

Design of an HDPE-lined platinum tailings facility in South Africa

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Key message of this presentation:

Although there are many environmental benefits to the inclusion of a liner in a tailings dam, this does increase the **complexity** of the design, construction and operation of the tailings dam.

01

The requirement for a liner

In South Africa

The Requirement for a Liner

DWS's philosophy has changed in the past 20 years

Historic Philosophy	New Philosophy
<ul style="list-style-type: none">• Dilution and attenuation of water contamination• Mitigating contamination spread• Pollution clean-up.	<ul style="list-style-type: none">• Protection of water resources• Prevention of contamination in the first place

NEMA Regulations (632, 634, 635 & 636) administered by the DWS

→ Waste Acceptance Criteria for Disposal to Landfill
applies to all waste, **including tailings**

The Requirement for a Liner

Waste Acceptance Criteria for Disposal to Landfill

Marula platinum tailings

Waste Type	Landfill Disposal Requirements
Type 0 Waste	The disposal of Type 0 waste to landfill is not allowed . The waste must be treated and re-assessed in terms of the <i>Norms and Standards for Assessment of Waste for Landfill Disposal</i> .
Type 1 Waste	Type 1 waste may only be disposed of at a Class A landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a Hh / HH landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2 nd Ed., Department of Water Affairs and Forestry, 1998).
Type 2 Waste	Type 2 waste may only be disposed of at a Class B landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a GLB+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2 nd Ed., DWAF, 1998).
Type 3 Waste	Type 3 waste may only be disposed of at a Class C landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a GLB+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2 nd Ed., DWAF, 1998).
Type 4 Waste	Type 4 waste may only be disposed of at a Class D landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a GLB- landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2 nd Ed., DWAF, 1998).

The Requirement for a Liner

Type 3 Waste	Type 3 waste may only be disposed of at a Class C landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a GLB+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2 nd Ed., DWAF, 1998).
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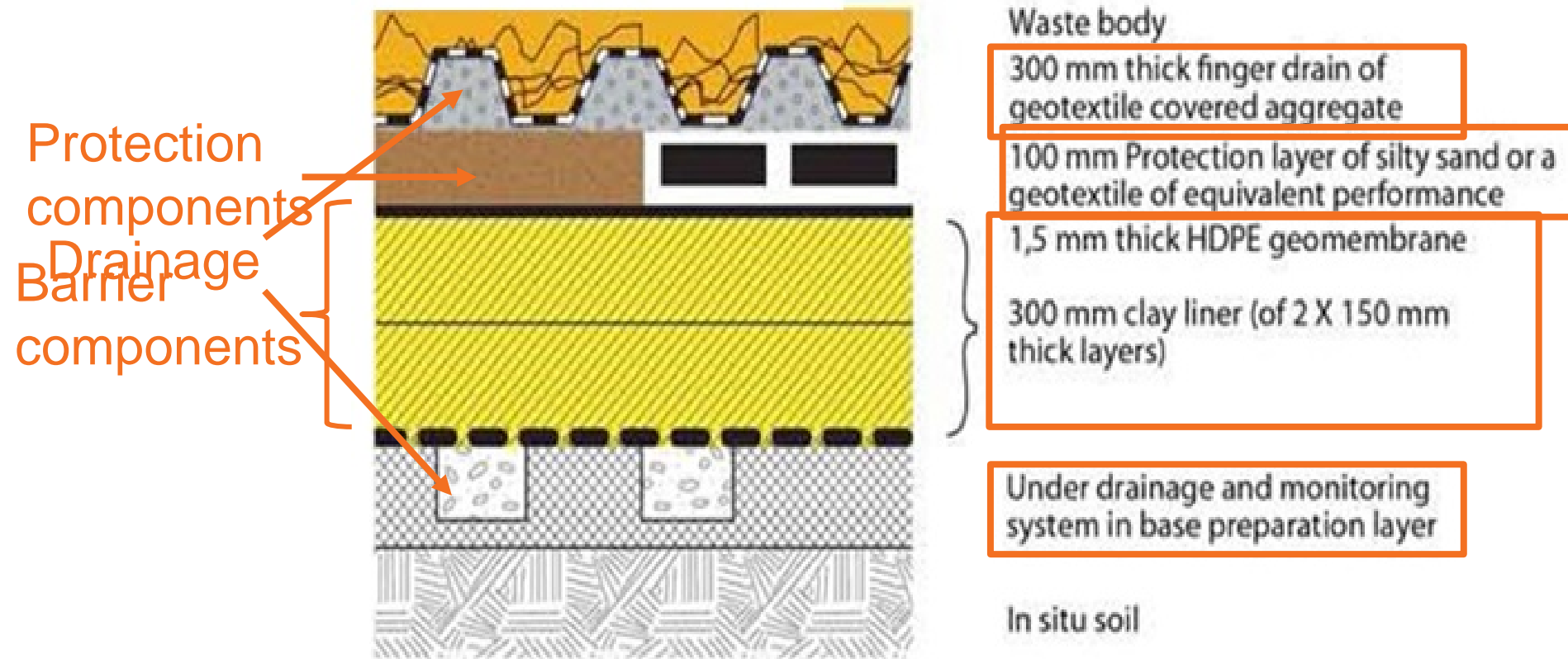
Type 3 waste requires a Class C landfill barrier system

