

Closure Cost Assessment for Tronox Namakwa Sands East OFS Project

Report Prepared for

Tronox Mineral Sands (Pty) Ltd



Report Number 548215/CCA



Report Prepared by



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Disclaimer

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List of Abbreviations

CCA	Closure Cost Assessment
EOFS	East Orange Feldspathic Sand
EMPr	Environmental Management Plan Report
RAS	Red Aeolian Sand
RSF	Residual Storage Facility
SRK	SRK Consulting (South Africa) (Pty) Ltd

1 Objectives and Scope of Report

1.1 Introduction

Tronox Mineral Sands (Pty) (Ltd) (Tronox) mines heavy mineral sands at the existing Namakwa Sands Mine at Brand se Baai, using open-cast strip-mining methods at the East Mine and West Mine, in accordance with approved Environmental Management Programmes (EMPrs) and within an authorised mining area (see Figure 1-1).

The East Mine is currently a shallow mine, where mining of only the top Red Aeolian Sand (RAS) layer occurs. Mined material (sand ore) is processed at the Primary Concentration Plant at the East Mine (PCP East) to produce a heavy mineral concentrate (HMC). Waste products from the PCP East include sand tailings (coarser material) and (finer) residue called fines. Sand tailings are backfilled into the mining void(s), and residue slurry is disposed of in Residue Storage Facilities (RSFs).

Tronox is authorised to also mine and process the deeper Orange Feldspathic Sand (OFS) resource underlying the RAS material at the East Mine (known as the EOFS Project). Tronox will modify the approved residue disposal plan and this entails a single RSF to accommodate all fine residue from the project (as opposed to three smaller RSFs as per the current EOFS Project authorisation), backfilling that will change the topography of the area (shallow deposition area with trucks and deep deposition areas via conveyors (Sand Tailings Facilities (STFs)) and the upgrade of infrastructure.

SRK Consulting (South Africa) Pty Ltd (SRK) has been appointed by Tronox to carry out a Closure Cost Assessment (CCA) for this project, considering all of the project aspects that are unique to the EOFS project as closure provisions for other infrastructure are made in the overall CCA for the Mine site.

1.2 Study area

The study area is depicted in Figure 1-1 and Figure 1-2.

1.3 Objectives

The closure costs calculated in this CCA are for scheduled closure (i.e. closure at life of mine (LOM)) since no new infrastructure proposed for the EOFS project is yet in place. The CCA objectives are to:

- Comply with DMRE standards;
- Follow best practice for key closure cost measures;
- Use realistic quantities that take account of site conditions, and the rates used in the overall mine site CCA (for continuity) to calculate closure costs.

Based on these objectives, the CCA Scope of Work was to:

- Quantify all features, facilities and infrastructure proposed for the EOFS project requiring closure efforts and capture rehabilitation actions needed during closure chronologically;
- Use 3rd party rates that are realistic and representative of the sector, taking cognisance of existing rates used in the overall CCA for the mine site;
- Include additional allowances (as per DMRE guideline) as follows:
 - Preliminary and general (12 %);
 - Engineering and project management for the implementation of closure measures (5%);
 - Contingencies (10%);
 - Management and staff cost (6%).

