKS AND EXCAVATIONS -TSF

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
C4					
C4 1	*Base preparation of insitu material (Rip and recompacted 300mm deep or as specified by the Engineer) to under side of:*				
C4 1.1	TSF Basin	m^2	224 063	8.02	1 796 985.26
C4 2	*Restricted excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by the Engineer within a 2 km free haul distance (rate to allow for, sourcing, excavation, loading, shoring, cutting back, dewatering, shaping, trimming, etc.).*				
C4 2.1	Liner Anchor Trench	m^3	463	37.75	17 463.15
C4 2.2	Leakage Detection Trenches	m^3	550	37.75	20 762.50
C4 2.3	Leakage Detection Outlet Trenches	m^3	125	37.75	4 718.75
C4 3	*Backfill with selected and approved material from approved borrows or excavations and compact as specified. Material to be sourced from Item C1.1 and C1.2 (rate to allow for watering, spreading, levelling, trimming, tie-ing in, forming side slopes, etc.).:*				
C4 3.1	Liner Anchor Trench	m^3	463	73.79	34 135.25
	TOTAL CARRIED TO SUMMARY				**1 814 448.41**

SAFTA MINE RESIDUE DISPOSAL FACILITY

CLASS C LINER (IF REQUIRED)

INFORMATION ONLY

SCHEDULE I4: LINER AND LEAKAGE DETECTION - TDF

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
I4 1	*Specialist contractor to supply all materials, labour and plant including QA testing equipment and install 1500 micron HDPE liner (rate to supply and lay flexible membrane to include for all bonds, welds, and sealings at specified points) to: Rate inc.Geosynthetic clay liner*				
I4 1.1	TSF Basin	m^2	241 417	118.16	28 525 820.90
I4 2	*Supply and install 160mm diameter slotted HDPE Dainex pipes or similar approved*				
I4 2.1	Leakage Detection Trenches	m	2 200	52.69	115 918.00
I4 3	*Supply and install 160mm diameter NON slotted HDPE Dainex pipes or similar approved with joints to SANS standard (including jointing material and fittings) to:*				
I4 3.1	Leakage Detection Outlet Trenches	m	500	52.69	26 345.00
I4 4	*Supply and place washed coarse stone to:*				
I4 4.1	Leakage Detection Trenches	m^3	550	486.77	267 723.50
I4 4.2	Leakage Detection Outlet Trenches	m^3	125	486.77	60 846.25
I4 5	*Supply and install precast concrete manholes to a depth of (including chambers,*				
I4 5.1	Manholes of depth between 3 - 4.5m	No	10	19 470.00	194 700.00
I4 6	*Supply and place precast Type 4 manhole cover, frame and cover slab to drainage*	No	10	2 612.52	26 125.20
	TOTAL CARRIED TO SUMMARY				**29 217 478.85**

