



# Applying Sustainable Remediation Criteria In The Remediation And Redevelopment of An Asbestos Contaminated Industrial Park

Presented by:

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SOIL | WATER | AIR



# Acknowledgments

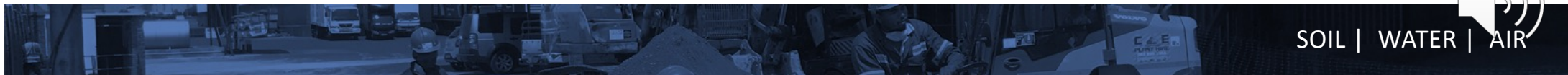


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1. Introduction
2. Project Background
3. Site Characterization
4. Multi-Criteria Decision Analysis
5. Remedial Action Plan / Engineering Design
6. Measurable Sustainable Outcomes
7. Take Home – 7 Keys





- **Asbestos:** naturally occurring crystalline mineral in form long thin fibers and fiber bundles.

- 6 known types / two groups:

- **Serpentines Group:**

- Chrysotile (White, Long, thin, flexible, inelastic & silky fibers)

- **Amphibole Group:**

- Amosite (Brown, short needle like fibers)
- Crocidolite (Blue, short needle like fibers)
- Anthophyllite (Straight, needle like, flexible / elastic fibers)
- Tremolite (fibrous)
- Actinolite (fibrous)



## Asbestos Mining in Southern Africa, 1893–2002 – (2008)

## Uses of Asbestos



Brake pads and clutch plates

Boiler linings and firebox casings

Engine compartments

Roofing and floor tiles

Gaskets

Hoses used for hydraulics and steam supply lines

Insulation in company buildings and railcars

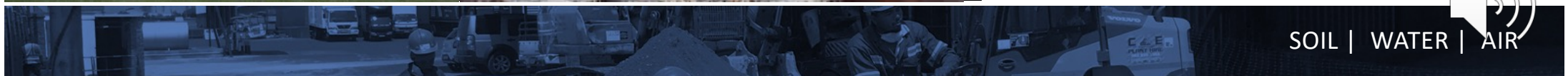
Rope, packing, and cement supplies

Sealants

Valves

Wallboard and paint

Rail track lagging



Asbestos: CAS RN 1332-21-4

GHS



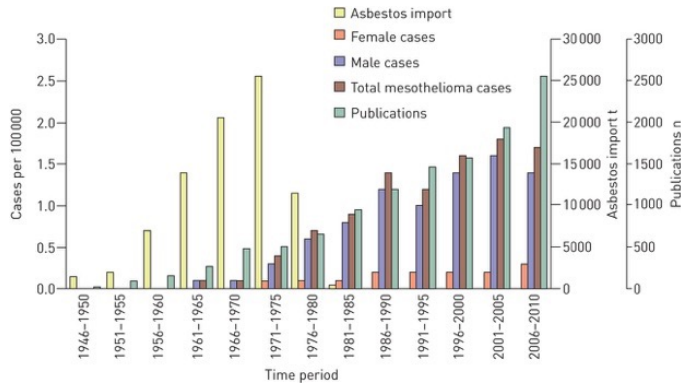
#### GHS Hazard Statement

H335: May cause respiratory irritation  
[Warning Specific target organ toxicity, single exposure; Respiratory tract irritation]  
H341: Suspected of causing genetic defects  
[Warning Germ cell mutagenicity]  
H350: May cause cancer  
[Danger Carcinogenicity]  
H372: Causes damage to organs through prolonged or repeated exposure  
[Danger Specific target organ toxicity, repeated exposure]

## Health Effects

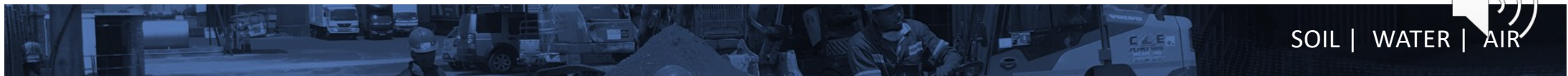
- Asbestosis, a form of pneumoconiosis
- Bronchial carcinoma, classic lung cancer
- Pleural plaques, condition involving pleural thickening
- Cancers of larynx/gastrointestinal tract, rare cancers “associated” with asbestos
- Mesothelioma, cancer of the pleura and peritoneum