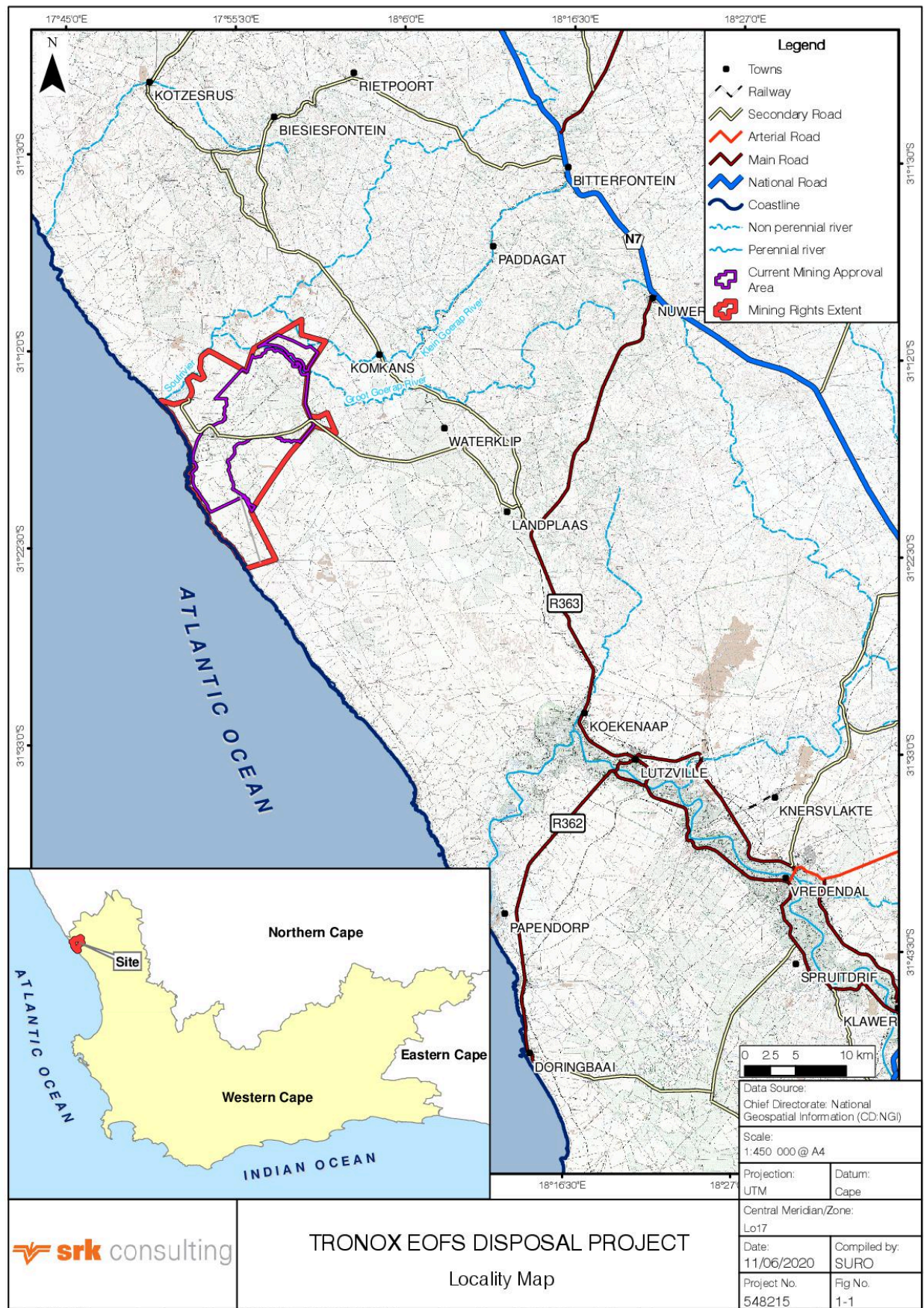


Figure 1-1: Locality map

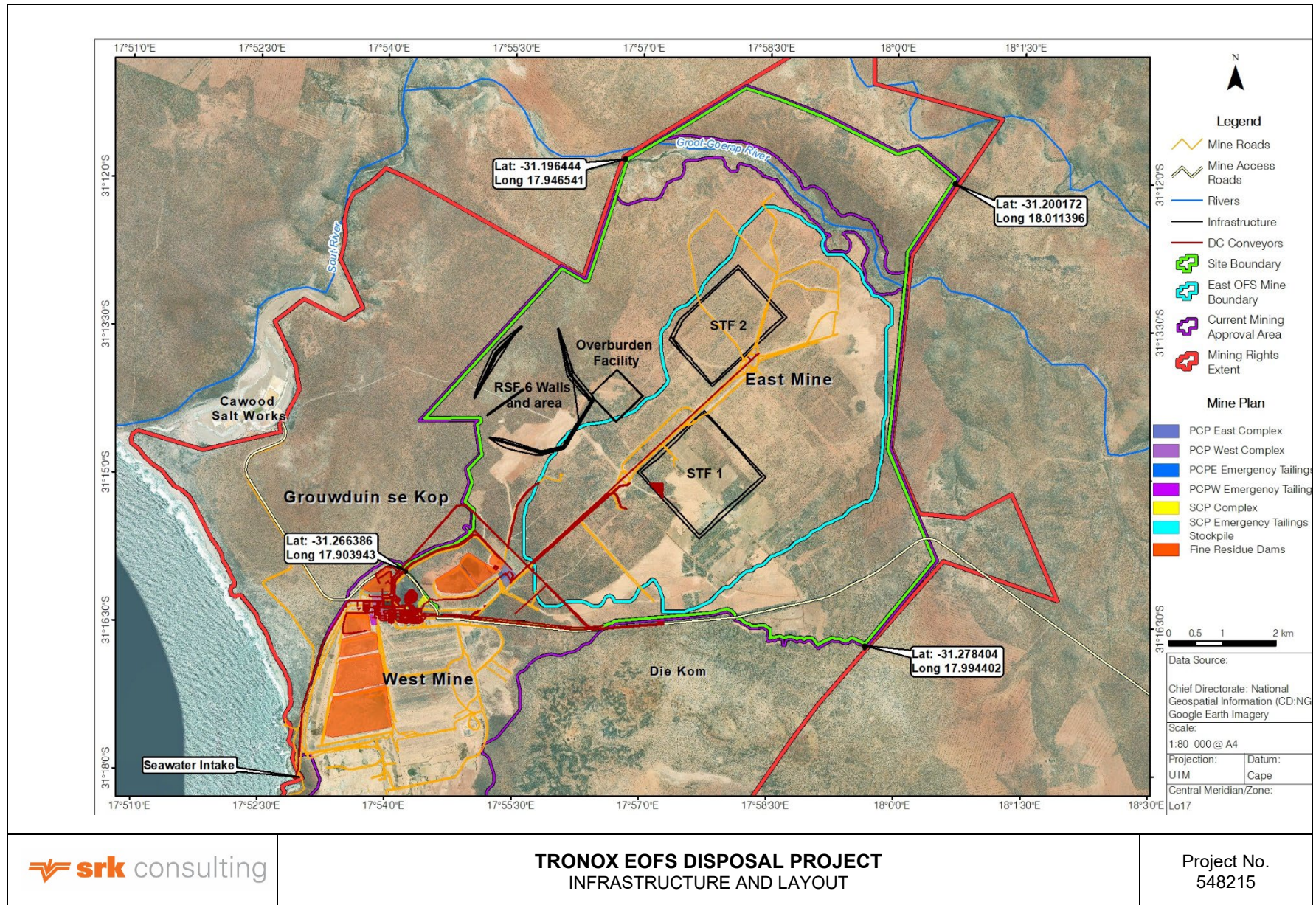


Figure 1-2: Proposed East OFS Infrastructure and Layout

2 Legal and other obligations

2.1 Environmental regulatory requirements

There are a multitude of legal and regulatory frameworks to which Tronox must comply. The following represents the key legislation which could materially affect rehabilitation and closure:

- Constitution of the Republic of South Africa (Act 108 of 1996) (Constitution);
- National Environmental Management Act (Act 107 of 1998);
- National Environmental Management Amendment Act (Act 62 of 2008) (NEMA);
- National Environmental Management Act: Regulations pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GNR 1147) which replaces the Mineral and Petroleum Resources Development Act (Act 68 of 2002) (MPRDA) – closure and financial provision elements repealed;
- Environmental Impacts Assessment Regulations 2014, as amended in 2017;
- Mineral and Petroleum Resources Development Act (Act 68 of 2002) (MPRDA) as it pertains to the social and labour plan;
- National Environmental Management: Waste Act (59 of 2008) and supporting regulations;
- Waste Classification and Management Regulations;
- National Environmental Management: Air Quality Act (Act 39 of 2004);
- National Environmental Management: Biodiversity Act (Act 10 of 2004);
- National Environmental Management: Protected Areas Act (Act 57 of 2003);
- National Water Act (Act 36 of 1998) (NWA);
- The Nuclear Energy Act (Act 131 of 1999) and National Nuclear Regulatory Act (Act 47 of 1999);
- The National Radioactive Waste Disposal Institute Act (Act 53 of 2008); and
- Mine Health and Safety Act (Act 29 of 1996).

Table 2-1 provides a brief description of the legislation as it pertains to closure and the implications that Tronox should consider.

Table 2-1: Summary of SA legislation and implications for closure

Legislation	Implications for Closure
The Constitution In terms of Section 24 of the Constitution “Everyone has the right to: <ul style="list-style-type: none"> • An environment that is not harmful to their health or well-being; and • Have the environment protected, for the benefit of present and future generations.” 	Constitutional requirement to ensure that the Plan includes measures that protect the rights of people to an environment that is not harmful to health or well-being post closure.
National Environment Management Act (107 of 1998) Sections 28 (1) and (3) of NEMA set out the duty of care principle, which is applicable to all types of pollution and must be taken into account in considering any aspects of potential environmental degradation. Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.	The measures required in terms of subsection (1) may include measures to: <ul style="list-style-type: none"> • Investigate, assess and evaluate the impact on the environment; • Inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed to avoid causing significant pollution or degradation of the environment; • Cease, modify or control any act, activity or process causing the pollution or degradation; • Contain or prevent the movement of pollutants or the causes of degradation; • Eliminate any source of the pollution or degradation; or • Remedy the effects of the pollution or degradation.
Environmental Impacts Assessment Regulations, 2014 as amended in 2017 These regulations were developed for the preparation, evaluation, submission, processing and consideration of, and decision on, applications for environmental authorisations.	Any new EIAs or BAs for the mine will be required to consider closure during planning and to include a closure plan and closure estimate to support an authorisation application. Environmental Authorisation will be required for closure of the Mine.
National Environment Management: Waste Act (59 of 2008) Part 8 of Chapter 4 of the Act indicates the requirement to identify the status and risk of contaminated sites and provides a legal mechanism for remediation activities to be instigated and controlled.	Contamination resulting from operational activities will require remediation, with the final soil quality meeting requirements as specified in the Acts Regulations.
Waste Classification and Management Regulations The Waste Classification and Management Regulations require that (Chapter 2, 4(2)) all waste generators must ensure that the waste they generate is classified in accordance with SANS 10234 within 180 days of generation and if the waste is to be disposed of to landfill that (Chapter 2 (8)1) (a) the waste is assessed in accordance with the Norms and Standards for Assessment of Waste for Landfill Disposal. Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits The regulations specify design approach and considerations for Residue Stockpiles and Residue Deposit (RSRD), but more importantly specify that these facilities must comply with the Norms and Standards.	The Waste Classification and Management Regulations and the supporting Norms and Standards as well as Regulations regarding the Planning and Management of Residue Deposits and Residue Stockpile do not contain specifications around closure, other than the requirements in Regulations regarding the Planning and Management of Residue Deposits and Residue Stockpile that stockpiles and deposits be closed according to the relevant provisions in the environmental authorisations, an EMPr and any other applicable legislation