OR

a barrier of equivalent performance

The Requirement for a Liner

Core components of a Class C landfill barrier system

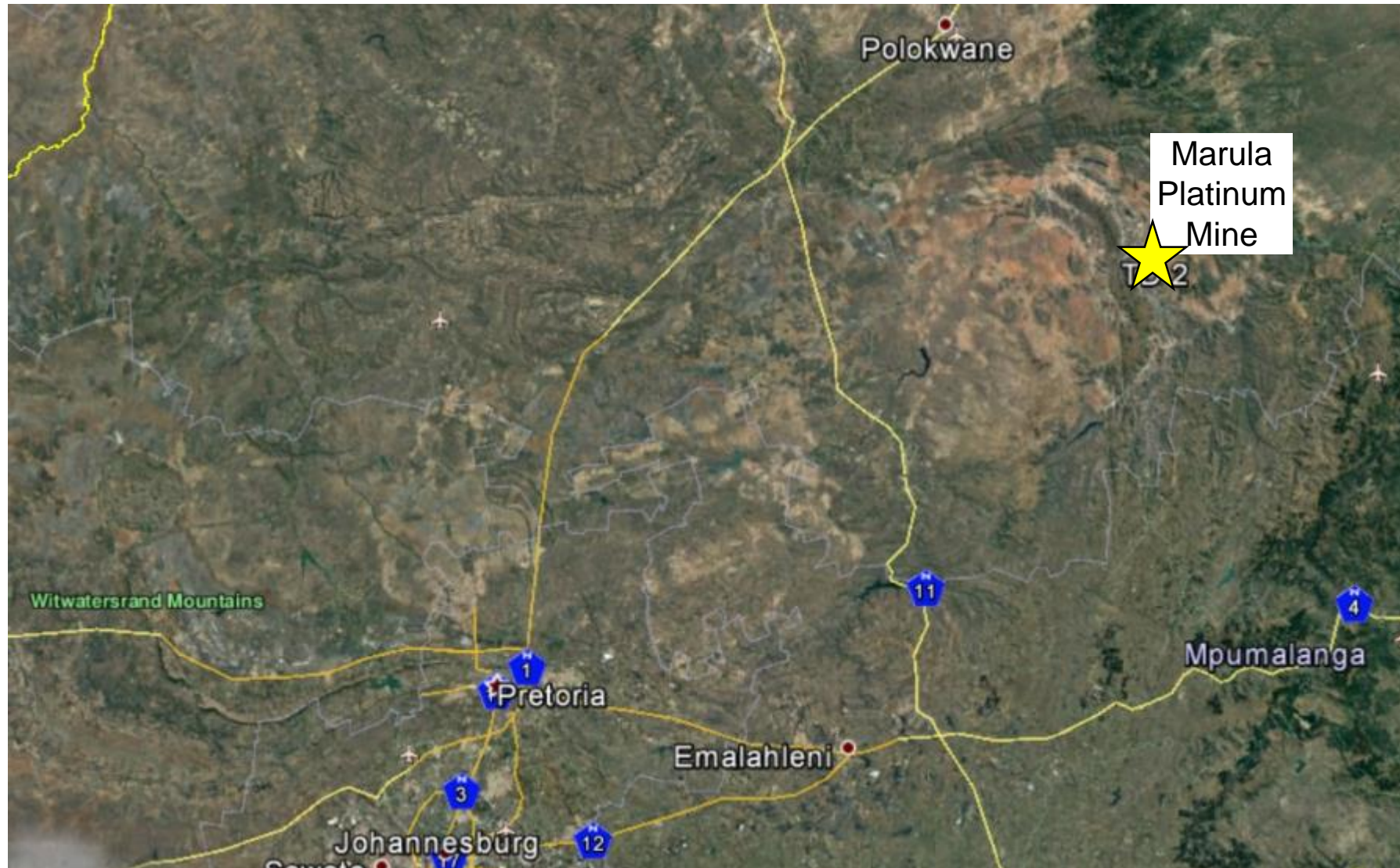


02

Case study

Marula Tailings Dam 2

Marula Tailings Dam 2



Marula Tailings Dam 2



TD 2 Statistics

Footprint: 77 Ha

Max height: 47 m

Design life: 20 yrs

Tailings received from same plant
as existing TD 1

Elevated nitrate (NO_3) levels

03

Design challenges

Drainage

Stability

Others

Drainage

Purpose

Above-liner drains

- Draw down the phreatic surface
- Reduce head on the liner → reduce seepage gradient
- Reduce liquefaction potential of tailings

Under-liner drains

- Mitigate against construction issues
- Provide leakage detection layer
- Drain seepage from existing TD 1

Additional challenges

- Protection from stormwater damage
- Protection from blinding from fine tailings