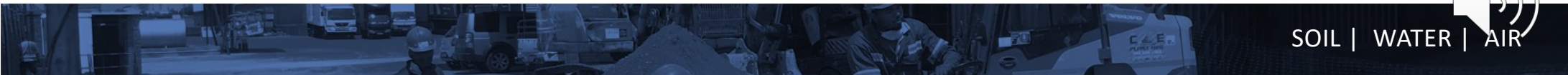
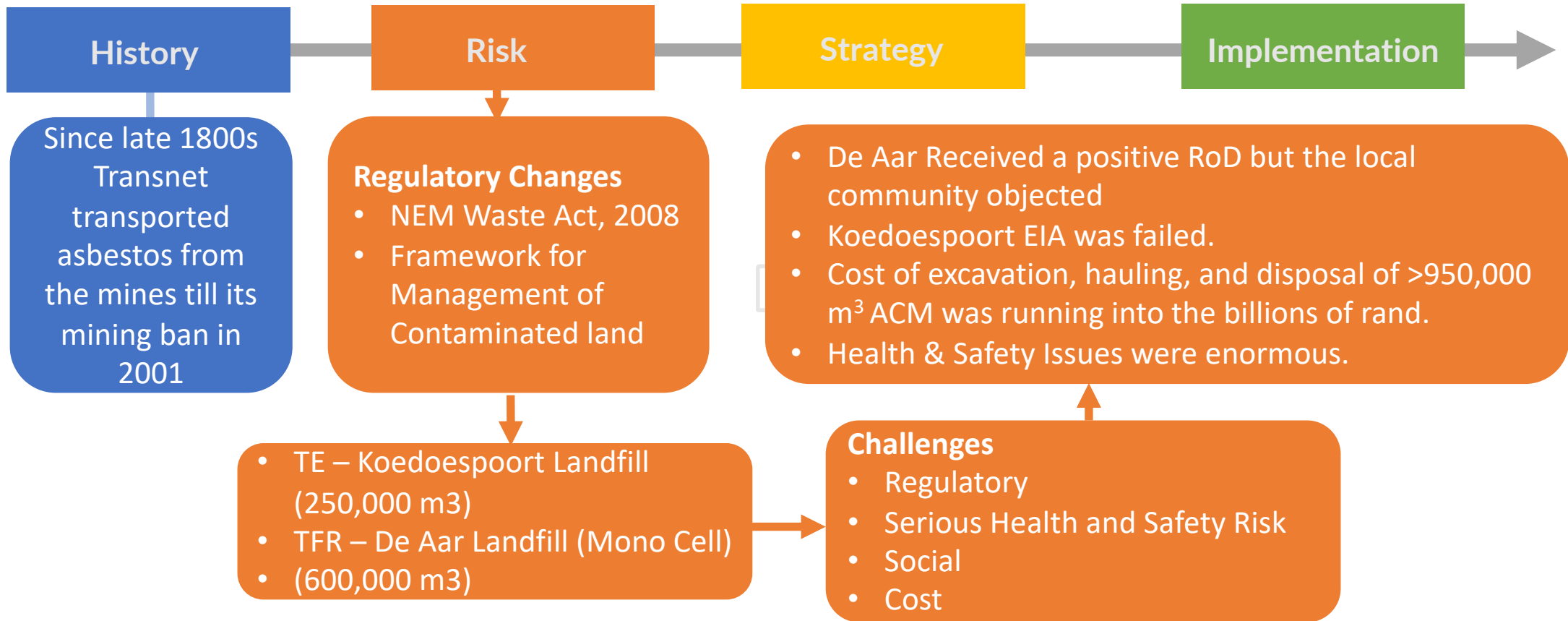