Legislation	Implications for Closure
<p>Regulations pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations</p> <p>The purpose of these Regulations is to regulate the determination and making of financial provision as contemplated in the Act for the costs associated with the undertaking of management, rehabilitation and remediation of environmental impacts from prospecting, exploration, mining or production operations through the lifespan of such operations and latent or residual environmental impacts that may become known in the future.</p> <p>The Regulations also include detailed descriptions of the wording required in the documentation to support the provisioning for liability using Bank Guarantees and Trust Funds.</p> <p>Finally, the legislation also provides detailed on the information to be contained in the following plans:</p> <ul style="list-style-type: none"> • Annual rehabilitation plan; • Final rehabilitation, decommissioning and mine closure plan; • Environmental risk assessment report; and • Care and maintenance plan. 	<p>Tronox's CCA for the overall Mine must include:</p> <ul style="list-style-type: none"> • Annual rehabilitation plan; • Final rehabilitation, decommissioning and mine closure plan (of which this CCA forms part); • Environmental risk assessment report; and • Care and maintenance plan.
<p>The National Environment Management: Air Quality Act (39 of 2004)</p> <p>This Act regulates atmospheric pollution and repealed the Atmospheric Pollution Prevention Act. The Act came into full effect on 1 April 2010 and entrusts the Department of Environmental Affairs with the task of preventing pollution and ecological degradation, while at the same time promoting justifiable economic and social development. Metropolitan and District Municipalities are charged with issuing atmospheric emission licenses for certain listed activities. It must be shown that the best practical means are being employed to limit air pollution before these certificates will be issued. Penalties and criminal sanctions are imposed for non-compliance with the National Management: Air Quality Act.</p> <p>On 1 April 2010, the Department of Environmental Affairs established a list of activities, which require atmospheric emission licenses. The Department has published the minimum emission standards resulting from these listed activities. These include the permissible amount, volume, emission rate or concentration of that substance or mixture of substances that may be emitted into the atmosphere and the manner in which measurements of such emissions must be carried out. The consequences of the listing of these activities is that no person may, without a provisional atmospheric emission licence or an atmospheric emission license, conduct an activity listed on the list anywhere in the Republic or listed on the list applicable in a province anywhere in that province.</p>	<p>Other aspects of the NEM:AQA such as monitoring and application of management/mitigation measures may apply during closure.</p>

Legislation	Implications for Closure
<p>The National Environmental Management: Biodiversity Act, (10 of 2004)</p> <p>The Act seeks amongst other things, to manage and conserve biological diversity, to protect certain species and ecosystems, to ensure the sustainable use of biological resources and to promote the fair and equitable sharing of benefits arising from bio-prospecting involving those resources. The NEM:BA includes a Regulation related to the management of threatened and protected species. A similar Regulation is applied to Threatened Ecosystems. NEM:BA has a set of norms and standards for the development of management plans for both species (e.g. Threatened or Migratory Species) and ecosystems (Endangered or Critically Endangered).</p> <p>The National Environmental Management: Protected Areas Act, (57 of 2003)</p> <p>Protected areas such as nature reserves and special nature reserves are declared and managed in terms of this Act. Depending on the nature of the protected area, certain activities (such as mining) may require Ministerial consent or be prohibited outright. The Act also aims to promote the sustainable use of protected areas and the participation of local communities in such areas. In addition, it provides for the continued existence of the South African National Parks.</p>	<p>If relevant species or threatened ecosystems are presence on the mine concession, a management plan must be developed in alignment with these norms and standards.</p>
<p>Mineral and Petroleum Resources Development Act (Act 28 of 2002)</p> <p>The MPRDA makes provision for equitable access to and sustainable development of South Africa's mineral resources. The MPRDA requires that the environmental management principles set out in NEMA shall apply to all mining operations and serves as a guideline for the interpretation, administration and implementation of the environmental requirements of NEMA.</p>	<p>Historically requirements relating to closure planning and provisioning were included in the MPRDA. These have now been replaced by those in the Financial Provision Regulations under NEMA.</p>
<p>MPRDA 2002 Part II Social and Labour Plan</p> <p>The objectives of the social and labour plan are to:</p> <ul style="list-style-type: none"> • Promote employment and advance the social and economic welfare of all South Africans; • Contribute to the transformation of the mining industry; and • Ensure that holders of mining rights contribute towards the socio-economic development of the areas in which they are operating. <p>A social and labour plan lodged with the Regional Manager is valid until a closure certificate has been issued in terms of section 43 of the Act.</p> <p>The contents of a social and labour plan relevant to closure includes:</p> <ul style="list-style-type: none"> • A human resources development programme; and • A local economic development programme; • Processes pertaining to management of downscaling and retrenchment which must include: <ul style="list-style-type: none"> ○ The establishment of the future forum; ○ Mechanisms to save jobs and avoid job losses; 	<p>Provisions for the ongoing implementation of SLP commitments across the three core Social and Labour Action Plan content areas must be included in financial and resourcing commitments.</p>

Legislation	Implications for Closure
<ul style="list-style-type: none"> ○ Mechanisms to provide alternative solutions and procedures for creating job security where job losses cannot be avoided; ○ Mechanisms to ameliorate the social and economic impact on individuals, and ○ Regions and economies where retrenchment or closure of the mine is certain. <p>To provide financially for the implementation of the social and labour plan in terms of the implementation of:</p> <ul style="list-style-type: none"> • The human resource development programme; • The local economic development programmes; and • The processes to manage downscaling and retrenchment. 	
<p>National Water Act (36 of 1998)</p> <p>Section 19 of the NWA sets out the principles for “an owner of land, a person in control of land or a person who occupies or uses land” to:</p> <ul style="list-style-type: none"> • Cease, modify or control any act or process causing pollution; • Comply with any prescribed waste standard or management practice; • Contain or prevent the movement of pollutants; • Eliminate any source of pollution; • Remedy the effects of the pollution; and • Remedy the effects of any disturbance to the bed and banks of a watercourse. <p>It also describes the actions that can be taken by the catchment management agency to enforce the requirements of the NWA.</p>	<p>This places the obligation to mitigate any aspects that cause or have caused pollution as well as to remediate any residual contaminated water at closure.</p>
<p>Mine Health and Safety Act (29 of 1996)</p> <p>This Act deals with the protection of the health and safety of persons in the mining industry but has some implications for environmental issues due to the need for environmental monitoring within mine operations and maintenance of mine residue deposits.</p>	<p>All closure activities will have to be undertaken in a safe manner where the Health and Safety of all workers involved in closure activities is protected.</p>