SAFTA MINE RESIDUE DISPOSAL FACILITY
RETURN WATER DAM & STORM WATER DAM
INFORMATION ONLY

SCHEDULE C2: EARTHWORKS AND EXCAVATIONS

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
C3	**EARTHWORKS AND EXCAVATIONS**				
C3 1	*Restricted excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by the Engineer within a 2 km free haul distance (rate to allow for, sourcing, excavation, loading, shoring, cutting back, dewatering, shaping, trimming, etc.).*				
C3 1.1	RWD and SWD Outlet pipe to pump station	m^3	60	37.75	2 265.00
C3 1.2	RWD and SWD spillway beams	m^3	300	37.75	11 325.00
C3 1.3	RWD spillway beam from canal	m^3	50	37.75	1 887.50
C3 1.4	RWD and SWD Sumps	m^3	390	37.75	14 722.50
C3 1.5	RWD & SWD HDPE liner anchor trench	m^3	144	37.75	5 436.00
C3 1.6	RWD & SWD Manila rope anchor block	m^3	12	37.75	453.00
C3 1.7	Silt trap spillway beam from canal (into RWD)	m^3	110	37.75	4 152.50
C3 1.8	RWD and SWD Collection Manholes	m^3	32	37.75	1 208.00
C3 2	*Bulk excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by the Engineer within a 2 km free haul distance (rate to allow for, sourcing, excavation, loading, shoring, cutting back, dewatering, shaping, trimming, etc.).*				
C3 2.1	RWD & SWD wall box cut	m^3	12 793	32.48	415 516.64
C3 3	*Extra over Class A material for Class B material and spoil (Rate to include for loading, hauling, and disposing of material as directed by the Engineer within 2km free haul distance):*				
C3 4	*Extra over Item C2.1 & C2.2 for haul distance over and above the 2km free haul.*				
C3 4.1	Overhaul of 0.0 to 0.5km	m^3/km	Rate Only	4.21	
C3 4.2	Overhaul of 0.5 to 1.0km	m^3/km	Rate Only	4.21	
C3 4.3	Overhaul of 1.0 to 1.5km	m^3/km	Rate Only	4.21	
C3 4.4	Overhaul of 1.5 to 2.0km	m^3/km	Rate Only	4.21	
	TOTAL CARRIED FORWARD				**456 966.14**

SAFTA MINE RESIDUE DISPOSAL FACILITY

RETURN WATER DAM & STORM WATER DAM

INFORMATION ONLY

SCHEDULE C2: EARTHWORKS AND EXCAVATIONS (CONTINUED)

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
C3	**EARTHWORKS AND EXCAVATIONS**				
C3 4	*Base preparation of insitu material (Rip and recompacted 300mm deep or as specified by the Engineer) to under side of:*				
C3 4.1	Lined RWD & SWD basin (95% Proctor)	m^2	18 620	8.02	149 332.40
C3 4.2	RWD and SWD Outlet pipe to pump station (98% Proctor)	m^2	150	29.66	4 449.00
C3 4.3	RWD and SWD Box cut	m^2	18 780	29.66	557 014.80
C3 5	*Construct compacted embankment walls and fills with selected and appropriate material from approved borrow pits, excavations, stockpiles and compact to required specifications. Material to be sourced from Item B1 and B2 (rate to allow for watering, spreading, levelling, trimming, tie-ing in, forming side slopes, etc.)*				
C3 5.1	RWD & SWD embankment (incl box cut 98% Proctor)	m^3	59 653	28.42	1 695 338.26
C3 5.2	RWD & SWD embankment (cut 98% Proctor)	m^3	46 860	28.42	1 331 761.20
C3 6	*Backfill with selected and approved material from approved borrows or excavations and compact as specified (rate to allow for watering, spreading, levelling, trimming, tie-ing in, forming side slopes, etc.).:*				
C3 6.1	RWD & SWD anchor trench for HDPE liner	m^3	144	73.79	10 625.76
C3 6.2	RWD and SWD Outlet pipe to pump station (98% Proctor)	m^3	30	73.79	2 213.70
C3 6.3	RWD basin Preparation (if needed)	m^3	740	73.79	54 604.60
	TOTAL CARRIED TO SUMMARY				**3 805 339.72**

SAFTA MINE RESIDUE DISPOSAL FACILITY

RETURN WATER DAM & STORM WATER DAM

INFORMATION ONLY

SCHEDULE D2: LINER AND DRAINAGE

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
D3	**LINER AND DRAINAGE**				
D3 1	*Supply and place A6 Bidim to:*				
D3 1.1	Basin of RWD and SWD secured in liner anchor trench	m^2	20 060	19.48	390 768.80
D3 2	*Specialist contractor to supply all materials, labour and plant including QA testing equipment and install 1500 micron HDPE liner (rate to supply and lay flexible membrane to include for all bonds, welds, and sealings at specified points) to:*				
D3 2.1	Basin of RWD and SWD secured in liner anchor trench	m^2	20 060	52.51	1 053 350.60
D3 4	*Supply and install 300mm diameter HDPE pipes or similar approved with joints to SANS standard (including jointing material and fittings) to:*				
D3 4.1	RWD and SWD Outlet pipe to pump station	m	400	431.88	172 752.00
D3 6	*Supply and install precast concrete manholes to a depth of (including chambers, shafts, adaptor slabs, reducer slabs, benching, connecting of pipes, frames, step irons, sealant and bandage etc.):*				
D3 6.1	Manholes of depth between 3 - 4.5m	No.	2	19 521.92	39 043.84
D3 7	*Supply and place precast Type 4 manhole cover, frame and cover slab to drainage manholes.*				
D3 7.1	RWD and SWD collection manhole	No.	2	2 612.52	5 225.04
	TOTAL CARRIED TO SUMMARY				**1 661 140.28**