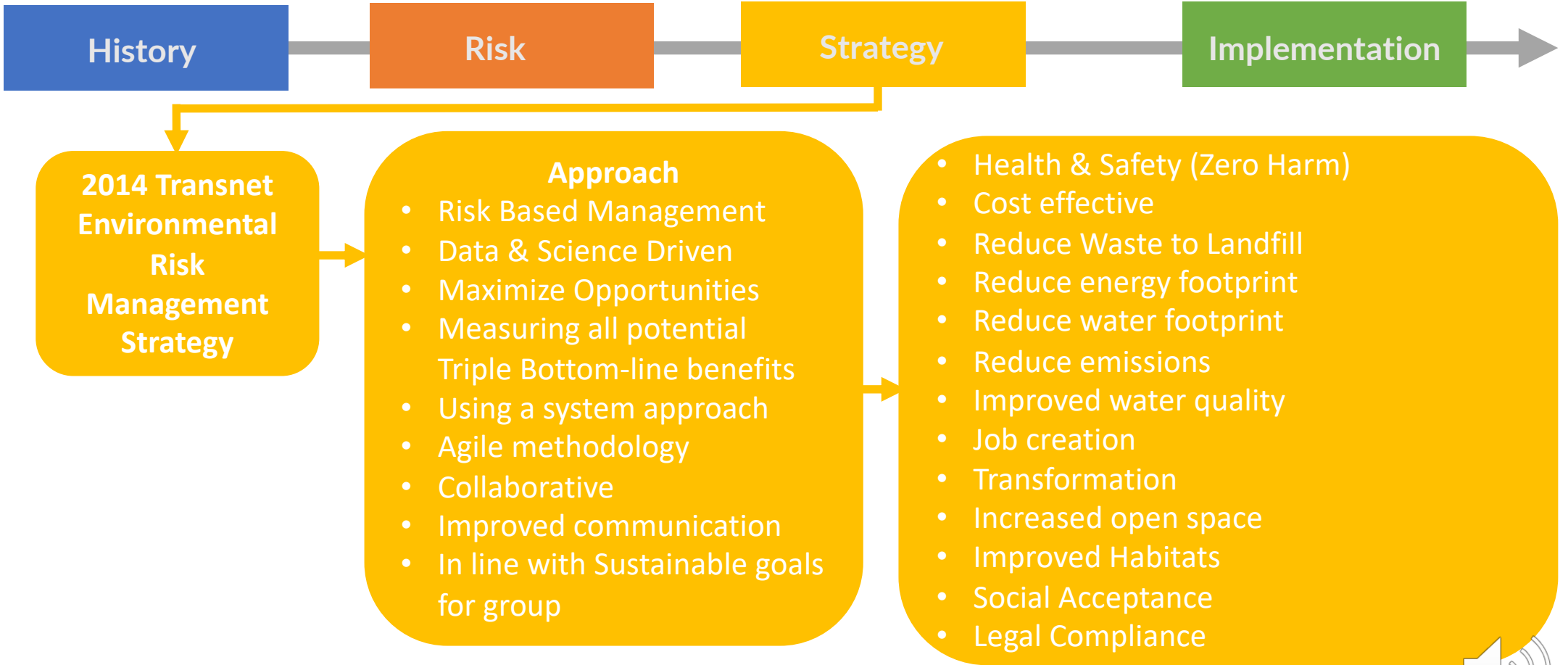
## Drivers

- UN -  $\approx$  125 million people /year exposed to asbestos.
- ILO  $\approx$  100,000 workers die each year from a related disease.
- WHA R58.22 - Special Attention to avoidable exposure to carcinogenic chemicals in the workplace.
- WHA R60.26 - elimination of asbestos-related diseases.
- UN SDG 3 – Ensure good healthy lives and promote wellbeing for all at all ages.
  - Reduce Exposure to hazardous chemicals
  - **Exposure to asbestos** is specifically identified in the thesis for SDG3.