2.2 Authorisation obligations

These obligations are linked to commitments in the current EMPr and WUL conditions dealing specifically with rehabilitation. These conditions and commitments generally provide a rehabilitation strategy for the operational phase, but commit Tronox to closure ideals.

2.3 South African good practice

Because the post-closure impacts associated with mining operations very often include significant impacts on water resources, the Department of Water and Sanitation (DWS) has a particular interest in the water management aspects associated with mine closure. Recognising the potential mining impact on water, the DWS formerly known as the Department of Water Affairs and Forestry (DWAF) and has since changed to the Department of Human Settlements, Water and Sanitation (DHSWS) – commissioned a series of Best Practice Guidelines (BPG) to assist with aspects of DHSWS's water management hierarchy. Included in this series of guidelines is BPG5: Water Management Aspects for Mine Closure. The principles in the BPG5 that are appropriate and that should be used to formulate the rehabilitation strategy are:

- Management measures at closure should primarily be of a passive nature with minimal long-term maintenance and operating costs;
- The final landform must be sustainable, must be free draining, must minimise erosion and avoid ponding;
- Concurrent rehabilitation must be undertaken in a manner that supports the final closure landform in order to ensure that rehabilitation does not need to be redone at a later stage;
- Land use plan which is directly interlinked with water management issues insofar as water is required to support the intended land use and the land use itself may have an impact on the water resource; and
- Biodiversity plan will consider the establishment of vegetation to limit use of invasive species which may impact on water resources. In addition, the receiving environments water needs will be considered when developing closure strategies.

2.4 Interpretation of legislation for this CCA

As can be seen from Sections 2.1 to 2.3 above, legislation influencing closure is vast and varied. That said, a common thread is that the impacts of the operation on the environment need to be mitigated and the solutions implemented are required to be sustainable within the existing constraints presented by the biophysical environment. In particular, removing significant residual impacts on water resources is critical. It is assumed that residual impacts linked to the EOFs project are inherently mitigated in the design and the overall mine CCA, and no special provisions are made in this CCA.

The Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits (RSRD) require that a risk-based approach must define the closure costs on RSRD. From past experience, SRK notes that:

- The RSF's are containment facilities with containment walls built from coarser tailings material;
- Residues (fines material) are then deposited within the containment facilities, and it is with certainty that these residues have an exceptionally low permeability; retarding water percolation from or through them for considerable time periods;
- The nature of the Tronox fines residues (from past experience of these materials on site) is such that some consolidation of the fines must take place before it is safe to begin placing capping on the slimes – for this reason, it is accurate to assume that capping of the RSF cannot take place during operations, as the RSF fines surface will only be accessible some time after fines residue

deposition has stopped (if left to settle under own weight, the fines residue at this site can take hundreds of years to reach 90% consolidation);

- It is noted that the current commitment to closing RSFs at this site (i.e. capping with tailings and 'whalebacking' the final surface into a free draining landform) may not be practical due to the size of the proposed EOFs RSF – it will, however, be necessary to cap and shape the RSF in such a way that a free draining profile is left in place. This may not take the form of a whalebacked profile, and it may be necessary to control surface water in another way (e.g. conveying runoff to the centre of the capped RSF and gravity feeding this water off the top of the RSF in a dedicated channel). This is deemed a detailed design challenge, and such detail will present a sustainable solution to protecting water resources at this site, but affecting such closure measures will not be possible during operations and therefore the total cost of capping and shaping of this facility must be included in this CCA as these activities will commence at scheduled closure.

It is assumed that the following legal commitments are, or will be, captured in the overall mine CCA, and are therefore not catered for in this specific EOFs CCA:

- Annual rehabilitation plan and associated closure costs;
- Final rehabilitation, decommissioning and mine closure plan and associated closure costs;
- Environmental risk assessment report; and
- Care and maintenance plan and associated closure costs.

In addition, financial provisions are dealt with in the following way:

- Only preliminary and general (12%) and contingencies (10%) are provided for in this CCA;
- Engineering and project management and staff costs are assumed to be catered for in the overall CCA, and no provision is made in this CCA.