Marula TD 2 Drainage Design



Marula TD 2 Drainage Design

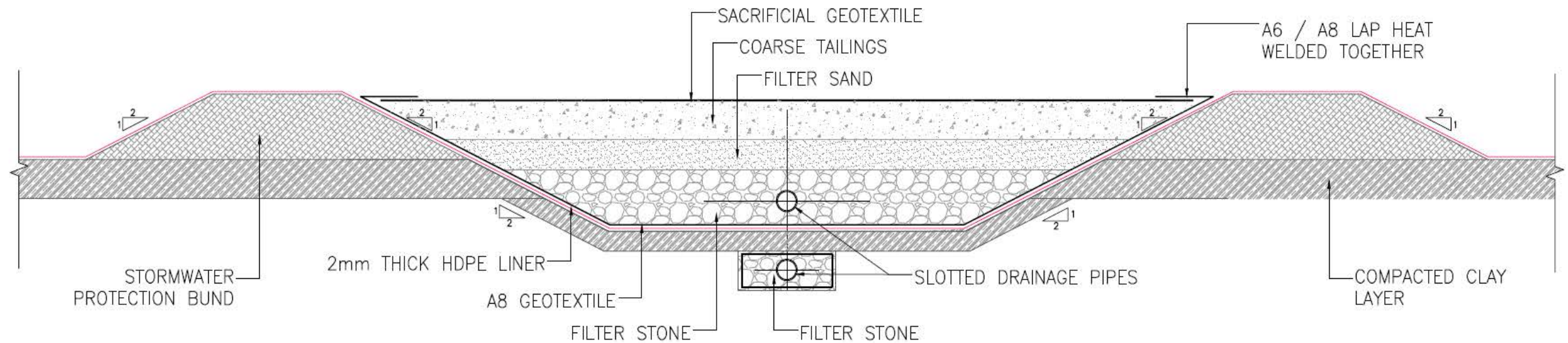


Marula TD 2 Drainage Design

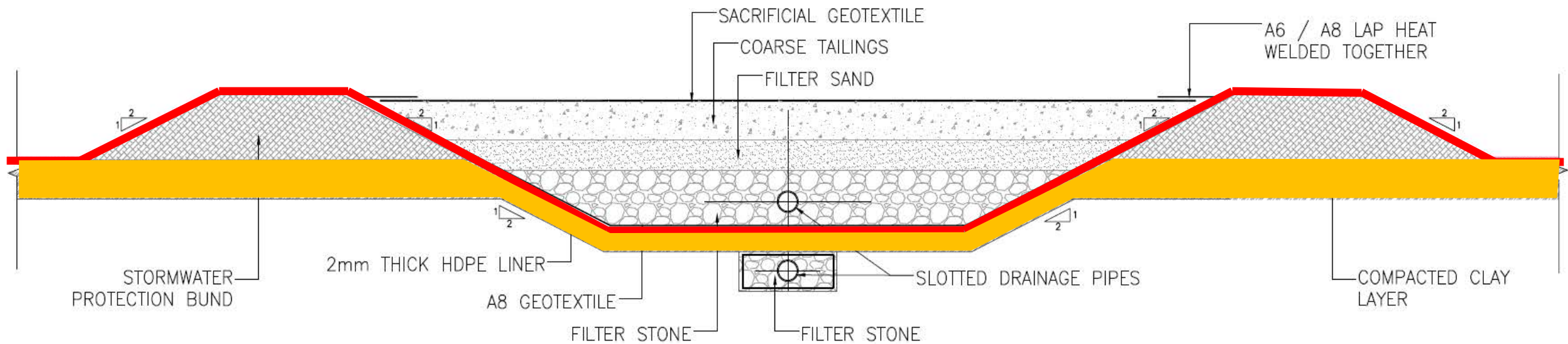


Marula TD 2 Drainage Design

Section through a typical drain



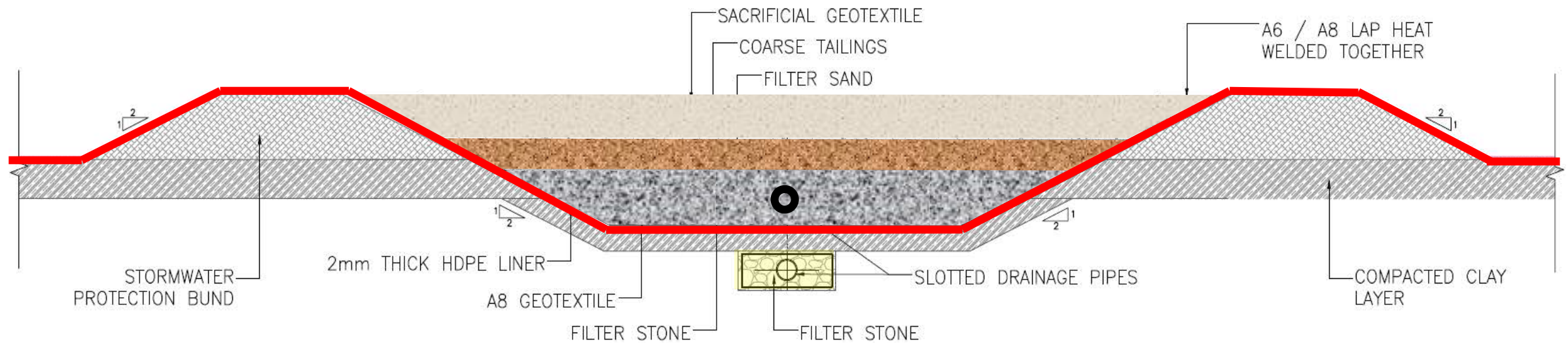
Section through a typical drain



Barrier components

Marula TD 2 Drainage Design

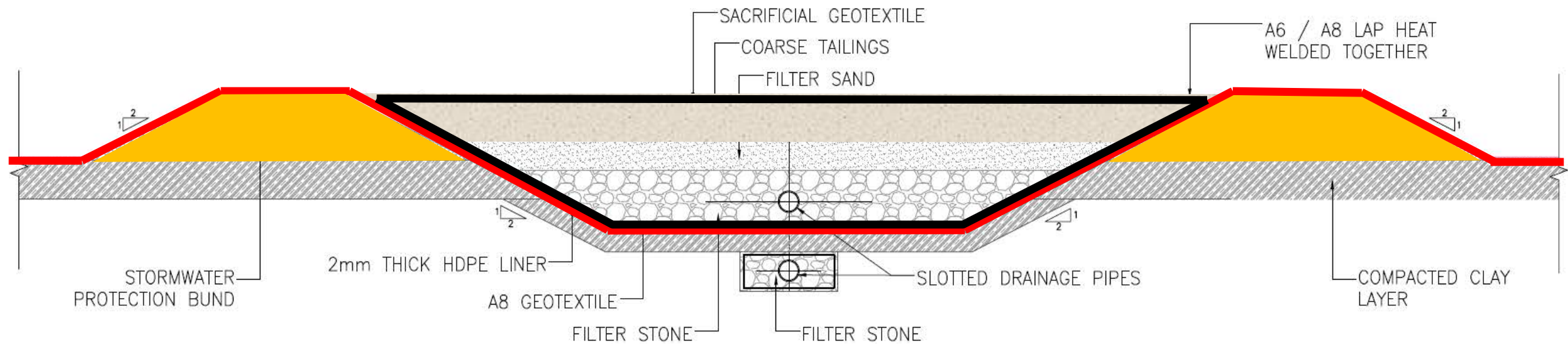
Section through a typical drain



Drainage components

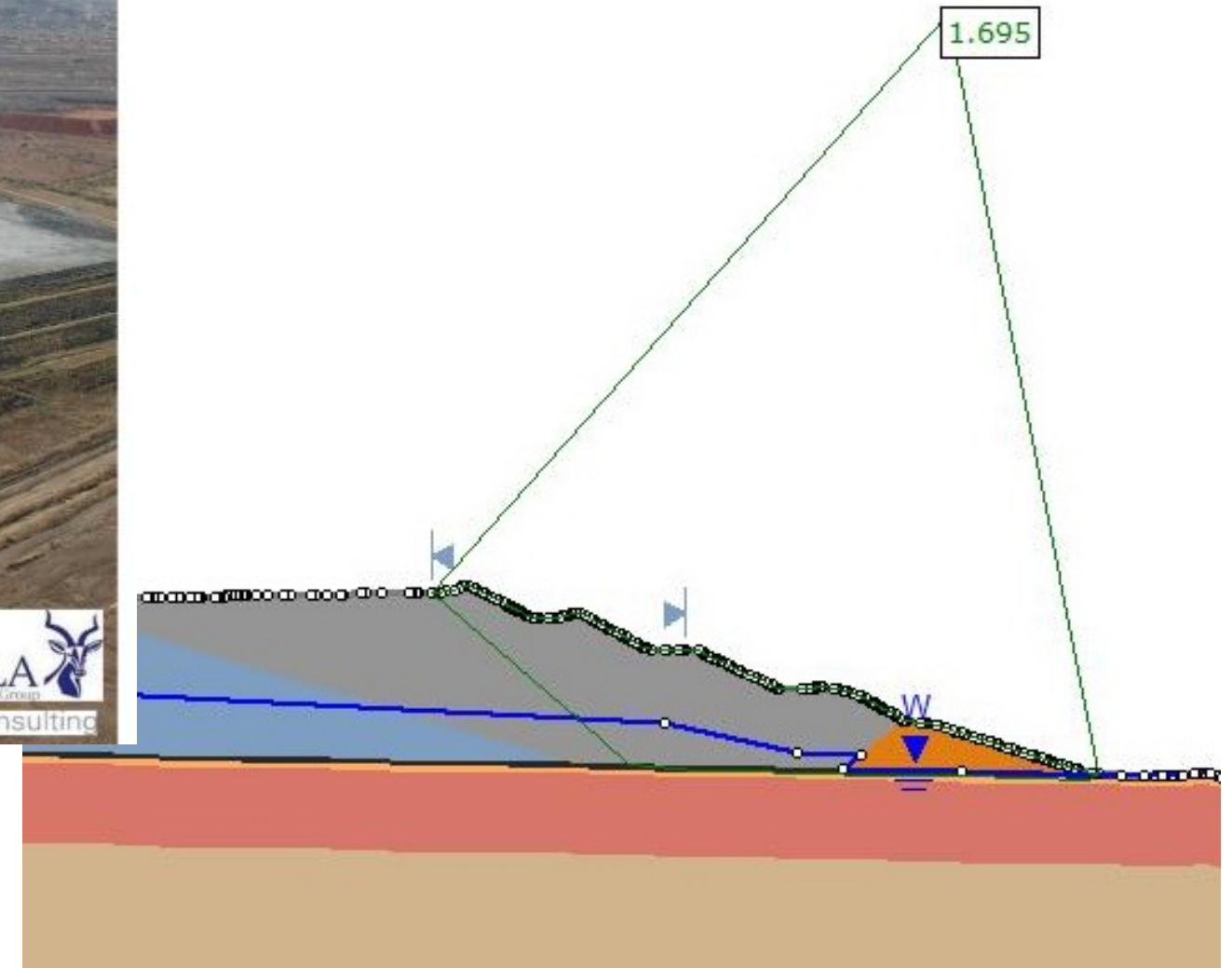
Marula TD 2 Drainage Design

Section through a typical drain



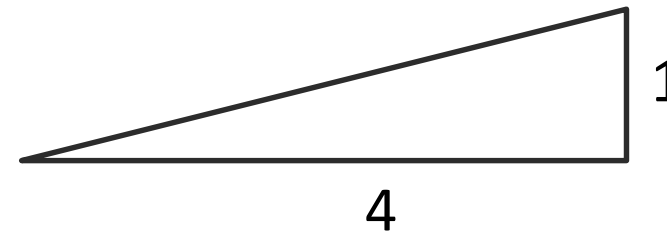
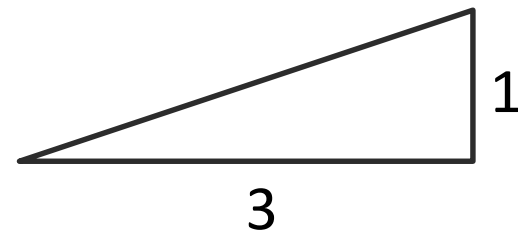
Protection components