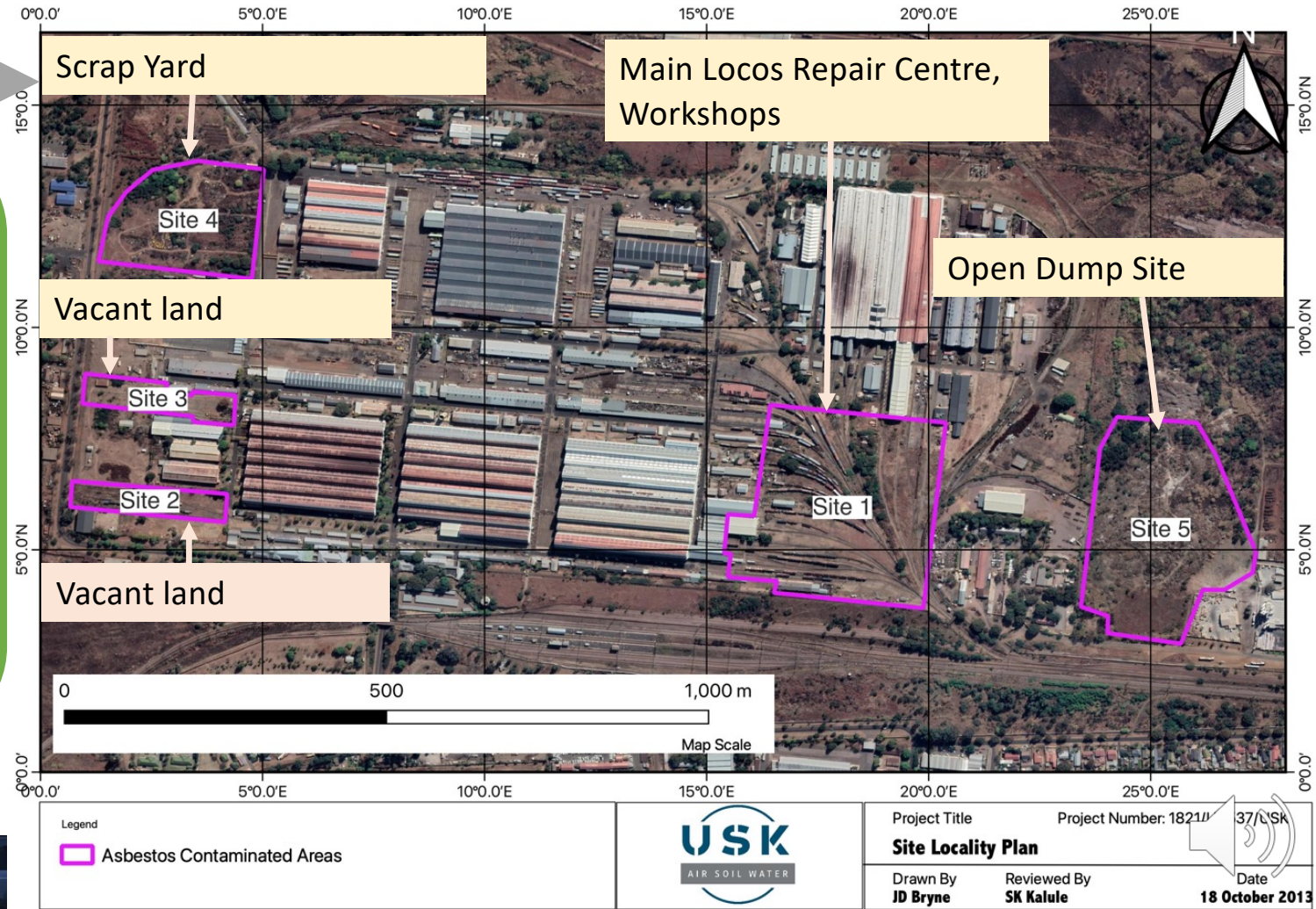




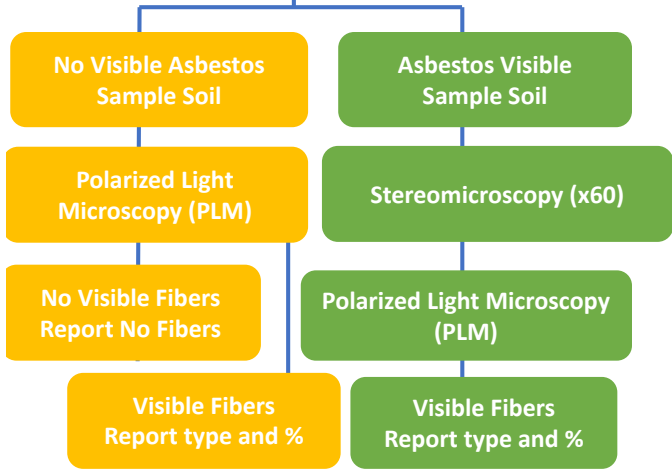
## Implementation

### Transnet Koedoespoot Center

- 29 Ha of asbestos contaminated Prime industrial Land
- $\approx 241,758.33 \text{ m}^3 \text{ ACM}$



**Field Investigation**  
Visual Screening of Asbestos soil contamination by type (ACM and FA)



**IATL INTERNATIONAL**  
ASBESTOS TESTING LABORATORY

**PLM Soil Characterization**

Client Name: USK Consulting IATL Sample #: 406131  
 Client Project #: TREC LA26-098-0251 Client Sample #: 22E15  
 Project Name: TREC-Soil Analysis

Chain of Custody Summary and Analytical Data

Receipt: 1/27/2012 Client Contact: Steve Kahlert  
 Log #: 130/2012 Phone #: 2712261320  
 Analyzed: 4/10/2012 Fax #: \_\_\_\_\_  
 Reviewed: \_\_\_\_\_ Email: [skahl@iatl.com](mailto:skahl@iatl.com)

**PLM Macroscopic / Microscopic Analysis Data: Observations by Fraction Size**

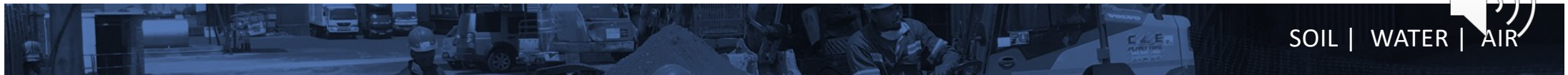
Description	Particle size (mm)			Comments	Sample Totals
	>10.0	10.0 - 1.0	< 1.0		
Fraction of Sample	20	40	30		100
Labels (g)	10000	1000	1000		
<b>Organic Category</b>					
Vegetation (natural vegetation)				None	0.1
Coal					
Insulation					
Paint					
Other					
<b>Non-oxide (inorganic)</b>					
Glass Fibers					
Synthetic Fibers					
Processed Cellulose					
Composites		20	20	Chips	14.0
Building Materials					
Soil					
Glass Fragments					
<b>Geological Materials</b>					
Dusts			40	UV	12.0
Carbonates					
Iron Oxide					
Manganese Oxide	0		10	Quartzite	3.0
Quartzite					
Ferrous Oxide / Clay			25	Y	22.0
Iron Oxide / Clay	20	55		Y	20.0
Brucite					
Other					
<b>Asbestos</b>					
Chrysotile					
Amphibole					
Tremolite					
Anthophyllite					
Actinolite					
Crocidolite	15	20		Blue/Grey Woven Fibers	30.8
Fraction Totals	100	100	100		100

**Analysis by:** Modified NIOSH 4090 R-03116, Method for the Determination of Asbestos in Bulk Building Materials

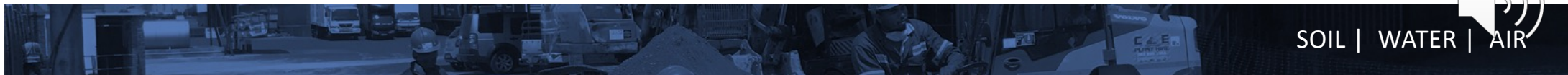
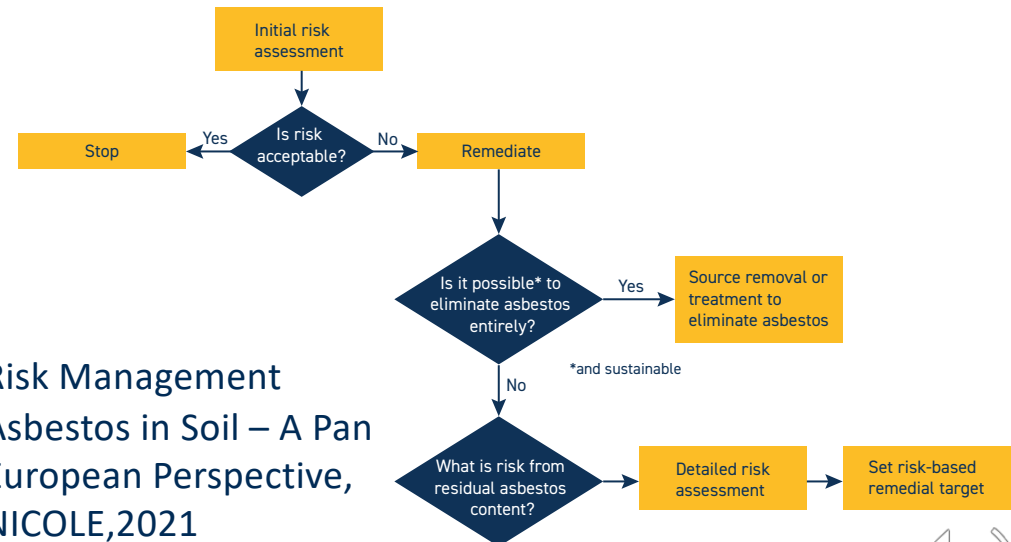
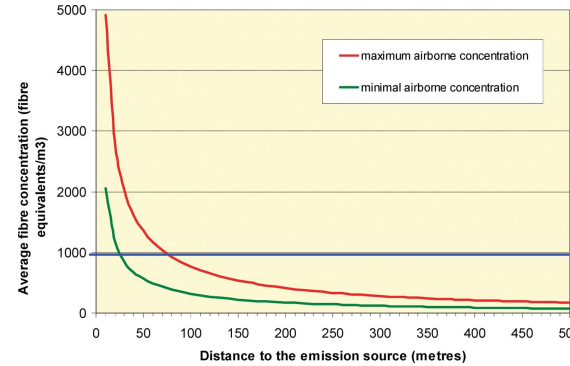
1. Includes color, touch, and smell.  
 2. Rounded whole numbers derived from Point Counts.  
 3. TR = Trace, observed but not quantifiable.