3 Closure Principles

This CCA assumes the following activities and/or basic assumptions in deriving the closure costs:

- Closure will return the project area to grazing land as committed to in the EMPr;
- All structures (including buildings, roads, pipelines) considered in this CCA are proposed facilities (earmarked to support the EOFs project) and not existing facilities as these have not been provided for in the overall closure provisions for the mine CCA – these proposed EOFs facilities will be demolished (including foundations) and demolished materials placed in the mine void;
- All proposed ore stockpile areas will contain no materials at scheduled closure as these materials will have been processed – no closure provision is therefore required apart from rehabilitation of the stockpile footprints which is assumed to be catered for in the overall mine CCA;
- Disturbed areas (structure and stockpile footprints) will be rehabilitated by profiling, stabilising with netting and vegetating the disturbed areas and is catered for in the overall mine CCA;
- Backfill of the East mine void (pit) is catered for in the overall mine CCA and/or will be done during operations;
- All 1:5 sloping, vegetation and netting of the outer walls of the residue storage facility (RSF) will be achieved during operations – capping, shaping, vegetating and netting of the top of the RSF can only be done at scheduled closure and has been catered for in this CCA;
- Meeting the general EMP closure commitment of whalebacking the RSF will not be possible due to the size of the proposed EOFs RSF, and some other means of creating a free draining system will be designed – that said, it is reasonable to assume (and this assumption has been made in

the calculation of the closure costs for closing the RSF) that, on average, 1 m of tailings material will be imported onto the top of the RSF (and shaped) at closure;

- It is assumed that maintenance (groundwater monitoring and maintenance of re-vegetated areas) of rehabilitated areas has been catered for in the overall Mine CCA and no provision has been made in this CCA as a result;
- No positive offsets (e.g. positive cash flow from sale of scrap metal) are accommodated in this CCA;
- Closure costs are calculated for LoM closure (scheduled closure) as no EOFs project specific infrastructure has yet been developed.

4 Information Sources

Information sources are listed in Table 4-1.

Table 4-1: Information sources

Information or data	Source
Report 474533:Tronox East OFS Project Closure Cost Assessment (CCA) – Letter Report Revision 1 dated 29 January 2015	SRK
MINE CLOSURE AN UPDATE OF THE QUANTUM OF CLOSURE RELATED FINANCIAL PROVISION FOR 2019 – NORTHERN OPERATIONS: BRAND SE BAAI AND MSP	Environmental Assurance (Pty) Ltd.
Namakwa Sands East OFS Project Feasibility Study (FS) Scope dated February 2020	Tronox
Various drawings linked to the PFS	Tronox
Various email correspondence ex Correen Le Roux	Tronox

5 Closure scope

A CCA was conducted by SRK in 2015 (ref Table 4-1) that included the following closure scope (at the time this was separated into 2 phases):

The following infrastructure/material handling areas were included in the 2015 CCA. It is acknowledged that some minor changes have been made since 2015, but these would contribute to only marginal increases (and decreases) in cost provisions:

- A surfaced satellite earthmoving vehicle workshop and engineering workshop complex, which will include:
 - A lubrication facility, including fresh and dirty (waste) oil storage; and
 - A washing bay.
- Mine offices including:
 - Ablution facilities;
 - Engineering workshop (including spares store, tool store and small oil store);
 - Surfaced general waste collection area; and
 - Bunded diesel tank.
- Mobile Run of Mine (ROM) tip and supporting infrastructure including:
 - A sizer to size oversize material; and
 - A new conveyor from the new ROM tip to the Duel Carry Conveyor (DCC).
- Additional infrastructure and upgrades of existing infrastructure at Primary Concentration Plant East (PCP) East including:

- Upgrade to the feed preparation infrastructure;
 - An additional 35 m thickener;
 - Replacement of the existing flocculent plant with a larger flocculent plant at the new thickener;
 - Upgrade or replacement of existing de-sliming cyclones; and
 - A second Load-Out Station (LOS) fresh tailings stockpile.
- A second mobile ROM tip in the East Mine with its supporting infrastructure, e.g. conveyors;
- Additional conveyors for tailings backfill;
- Two new stockpiles at PCP East, including:
 - A new 17 000 ton capacity ROM stockpile to replace existing 3 000 ton capacity ROM stockpile (2ha);
 - Emergency tailings stockpile(1 ha); and
- Additional or upgraded infrastructure at PCP East, including:
 - Two scrubbers at the new ROM stockpile;
 - An additional 35 m thickener for slimes dewatering;
 - Additional tailing spirals for dewatering; and
 - Small annex building for new spirals.
- Altered Sea Water Supply and Storage Systems:
 - More effective pumps;
 - Enlarged gully and suction cage;
 - Enlargement of the suction cage from 5m² at the surface to a maximum of 10m²;
 - Excavation (by blasting) of the intake gully including:
 - An additional Ø 630 mm below ground pipeline from the sea water intake to the existing sea water dam;
 - New booster pumpstation mid-way between existing booster station and proposed buffer dam;
 - Additional lined sea water buffer dam with a capacity of up to 40 000 m³;
 - New pipeline from the sea water dam to the PCP East,;
 - Raw water dam for PCPE with a capacity of 20 000m³;
 - Associated pumping infrastructure at the proposed new PCP East raw water dam.

This CCA assumes the same infrastructure with the following additions:

- PCPE mill: which is a replica of the PCPW mill;
- PCPE ROM stockpile: The footprint is the same as 2015, but with the addition of a tunnel added at the base;
- RSF: as per the PFS design;
- RSF pipelines: slimes delivery and return water pipelines;
- RSF Powerline: A new line to the RSF;
- Pipeline between PCPE and SCP: Although the scope of this line is considered the same as that considered in 2015.
- Seawater intake: assumed from a quantities perspective to be similar to that catered for in 2015.