SAFTA MINE RESIDUE DISPOSAL FACILITY
RETURN WATER DAM & STORM WATER DAM
INFORMATION ONLY

SCHEDULE E2: CONCRETE STRUCTURES

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
E3	**CONCRETE STRUCTURES**				
E3 1	*Formwork*				
E3 1.1	*Rough Shuttering to:*				
E3 1.1.1	RWD and SWD collection manhole base	m^2	9	403.64	3 632.76
E3 1.1.2	RWD spillway beam from canal	m^2	25	403.64	10 091.00
E3 1.1.3	RWD spillway beam (to SWD)	m^2	60	403.64	24 218.40
E3 1.2	*Wood float finishing to:*				
E3 1.2.1	RWD and SWD collection manhole base	m^2	19	12.46	233.63
E3 1.2.2	RWD spillway beam from canal	m^2	100	12.46	1 246.00
E3 1.2.3	RWD spillway beam (to SWD)	m^2	275	12.46	3 426.50
E3 2	*Blinding layer 50mm thick Class 10MPa/19mm concrete to:*				
E3 2.1	RWD spillway beam from canal	m^2	30	127.34	3 820.20
E3 2.2	RWD spillway beam (to SWD)	m^2	30	127.34	3 820.20
E3 2.4	RWD and SWD Sump	m^2	50	127.34	6 367.00
E3 2.5	RWD and SWD collection manhole base	m^2	30	127.34	3 820.20
E3 3	*30MPa/19mm, concrete to:*				
E3 3.1	RWD spillway beam from canal	m^3	50	1 931.29	96 564.50
E3 3.2	RWD & SWD Manila rope anchor block	m^3	12	1 931.29	23 175.48
	TOTAL CARRIED FORWARD				**180 415.87**

SAFTA MINE RESIDUE DISPOSAL FACILITY

RETURN WATER DAM & STORM WATER DAM

INFORMATION ONLY

SCHEDULE E2: CONCRETE STRUCTURES (Continued)

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
E3	**CONCRETE STRUCTURES**				
E3 4	*Supply and install galvanised eye bolts to concrete block for manila ropes*	No	15	313.88	4 708.20
E3 5	*Steel Reinforcement to:*				
E3 5.2	RWD spillway beam from canal	tonne	8	15 523.04	121 855.86
	TOTAL CARRIED TO SUMMARY				**126 564.06**

SAFTA MINE RESIDUE DISPOSAL FACILITY

TAILINGS DISPOSAL FACILITY
INFORMATION ONLY

SCHEDULE B1: SITE CLEARANCE

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
B1	**SITE CLEARANCE**				
B1 1	*Clear and grub site, including removal of trees up to 1m girth (spoil to be spread neatly within 2 km free haul distance as directed by Engineer):*				
B1 1.1	TSF (inc. Starter Embankment, RWD, SWD, Solution trench, Terraces, Toe Paddocks, Energy dissipators, Silt Trap & Canals)	m^2	365 370	3.93	1 435 904.10
B1 2	*Remove top soil to a maximum depth of 200mm and stockpile within 2 km free haul distance as directed by the Engineer :*				
B1 2.1	TSF (inc. Starter Embankment, RWD, SWD, Solution trench, Terraces, Toe Paddocks, Energy dissipators, Silt Trap & Canals)	m^3	73 074	18.93	1 383 290.82
B1 3	*Extra over Item B1 & B2 for approved haul distance over and above the 2km free haul.*				
B1 3.1	0 - 1 km	$m^{3/}$km	Rate Only	8.43	
B1 3.2	1 - 1.5km	$m^{3/}$km	Rate Only	4.21	
B1 3.3	1.5 - 2 km	$m^{3/}$km	Rate Only	4.21	
B1 3.4	2 - 2.5 km	$m^{3/}$km	Rate Only	4.21	
B1 4	*Extra over Item B1 for trees with a girth greater than 1m*				
B1 4.1	Individual trees	No	Rate Only	1 003.00	
	TOTAL CARRIED TO SUMMARY				**2 819 194.92**