Analyst: B. Kennedy  
 Date: 05-Apr-12

- 200 Soil Samples across the 5 sites.
- PLM / EM / Gravimetry
- Crocidolite and Chrysotile
- Site 1 & 5 most contaminated
- 86% samples at site 5 - > 0.1%
- 58% samples at site 1 - > 0.1%
- 38% samples at site 4 - > 0.1 %
- Sites 2 & 3 no visible asbestos but >0.1% in soil samples
- Vertical extent 600 – 800mm bgl

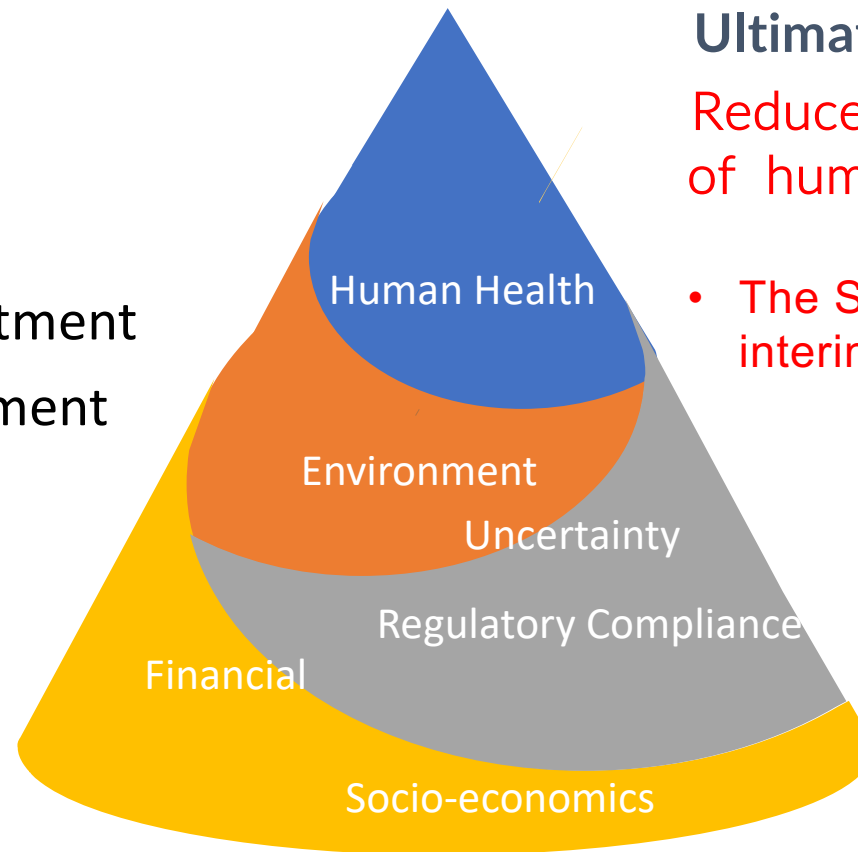


- Site Specific Release
- Determine Exposure
  - Ambient air monitoring < 0.01 f/ml) but greater during excavation or maintenance work
  - Modelled construction levels well above 0.01 f/ml
  - Duration of Exposure
- Cancer / Mesothelioma Risk derived from estimated exposure using exposure – response models.