Stability

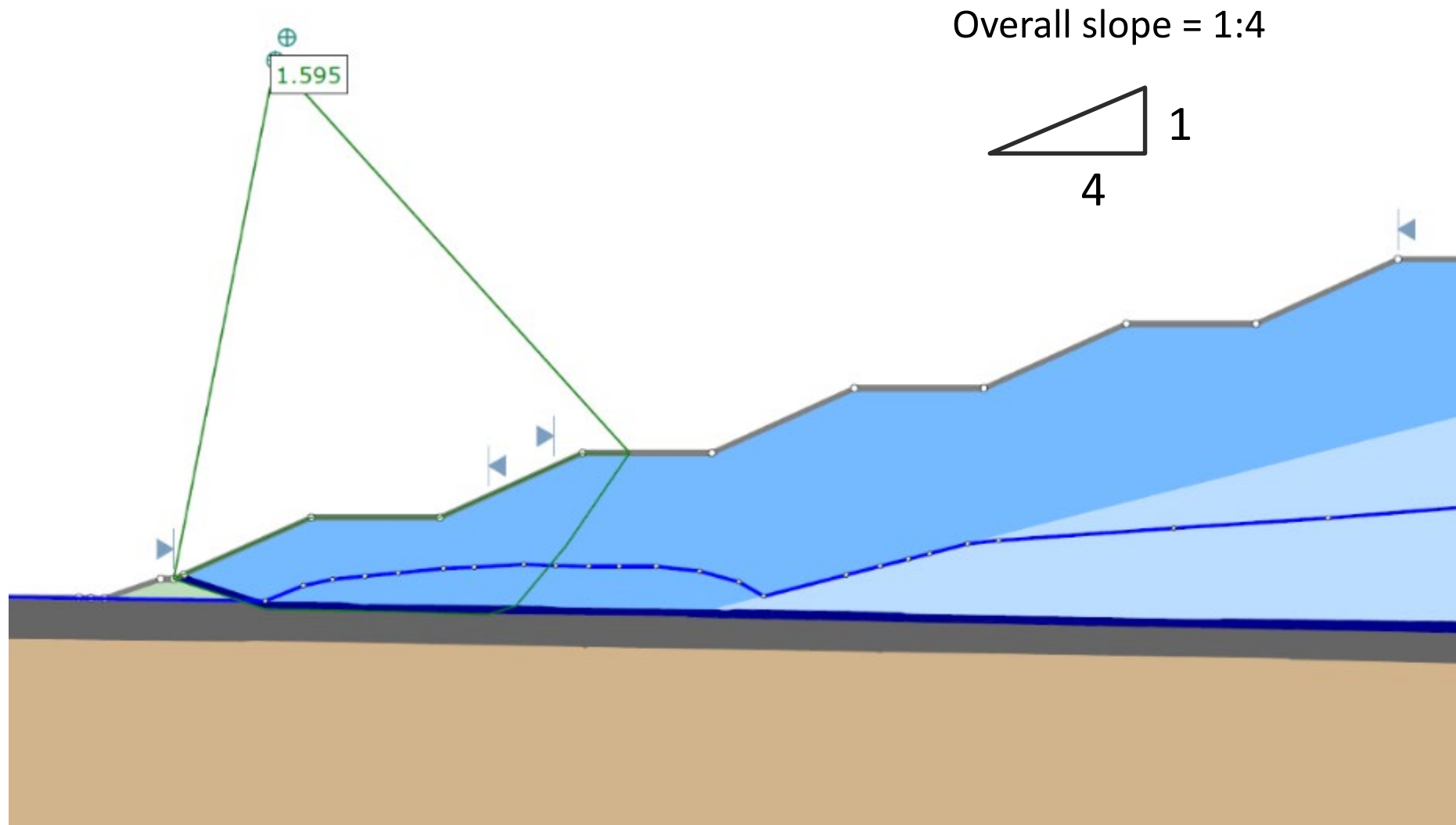


Stability

	Existing TD 1	New TD 2
	Unlined	Lined
Weakest layer	Underlying soil $\Phi = 21^\circ$	Liner interface $\Phi = 16^\circ$
Outer slope	1:3	1:4



Stability



Stability – determination of interface shear strength



Stability – determination of interface shear strength



03

Construction challenges

52 km of drainage pipes

700,000 m² of liner = 1,100 rolls

220 km of liner welds

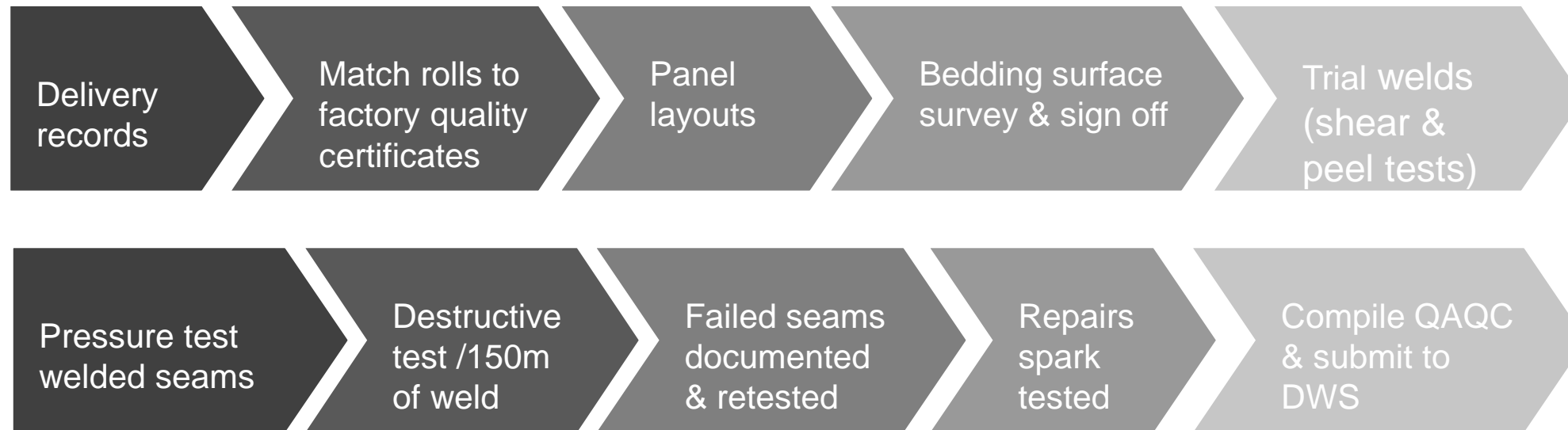
Quality Assurance

To ensure the tailings dam succeeds to limit seepage, it needs to be constructed to the highest standard