SAFTA MINE RESIDUE DISPOSAL FACILITY

TAILINGS DISPOSAL FACILITY
INFORMATION ONLY

SCHEDULE C1: EARTHWORKS AND EXCAVATIONS

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
C1	**EARTHWORKS AND EXCAVATIONS**				
C1 1	*Restricted excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments and terraces or disposed of as directed by the Engineer within a 2 km free haul distance (rate to allow for, sourcing, excavation, loading, shoring, cutting back, dewatering, shaping, trimming, etc.).*				
C1 1.1	Elevated Toe drain trench below 766.5mamsl	m^3	356	38.00	13 537.50
C1 1.2	NGL Toe drain trenches above 766.5mamsl	m^3	237	38.00	8 990.59
C1 1.3	Blanket Drain Trench	m^3	372	38.00	14 121.00
C1 1.3	Solution trench	m^3	2 347	38.00	89 173.48
C1 1.4	Penstock pipeline	m^3	899	38.00	34 175.68
C1 1.5	Intermediate Penstock intake	m^3	8	38.00	285.00
C1 1.5	Final penstock intake structure	m^3	14	38.00	513.00
C1 1.6	Northern Storm Water Diversion	m^3	792	38.00	30 096.00
C1 1.7	Southern Storm Water Diversion	m^3	4 488	38.00	170 544.00
C1 1.8	Drain Outlets	m^3	454	38.00	17 236.80
C1 1.9	Perimeter Access Road	m^3	3 794	38.00	144 153.00
C1 2	Solution Outfall Trench	m^3	218	38.00	8 265.00
C1 2	*Bulk excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments and terraces or disposed of as directed by the Engineer within a 2 km free haul distance (rate to allow for, sourcing, excavation, loading, shoring, cutting back, dewatering, shaping, trimming, etc.).*				
C1 2.1	Starter Embankment box cut and Key	m^3	26 213	32.00	838 816.00
C1 2.2	Borrow Material	m^3		49.22	
C1 3	*Extra over Class A material for Class B material for cut to spoil (Rate to include for loading, hauling, and disposing of material as directed by the Engineer within 2km free haul distance):*	m^3	Rate Only	117.00	
	Extra over 2km free haul distances for items C1, C2, C3				
	Overhaul of 0km to 0.5km	m^3.km	Rate Only	4.00	
	Overhaul of 0.5km to 1km	m^3.km	Rate Only	4.00	
	Overhaul of 1km to 2km	m^3.km	Rate Only	8.00	
	TOTAL CARRIED FORWARD				**1 369 907.05**

SAFTA MINE RESIDUE DISPOSAL FACILITY

TAILINGS DISPOSAL FACILITY
INFORMATION ONLY

SCHEDULE C1: EARTHWORKS AND EXCAVATIONS (Continued)