# Remediation Options

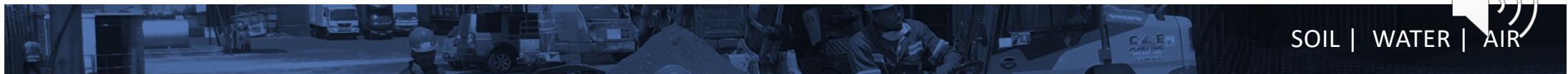
- Landfill Options
- Non-Landfill Options
- In-Situ Containment
- Stabilization
- Microwave thermal treatment
- Mechanochemical treatment
- Sorting



**Ultimate Remedial Objective**  
 Reduce / Eliminate Exposure  
 of humans (onsite/offsite) to  
 asbestos

- The Solution should not create in interim problem

Multiple objectives  
 internal and  
 external



# Multi Decision Criteria Analysis

<b>Criterion 1</b>	<b>Commercial /Financial</b>
1.1	CAPEX
1.2	OPEX
<b>Criterion 2</b>	<b>Engineering</b>
2.1	Availability of Technology
2.2	Construction Duration
2.3	O&M Human resources
<b>Criterion 3</b>	<b>Environmental / Health Risk</b>
3.1	Air Quality
3.2	Change in Soil Quality
3.3	Energy, Water & Waste
3.4	Human Health Safety Risk
<b>Criterion 4</b>	<b>Regulatory Compliance</b>
4.1	OHS Labour
4.2	Contaminated Land
4.3	Water Use Licensing
<b>Criterion 5</b>	<b>Socio-economic Impact</b>
5.1	Land Use /End Use Planning
5.2	Employment Opportunities
5.3	Public Acceptability
<b>Criterion 6</b>	<b>Uncertainty</b>
6.1	uncertainty

Weighting	Criterion Weighting Description
1	Non-Critical Criteria
10	Critical Criteria

Rating	Option Rating Description
1	Least Favorable
10	Most Favorable

Score	Score Significance
0 - 25	Least Preferred Option
25- 50	
50 - 75	
75- 100	Most Preferred

Site 1				In-Situ Containment		Stabilization		Microwave /Thermal Treatment		Mechanochemical Transformation	
Criteria ID.	Criterion	Criteria Description	Criterion Weight	Option Rating	Score	Option Rating	Score	Option Rating	Score	Option Rating	Score
<b>Criterion 1 Commercial /Financial</b>											
1.1	CAPEX	WILL THE OPTION HAVE A SIGNIFICANT CAPEX IMPACT OR CONSTRAINT?	8	7	56	5	40	1	8	1	8
1.2	OPEX	WILL THE OPTION HAVE A SIGNIFICANT OPEX IMPACT OR CONSTRAINT?	8	10	80	10	80	10	80	10	80
<b>Criterion 2 Engineering</b>											
2.1	Availability of Technology	IS THE TECHNOLOGY READILY AVAILABLE IN COUNTRY	8	10	80	10	80	1	8	1	8
2.2	Construction Duration	ARE THERE TIME CONSTRAINTS OR IMPACTS ASSOCIATED WITH THE TIMEFRAME FOR REMEDIATION?	8	8	64	6	48	2	16	2	16
2.3	O&M Human resources	ARE THERE IN-HOUSE HUMAN RESOURCE /EXPERTISE TO CARRY OUT O&M OF THE SITE	8	10	80	10	80	10	80	10	80
<b>Criterion 3 Environmental / Health Risk</b>											
3.1	Air Quality	NO ACUTE OR CHRONIC EXPOSURE TO AIRBORNE ASBESTOS FIBRES IS ACCEPTABLE	10	8	80	5	50	3	30	3	30
3.2	Change in Soil Quality	ASBESTOS LEVELS REDUCED TO LEVELS ACCEPTABLE FOR INDUSTRIAL LAND USE	5	8	40	8	40	8	40	8	40
3.3	Energy, Water & Waste	MINIMISE GENERATION OF WASTE AND USE ENERGY AND WATER IN A SUSTAINABLE MANNER	7	8	56	4	28	2	14	2	14
3.4	Human Health Safety Risk	NO UNACCEPTABLE RISK TO RECEPTORS AND WORKERS DURING AND AFTER REMEDIATION	10	9	90	5	50	5	50	5	50
<b>Criterion 4 Regulatory Compliance</b>											
4.1	OHS Labour	IS THE OPTION SUPPORTED BY LEGISLATION AND WILL IT RECEIVE AUTHORISATION?	10	8	80	8	80	1	10	2	20
4.2	Contaminated Land	IS THE OPTION SUPPORTED BY LEGISLATION AND WILL IT RECEIVE AUTHORISATION?	10	8	80	8	80	2	20	2	20
4.3	Water Use Licensing	IS THE OPTION SUPPORTED BY LEGISLATION AND WILL IT RECEIVE AUTHORISATION?	10	NA	NA	NA	NA	NA	NA	NA	NA
<b>Criterion 5 Socio-economic Impact</b>											
5.1	Land Use/End Use Planning	WILL RESTRICTIONS ON FUTURE LAND USE IMPACT ON THE BUSINESS AND LIMIT SITE RE-DEVELOPMENT OPTIONS?	5	10	50	10	50	10	50	10	50
5.2	Employment Opportunities	OPPORTUNITIES FOR JOB CREATION AND/OR TRAINING AND SKILLS DEVELOPMENT FROM REMEDIATION CONTRACT	3	7	21	5	15	2	6	2	6
5.3	Public Acceptability	IS THE TECHNOLOGY ACCEPTABLE TO THE PUBLIC	3	8	24	8	24	1	3	2	6
<b>Criterion 6 Uncertainty</b>											
6.1	uncertainty	PREDICTABILITY OF ACCEPTABLE OUTCOME	8	6	48	6	48	8	64	8	64
<b>Total Score</b>					929		793		479		492