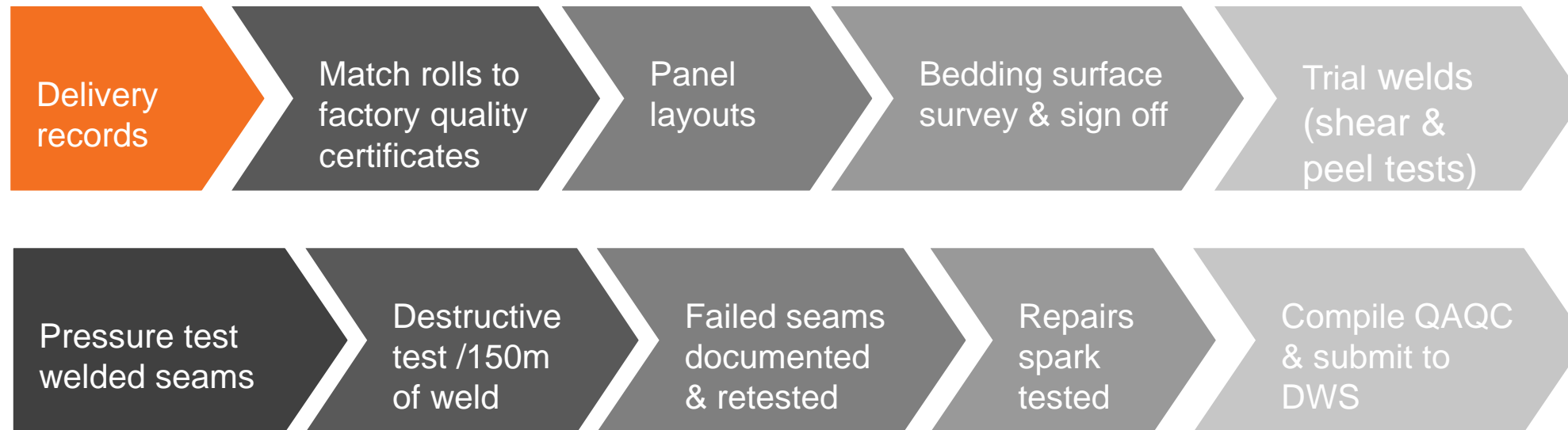
Quality Assurance

Quality control & assurance for liner



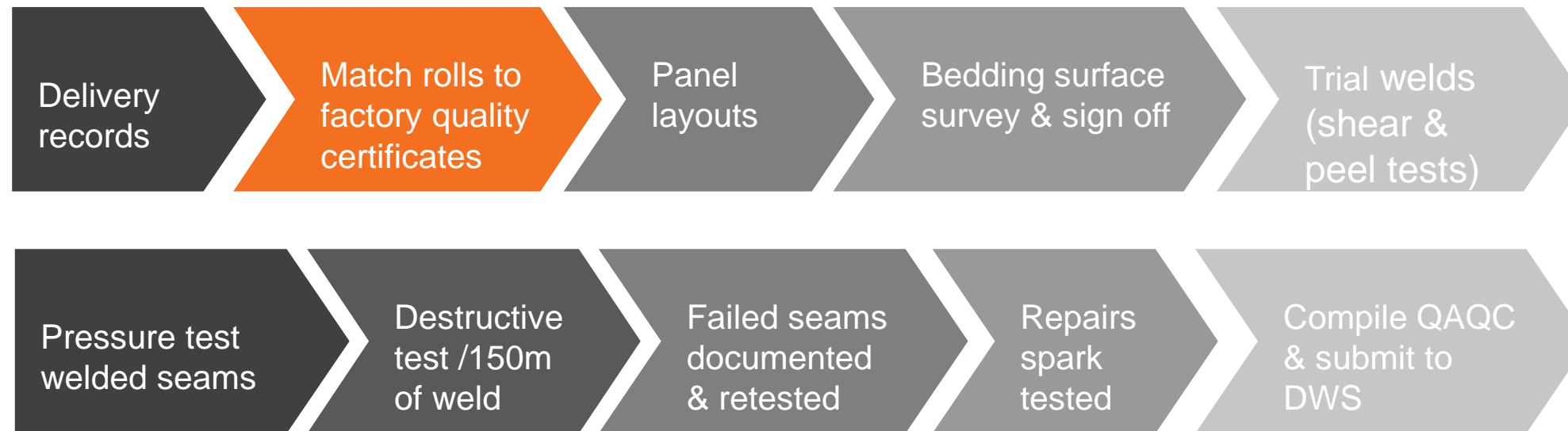
Quality Assurance

Quality control & assurance for liner



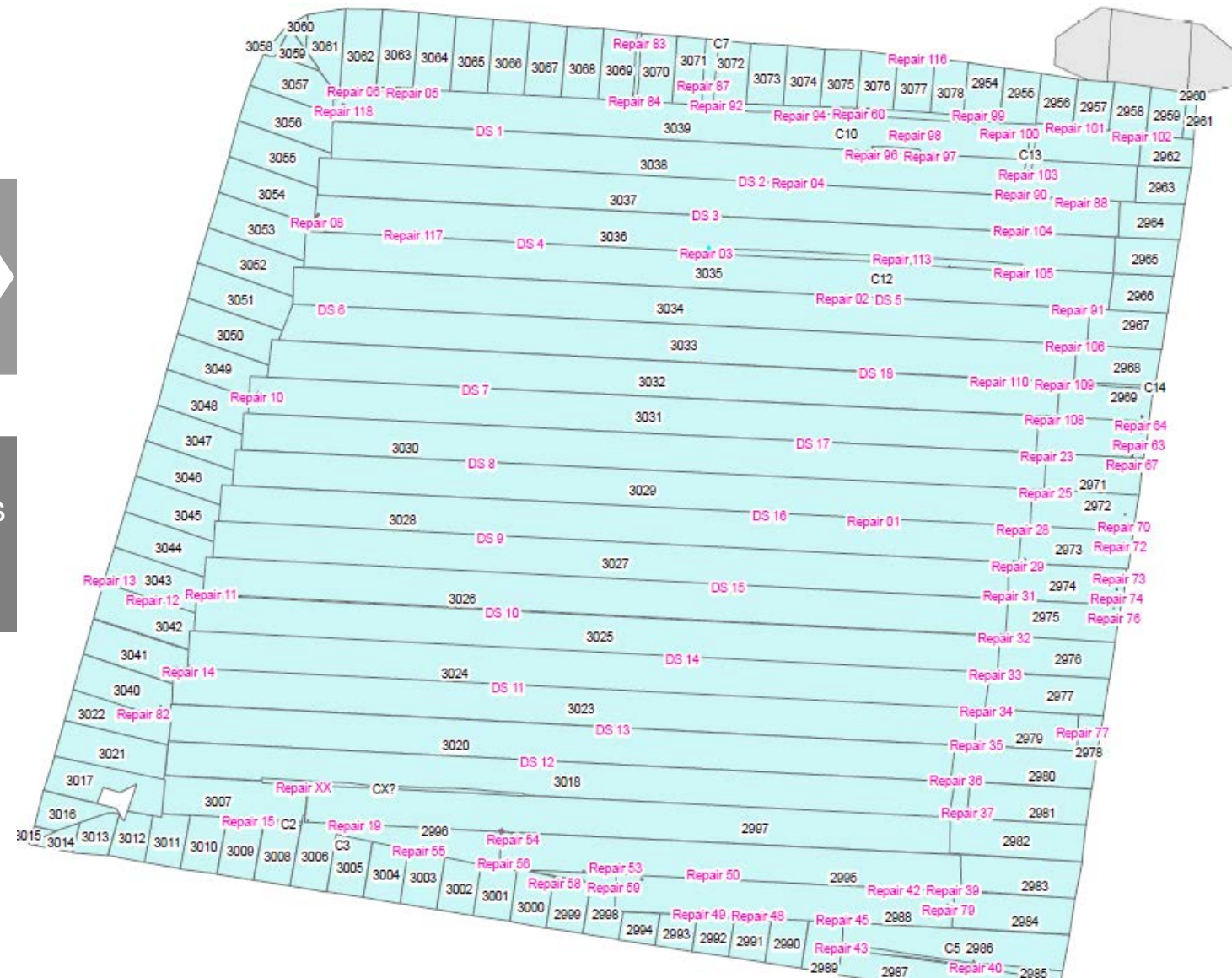