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
C1	**EARTHWORKS AND EXCAVATIONS**				
C1 5	*Base preparation of insitu material (Rip and recompacted 300mm deep or as specified by the Engineer) to under side of:*				
C1 5.1	Elevated Toe drain	m^2	2 375	29.66	70 442.50
C1 5.2	NGL Toe drain	m^2	2 629	29.66	77 971.01
C1 5.3	Blanket Drain	m^2	6 606	29.66	195 943.33
C1 5.4	Solution trench	m^2	3 755	18.65	70 024.65
C1 5.5	Penstock Pipeline and Platform	m^2	2 511	29.66	74 482.19
C1 5.6	Intermediate Penstock intake	m^2	8	29.66	222.45
C1 5.7	Final penstock intake structure	m^2	14	26.99	364.37
C1 5.8	Starter Embankment Box Cut	m^2	52 426	8.02	420 456.52
C1 5.10	Drain Outlets	m^2	756	29.66	22 422.96
C1 5.11	Perimeter Access Road	m^2	12 645	18.65	235 829.25
C1 5.12	Solution Outfall Trench	m^2	87	29.66	2 580.42
C1 6	*Construct compacted embankment walls and fills with selected and appropriate material from approved borrow pits, excavations, stockpiles and compact to required specifications. Material to be sourced from Item C1 and C2 and C3 (rate to allow for watering, spreading, levelling, trimming, tie-ing in, forming side slopes, etc.).*				
C1 6.1	Starter Embankment (98% mod. proctor)	m^3	314 288	26.54	8 341 203.52
C1 6.2	Starter Embankment box cut (98% mod. proctor)	m^3	26 213	25.04	656 373.52
C1 6.3	Elevated Toe drain Platform and Bund Wall (98% mod. proctor)	m^3	2 724	30.60	83 358.23
C1 6.4	NGL Toe drain bund wall (98% mod. proctor)	m^3	754	30.60	23 086.88
C1 6.4	Decant pool wall (98% mod. proctor)	m^3	2 000	30.60	61 200.00
C1 6.5	Catchment paddock perimeter wall (98% mod. proctor)	m^3	1 913	30.60	58 522.50
C1 6.6	Catchment paddock cross walls (98% mod. proctor)	m^3	935	30.60	28 611.15
C1 6.7	Starter Embankment wearing coarse (98% mod. proctor)	m^3	1 157	30.60	35 415.21
C1 6.8	Blanket Drain Bund Walls (98% mod. proctor)	m^3	2 370	30.60	72 522.49
C1 6.9	Perimeter Access Road (98% mod. proctor)	m^3	3 794	30.60	116 081.10
C1 6.10	Solution Trench Elevated Platform to 763 (98% mod. proctor)	m^3	2 891	30.60	88 468.43
C1 6.11	Penstock Elevated Platform (98% mod. proctor)	m^3	2 891	30.60	88 468.43
C1 6.12	Solution Trench Elevated Platform (98% mod. proctor)	m^3	14 590	25.04	365 333.60
	TOTAL CARRIED TO SUMMARY				**11 189 384.69**

SAFTA MINE RESIDUE DISPOSAL FACILITY

TAILINGS DISPOSAL FACILITY
INFORMATION ONLY

SCHEDULE D1: DRAINAGE

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
D1	**DRAINAGE**				
D1 1	*Supply and place A4 Bidim to:*				
D1 1.1	Penstock pipeline	m^2	254	12.05	
D1 2	*Supply and place A6 Bidim to:*				
D1 2.1	Elevated Toe Drain	m^2	4 361	19.48	84 958.27
D1 2.2	NGL Toe Drain	m^2	4 827	19.48	94 038.14
D1 2.3	Blanket Drain	m^2	7 582	19.48	147 700.31
D1 2.4	Drain Outlets	m^2	1 058	19.48	20 617.63
D1 3	*Supply and place washed filter sand to specification to form:*				
D1 3.1	Elevated Toe Drain	m^3	576	465.53	268 145.28
D1 3.2	NGL Toe Drain	m^2	402	465.53	187 241.07
D1 3.3	Blanket Drain	m^2	632	465.53	294 088.79
D1 4	*Supply and place washed intermediate stone to specification to form:*				
D1 4.1	Elevated Toe Drain	m^3	143	486.77	69 364.73
D1 4.2	NGL Toe Drain	m^2	158	486.77	76 778.05
D1 4.3	Blanket Drain	m^2	248	486.77	120 590.87
D1 5	*Supply and place washed coarse stone to specification to form:*				
D1 5.1	Elevated Toe Drain	m^3	214	486.77	104 047.09
D1 5.2	NGL Toe Drain	m^2	237	486.77	115 167.07
D1 5.3	Blanket Drain	m^2	372	486.77	180 886.30
D1 5.4	Drain Outlets	m^2	454	486.77	220 798.87
D1 7	*Supply and install 160mm diameter slotted HDPE Dainex pipes or similar approved with joints to SANS standard (including jointing material and fittings) to:*				
D1 7.1	Elevated Toe Drain	m	982	52.69	51 741.58
D1 7.2	NGL Toe Drain	m	956	52.69	50 371.64
D1 7.3	Blanket Drain	m	1 200	52.69	63 228.00
D1 8	*Supply and install 160mm diameter NON slotted HDPE Dainex pipes or similar approved with joints to SANS standard (including jointing material and fittings) to:*				
D1 8.1	Drain Outlets trenches to solution trench	m	1 608	52.69	84 725.52
D1 9	*Extra over items D7.1, D8.1 for bends, junctions, tees, makeup pieces and specials*	%	10%	250 066.74	25 006.67
	TOTAL CARRIED TO SUMMARY				**2 259 495.87**