## Site 1 and 4

- Hand pick VA / disposal
- In-situ containment

## Site 2 and 3

- In-situ containment

## Site 5

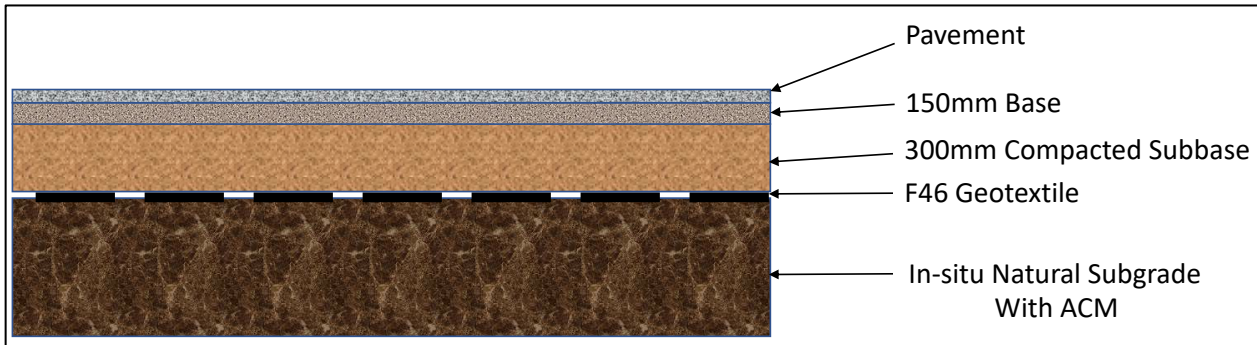
- Dedicated containment area

Site ID	Risk Level	Priority for Attention	Timeframe for Action
Site 1	High Risk	High	Short (12 – 18 Month)
Site 2	Low Risk	Low	Mid Term (18- 24 months)
Site 3	Low Risk	Low	Mid Term (18- 24 months)
Site 4	Low Risk	Low	Mid Term (18- 24 months)
Site 5	Very High Risk	Highest	Immediate 6 – 12 months

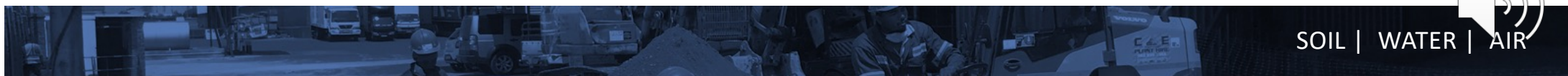
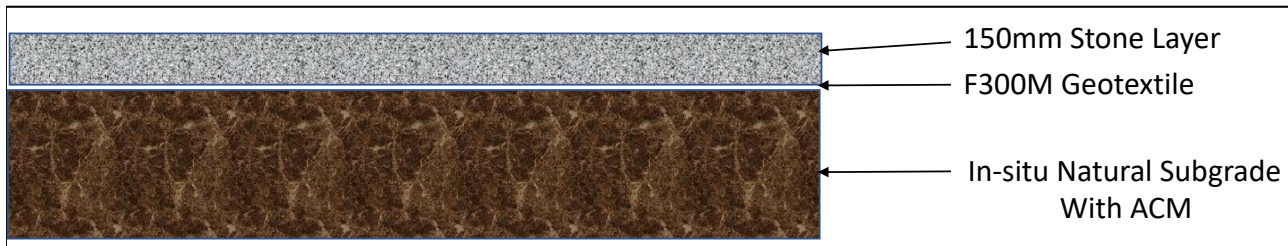
# Remedial Action Plan and Design

- Sites 2, 3 and 4 are prime infill industrial land.
- **Opportunity:** Develop - offices, training centres, workshops

**Opportunity**  
Recycle / Re-use Scrap metal



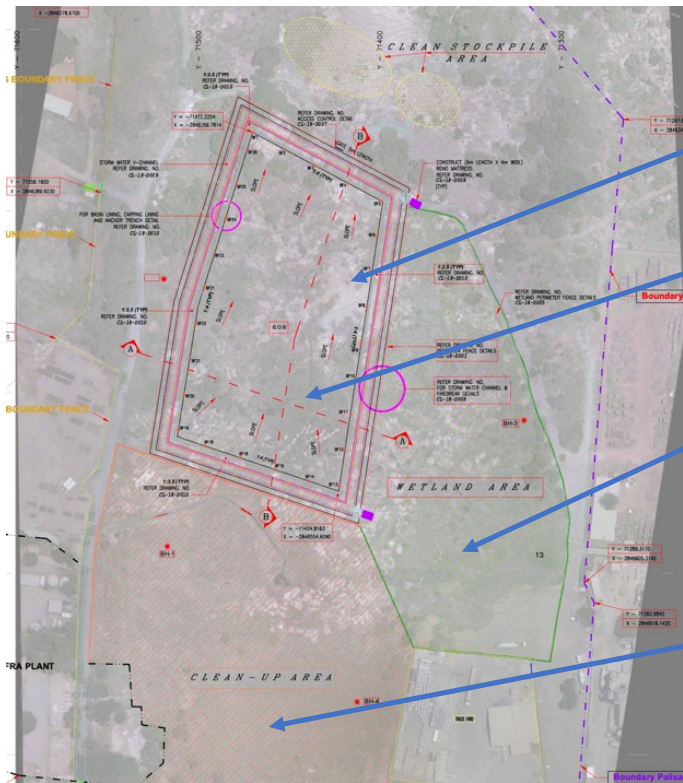
- Sites 1 Active Shunting Area
- Reduce risk of exposure during maintenance work.