Quality Assurance

Quality control & assurance for liner



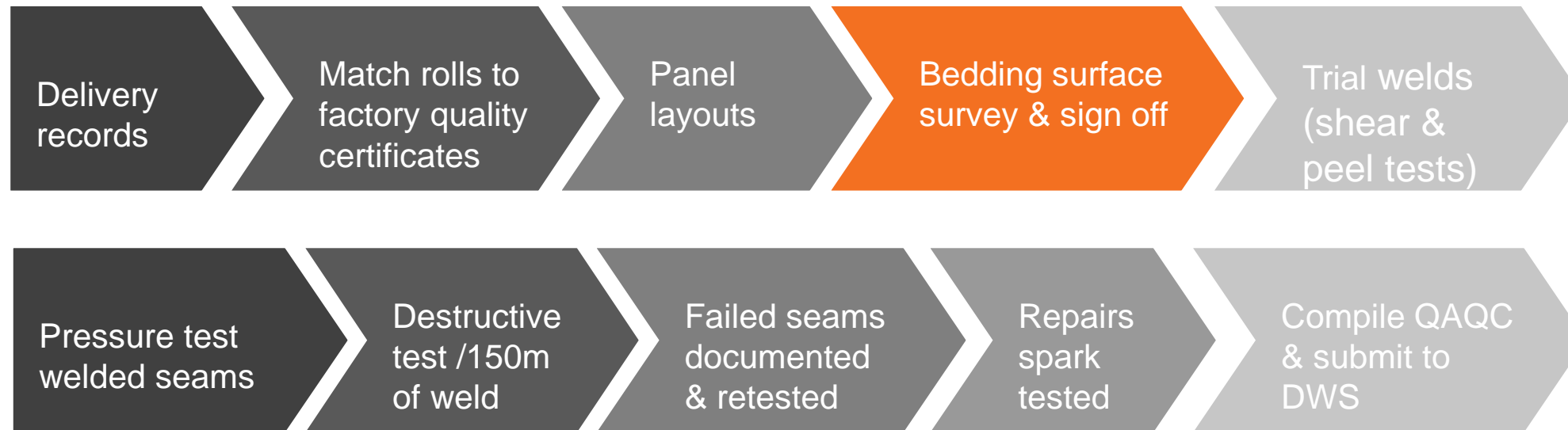
Quality Assurance

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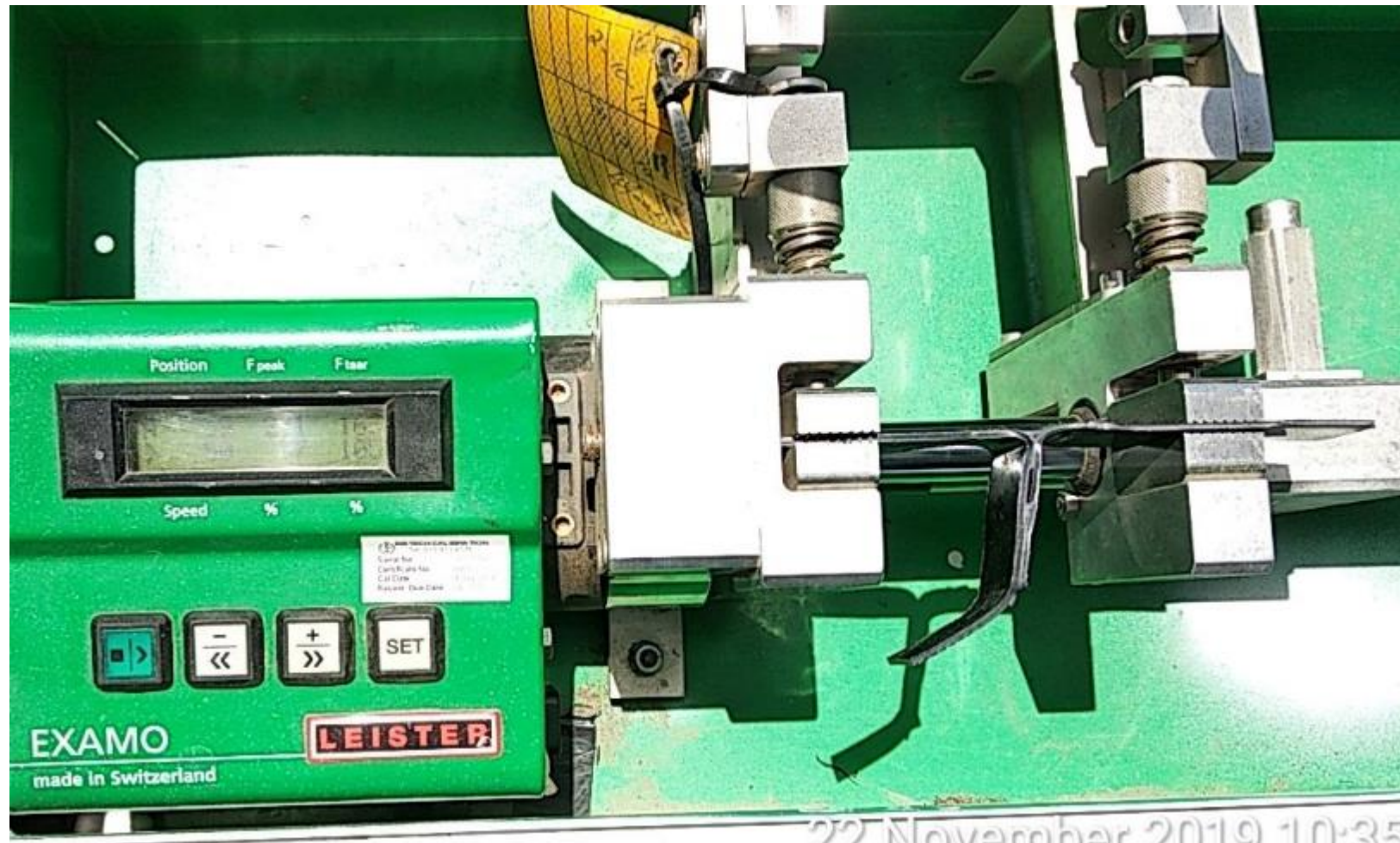
Quality Assurance