SAFTA MINE RESIDUE DISPOSAL FACILITY

TAILINGS DISPOSAL FACILITY
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SCHEDULE E1: CONCRETE STRUCTURES

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
E1	**CONCRETE STRUCTURES**				
E1 1	*Formwork*				
E1 1.1	*Rough shuttering to:*				
E1 1.1.1	Intermediate penstock intake structures	m^2	20	403.64	8 072.80
E1 1.1.2	Final penstock intake structure	m^2	40	403.64	16 145.60
E1 1.1.3	Penstock pipeline puddle flanges	m^2	83	403.64	33 502.12
E1 1.1.4	Solution Outfall Trench	m^2	314	403.64	126 616.70
E1 2	*Blinding layer 50 mm thick Class 10MPa/19mm concrete to:*				
E1 2.1	Intermediate penstock single intake structure	m^2	4	127.34	509.36
E1 2.2	Final penstock intake structure	m^2	10	127.34	1 273.40
E1 3	*30MPa/19mm, concrete to:*				
E1 3.1	Intermediate penstock intake structures	m^3	6	1 931.29	11 587.74
E1 3.2	Final penstock intake structure	m^3	18	1 931.29	34 763.22
E1 3.3	Penstock pipeline half encasement	m^3	90	1 931.29	173 816.10
E1 3.4	Penstock pipeline puddle flanges	m^3	15	1 931.29	28 969.35
E1 3.5	Solution Outfall Trench	m^3	90	1 744.44	156 816.43
E1 4	*Surface finish with wood float to:*				
E1 4.1	Intermediate penstock intake structures	m^2	2	12.46	28.04
E1 4.2	Final penstock intake structure	m^2	9	12.46	112.14
E1 4.3	Penstock pipeline half encasement	m^2	188	12.46	2 336.25
E1 4.5	Penstock pipeline puddle flanges	m^2	8	12.46	102.80
E1 4.6	Solution Outfall Trench	m^2	1 199	12.46	14 934.56
	TOTAL CARRIED FORWARD				**609 586.60**

SAFTA MINE RESIDUE DISPOSAL FACILITY

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SCHEDULE E1: CONCRETE STRUCTURES (Continued)

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
E1	**CONCRETE STRUCTURES**				
E1 5	*Cast in items:*				
E1 5.1	Supply and cast in 510 DN dia Rocla cement penstock rings to specification for intermediate and main penstock intake structures	No.	5	630.00	3 150.00
E1 5.2	Lost shutters to intermediate intake structures (including all cast in items)	No.	1	13 000.00	13 000.00
E1 5.3	Lost shutters to final intake structures (including all cast in items)	No.	1	26 000.00	26 000.00
E1 7	*Supply and install mesh REF 888 to:*				
E1 7.1	Intermediate penstock intake structures	tonne	1.5	15 523.40	23 285.10
E1 7.2	Final penstock intake structure	tonne	3.0	15 523.40	46 570.20
E1 7.3	Penstock pipeline half encasement	tonne	15	15 523.40	232 851.00
E1 7.4	Penstock pipeline puddle flanges	tonne	2.5	15 523.40	38 808.50
E1 7.5	Solution Outfall Trench	tonne	14.1	15 523.40	219 089.74
	TOTAL CARRIED FORWARD				**602 754.54**