Backfilling areas (shallow and deep (STFs)) will be rehabilitated during operations, and therefore do not fall within the scope of this CCA for scheduled closure of the EOFs project. The remaining void at end of LOM will be similar to that already catered for in the existing CCA for the operation.

6 Closure Costing

6.1 Rates used

The unit rates for the implementation of closure measures for this CCA were obtained from:

- Rates sourced from the overall Mine CCA (ref 2019 CCA - Table 4-1).
- Where rates are not obtainable from the existing CCA, they are calculated from first principles (i.e. an assessment of the costs related to plant and labour usage) based on industry-norm labour rates, consumables, fuel costs and plant hire rates – the basic rates used in these calculations are sourced as follows:
 - Plant hire costs – The Contractors Plant Hire Association (<http://www.cpha.co.za/>);
 - Labour costs – SAFCEC (<http://www.safcec.org.za/>).

The resulting rates for closure are contained in the closure schedule in Appendix A.

6.2 Closure activities

The following basic (chronological) actions constitute the closure efforts):

- Demolition of structures:
 - Steel structures are dismantled using plant and small tools by labour teams – no provision is made for any cash recovery on the steel won by demolition;
 - Foundations are demolished and rubble disposed of in the pit, then covered and backfilled by approximately 1 m of material;
 - The footprint will be shaped, vegetated and netted under existing provisions for the mine CCA.
- Closure of RSF:
 - External 1:5 sloping, vegetation and netting is achieved during operations;
 - When the plant is shut off at LOM, a consolidation period is allowed prior to capping and shaping the top surface of the RSF with tailings (average 1 m thick) using small plant capable of accessing the slimes surface;
 - The final surface is vegetated and netted.
- Infrastructure (e.g. conveyors, access roads, pipelines, power lines etc.):
 - Infrastructure is dismantled using plant and small tools by labour teams – no provision is made for any cash recovery on components won by demolition;
 - Foundations are demolished and rubble disposed of in the pit;
 - The footprint will be shaped, vegetated and netted under existing provisions for the mine CCA.
- Stockpile areas:
 - All ROM stockpile material will be processed at closure and the footprint will be shaped, vegetated and netted under existing provisions for the mine CCA .

6.3 Closure costs

Table 6-1 contains a summary of derived closure costs and Appendix A contains a more detailed breakdown of the CCA, indicating rates applied and quantities measured.

Table 6-1: East OFS Project CCA Summary

Item	Description	Decommissioning Cost	Restoration Cost	Total Closure Cost
1	(2015) Phase 1	1 248 391	-	1 248 391
2	(2015) Phase 2	789 089	-	789 089
3	Sea Water Supply and Storage Systems:	1 358 730	145 767	1 504 496
4	RSF	34 536 454	11 460 742	45 997 196
	Sub-total	37 932 663	11 606 509	49 539 172
	Add Prelim and General (12%)	4 551 920	1 392 781	5 944 701
	Sub-total	42 484 583	12 999 290	55 483 873
	Add 10% contingencies	4 248 458	1 299 929	5 548 387
	Total	46 733 041	14 299 219	61 032 260

It is noted that closure of the RSF dominates the closure costs as it is not possible to cap, shape and vegetate the RSF during operations.

7 Conclusions

Based on the above findings, the following conclusions are drawn:

- Tronox are made aware of the extensive legal setting guiding closure, but it is pointed out that this CCA will form part of the overall mine CCA (as an addendum) and for this reason, it is assumed that closure planning needs are contained in the overall mine CCA document;
- This closure costing assessment aims to return the EOFs project area to grazing land as committed to in the EMPr;
- Closure costs are dominated by the need to close the RSF at scheduled closure as access onto the fines residue surface will not be possible prior to this, and closure cannot be incrementally achieved during operations;
- Scheduled closure costs for the EOFs project re estimated to be R61 032 260 including P&G and Contingencies.

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M Law
Principal Environmental Scientist

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practice

Appendix A

Breakdown of Closure Costs

Item	Item Description	Unit	Quantity	Rate	Closure Cost	Remarks / Assumptions
1	(2015) Phase 1					
1.1	Satellite earthmoving vehicle workshop	m ²	760	269.02	204 457	Assumed 10m eaves, Structural steel IBR clad building
1.2	Engineering workshop complex					
1.2.1	Lubrication facility, including fresh and dirty (waste) oil storage	m ²	300	343.62	103 086	Assumed 4m eaves brick structure
1.2.2	Washing bay.	m ³	133	554.74	73 503	Assumed 0.5m thick concrete washing bay
1.3	Mine offices	m ²	100	343.62	34 362	Assumed 4m eaves brick structure
1.3.1	Ablution facilities;	m ²	50	343.62	17 181	Assumed 4m eaves brick structure
1.3.2	Engineering workshop	m ²	760	269.02	204 457	Assumed 10m eaves, Structural steel IBR clad building
1.3.3	Surfaced general waste collection area	m ³	400	554.74	221 897	Assumed 0.5m thick concrete 20m x 20m
1.3.4	Bunded diesel tank.	m ³	132.5	554.74	73 503	Assumed 0.5m thick concrete 10m x 10m
1.3.5	Dispose of rubble in the EOFS pit	m ³	1650	111.29	183 623	Assumed trucked operation
1.4	Mobile (ROM tip and supporting infrastructure)					
1.4.1	Sizer	Sum	1	20 073	20 073	Escalated by 6% from 2015
1.5	PCP East					
1.5.1	Feed preparation infrastructure	Sum	1	60 220	60 220	Escalated by 6% from 2015
1.5.2	35 m thickener	Included in existing Tronox CCA				Replacement unit only - existing provision exists
1.5.3	Flocculant plant at thickener	Included in existing Tronox CCA				Replacement unit only - existing provision exists
1.5.4	De-sliming cyclones	Included in existing Tronox CCA				Replacement unit only - existing provision exists
1.5.5	Load-Out Station fresh tailings stockpile - Consolidate to existing stockpile	No tailings will exist at scheduled closure				Rehabilitation covered under existing provisions
1.5.6	PCP East Mill					
1.5.6.1	Mill Structure	Sum	1	50 000	50 000	Sum Allowed
1.5.6.2	Tunnel trench	m ³	53	645.69	35000	
1.6	Dispose of rubble in the EOFS pit	m ³	153	111.29	17 027	Assumed trucked operation
	Total Phase 1 Closure Cost Estimate				1 298 391	