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Quality Assurance

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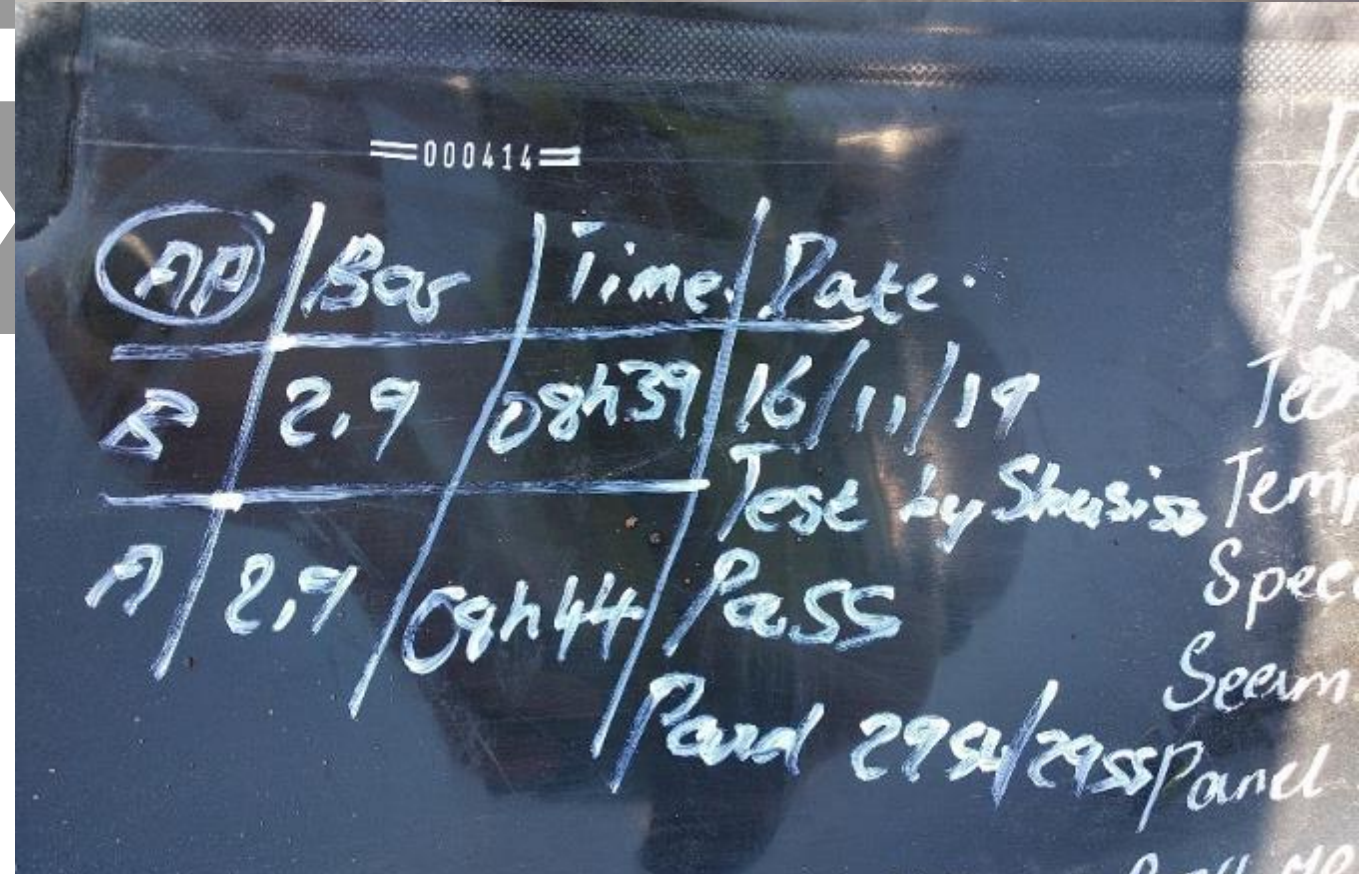
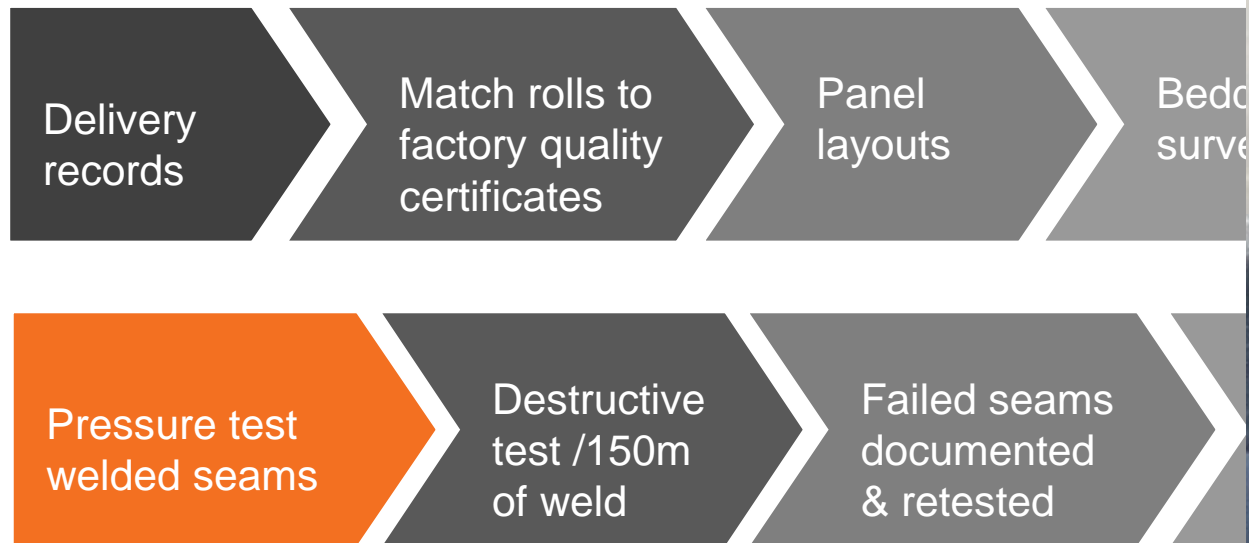


Trial welds
(shear &
peel tests)