SAFTA MINE RESIDUE DISPOSAL FACILITY

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SCHEDULE F1: PIPE WORK

Item	Description	Unit	Quantity	Rate	Amount (ZAR)
F1	**PIPE WORK**				
F1 1	*Supply and install 375 ND class 100 D spigot and socket reinforced concrete pipeline in 2.44 m standard lengths (rate to include for testing and rubber seals).*	m	292	865.00	252 580.00
F1 2	*Supply and Install 120 DN PE 80 SDR 11 PN 12.5 HDPE slurry delivery pipeline to SANS ISO 4427, flanged at both ends in 12m standard lengths (rate to include for bolts, nuts, washers, gaskets and testing, backing and bolts) Flanges to SANS 1123:2007 T 1600/3.*	m	100	196.00	19 600.00
F1 3	*Supply and Install 120 DN PE 80 SDR 11 PN 12.5 HDPE slurry delivery pipeline to SANS ISO 4427 with flanged spigot outlets at 3 x 50 DN at 3m centres, flanged at both ends in 12m standard lengths (rate to include for bolts, nuts, washers, gaskets and testing, backing and bolts) Flanges to SANS 1123:2007 T 1600/3.*	m	1 000	236.00	236 000.00
F1 4	*Supply and install spigot blank flanges (50 DN) to spigot pipeline including backing and bolts*	No	334	231.00	77 231.00
F1 5	*Supply and install slurry delivery pipeline blank flanges (120 DN) to spigot pipeline including backing and bolts*	No	10	399.00	3 990.00
F1 6	*Extra over items F1.2, F1.3 for bends, junctions, tees, makeup pieces and specials*	%	30%	508 180.00	152 454.00
	TOTAL CARRIED TO SUMMARY				**741 855.00**

SAFTA MINE RESIDUE DISPOSAL FACILITY

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SCHEDULE G1: CATWALK

Item	Description	Unit	Quantity		Amount (ZAR)
G1	**CATWALK**				
G1 1	*Supply and install as per drawing including all excavations, concrete, uprights bearers, planking, bracing, stay bolts, nails, and safety ropes to:*				
G1 1.1	Catwalk walkways (complete with bracing, including bolts, nuts and washers) as per details	m	200	2 950.00	590 000.00
G1 1.2	Intermediate intake platform	No	1	7 080.00	7 080.00
G1 1.3	Final Intake platform	No	1	7 080.00	7 080.00
	TOTAL CARRIED TO SUMMARY				**604 160.00**

SAFTA MINE RESIDUE DISPOSAL FACILITY

TAILINGS DISPOSAL FACILITY
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SCHEDULE H1: MISCELLANEOUS

Item	Description	Unit	Quantity		Amount (ZAR)
H1	**MISCELLANEOUS**				
H1 1	*Supply and install complete a 1.2m high double stranded barbed wire fence with 6 straining wires (Rate to include all excavations, concrete bases, galvanised corners, bracing posts, stays and Y section bitumen coated intermediate posts and painted etc.) to:*				
H1 1.1	Perimeter of TSF	m	2 625	41.30	108 412.50
H1 2	*Supply and install galvanised mild steel pedestrian access gate (Rate to include all excavations, concrete, posts etc.) to:*				
H1 2.1	TSF area	No	2	7 670.00	15 340.00
H1 3	*Supply and install galvanised mild steel 6m access gate (Rate to include all excavations, concrete, posts etc.) to:*				
H1 3.1	TSF Area	No	2	12 390.00	24 780.00
	TOTAL CARRIED TO SUMMARY				**148 532.50**