Item	Item Description	Unit	Quantity	Rate	Closure Cost	Remarks / Assumptions
2	(2015) Phase 2					
2.1	Mobile ROM tip and supporting infrastructure	Sum	1	47 173	47 173	Assume same as Item 1.4.1 and Item 2.2
2.2	Conveyors for tailings backfill	m	95	285.26	27 100	Measured from Appendix B5-1
2.2.1	Stockpiles at PCP East:					
2.2.1.1	-17 000 ton (live) ROM stockpile	No ROM stockpile will exist at scheduled closure				Rehabilitation covered under existing provisions
2.2.1.2	-Emergency tailings stockpile	No Emergency tailings stockpile will exist at scheduled closure				Rehabilitation covered under existing provisions
2.3	PCP East Infrastructure					
2.3.1	ROM stockpile scrubbers	Sum	1	66 911	66 911	Escalated by 6% from 2015
2.3.2	35 m thickener	m ²	1000	289.59	289 590	Assumed 10m high
2.3.3	Tailings spirals	Sum	1	289 590	289 590	Assumed same as thickener
2.3.4	Annex building	m ²	200	343.62	68 724	Assumed 4m eaves brick structure
2.4	Dispose of rubble in the EOFS pit	m ³	600	111.29	66 772	Assumed trucked operation
	Total Phase 2 Closure Cost Estimate				789 089	
3	Sea Water Supply and Storage Systems:					
3.1	Pumpstation (incl. pumps, enlarged gulley and suction cage)	Sum	1	20 742	20 742	Escalated by 6% from 2015
3.2	Ø 630 mm below ground pipeline	m	3300	99.80	329 347	Length of the PCP East pipeline approximately 3km (BAR)
3.3	Booster pumpstation	m ²	225	286.35	64 429	Assumed 15m x 15m footprint
3.4	Sea water buffer dam					
3.4.1	Removal of HDPE liner	m ²	17680	19.28	340 931	Assumed single skin liner
3.4.2	Shaping of pond area	ha	1.768	56107.311	99 198	Shaped to accommodate surface water flow.
3.4.3	Netting	ha	Included in mine rehab			
3.4.4	Vegetation	ha	Included in mine rehab			
3.5	Pipeline (sea water dam to the PCPE)	m	3000	99.80	299 406	Sea water pipeline will be 4.9 km in length Length of the PCP East pipeline approximately 3km (BAR)
3.6	Raw water dam (PCPE)					
3.6.1	Removal of HDPE liner	m ²	8300	19.28	160 052	Assumed single skin liner

Item	Item Description	Unit	Quantity	Rate	Closure Cost	Remarks / Assumptions
3.6.2	Shaping of pond area	ha	0.83	56107.311	46 569	Shaped to accommodate surface water flow.
3.6.3	Netting	ha	Included in mine rehab			
3.6.4	Vegetation	ha	Included in mine rehab			
3.7	Pumping infrastructure	Sum	1	133 823	133 823	Escalated by 6% from 2015
3.8	Dispose of rubble in the EOFs pit	Sum	1	10000.00	10 000	Provisional sum allowed
	Total Sea Water Supply Closure Cost Estimate				1 504 496	
4	RSF					
4.1	1:5 Sloping of Tailings Impoundment walls	Assumed to be affected during operation				
4.2	Capping and profiling of top of the facility requiring tailings infill	ha	348.30	96 980	33 777 929	Infill over 348 ha at an average of 1 meter - Rates from ENVASS 2019
4.3	Topsoil capping upper surface	ha	348.30	18 000	6 269 362	Rates from ENVASS 2019
4.4	Upper surface netting	ha	348.30	14 905	5 191 380	Rates from ENVASS 2019
4.5	Demolition of electrical line to RSF	km	4.90	99 802	489 030	SRK calculated rate
4.6	RSF slimes delivery and water pipelines	m	3800.00	70.92	269 496	Rates from ENVASS 2019, quantity taken off drawings
	Total RSF Closure Cost Estimate				45 997 196	
	TOTAL CLOSURE PROVISION ESTIMATE				49 589 172	