# Sites 5

- Dedicated remedial containment basin

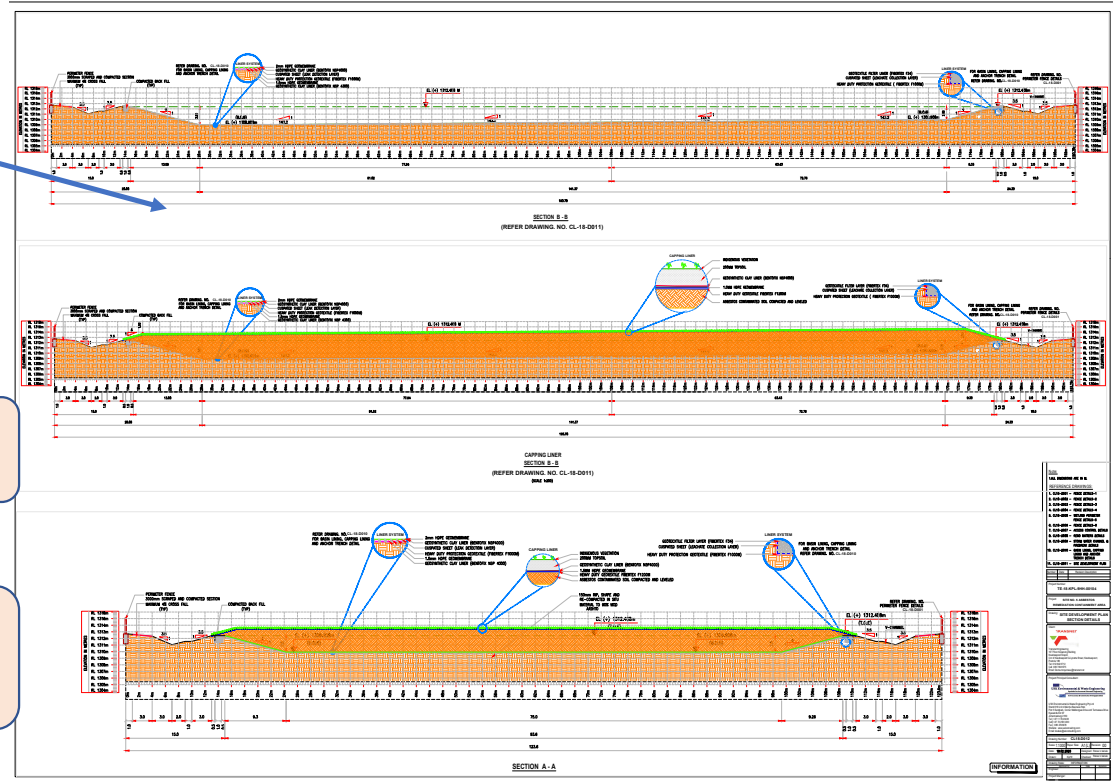


Containment Basin

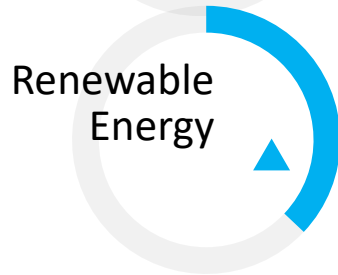
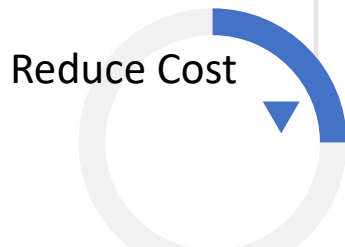
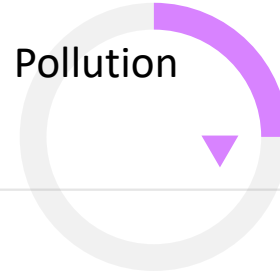
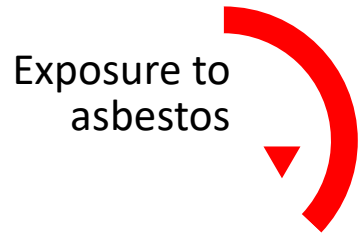
Solar PV Plant  
1535 MWh/ year

2.2 acres of  
Wetland Restored

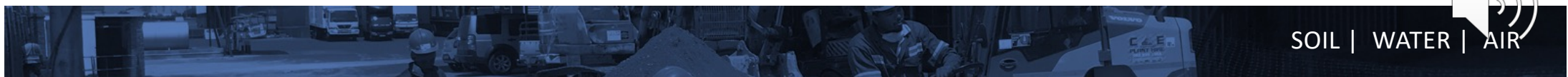
7.2 acres of  
Prime industrial  
Land Recovered



# Measurable Sustainable Outcomes



## 7 Keys to Sustainable Remediation:



# ENKOSI THANK YOU

The Preferred Partner on the African Continent

South Africa, Uganda, Tanzania, Kenya & Rwanda