Compile QAQC
& submit to
DWS

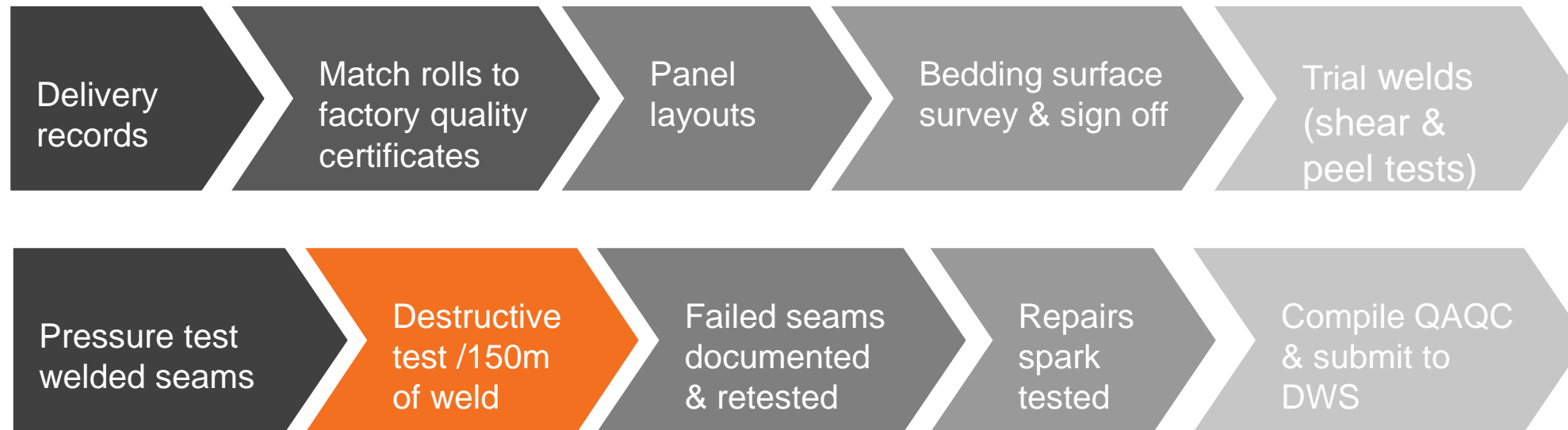
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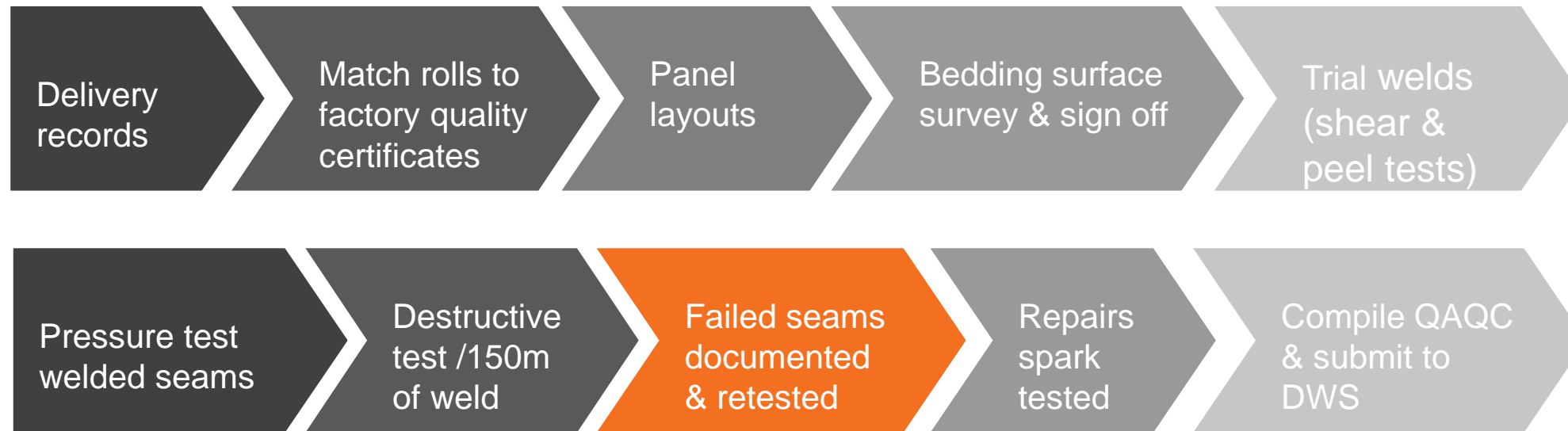
Quality Assurance

Quality control & assurance for liner



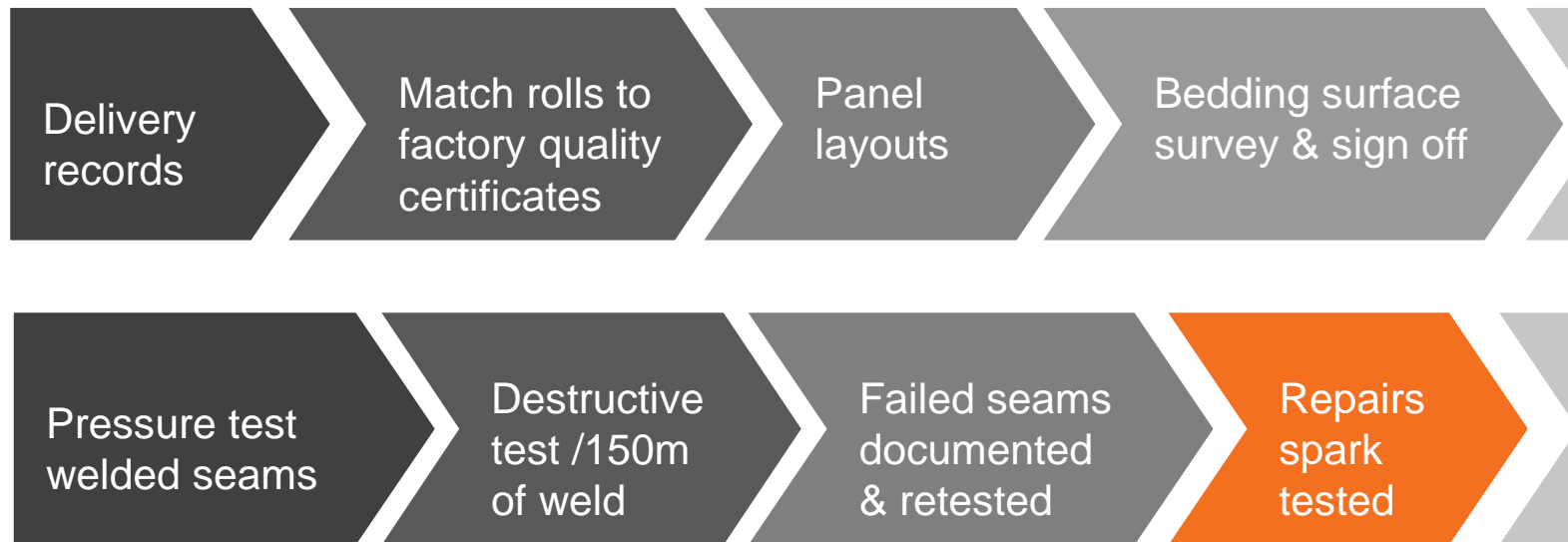
Quality Assurance

Quality control & assurance for liner



Quality Assurance

Quality control & assurance for liner



Quality control & assurance for liner

Delivery records

Match rolls to factory quality certificates

Panel layouts

Bedding surface survey & sign

PROGRESSIVE LINING INSTALLATION REPORT							QMFB
PROJECT NAME: <u>G-19 - 1st & 2nd Flare</u>		NUMBER: <u>FR 8156</u>		GRID REFERENCE: _____			
DATE	MATERIAL DESCRIPTION	ROLL NUMBER	ROLL SIZE m ² 150m x 7m =	CUT SIZE	TOTAL M ²	SIGNED	NAME
24/09/19	1.5mm HDPE Smooth	411	1050m ²	13mm	91m ²	<i>MB</i>	<i>MB</i>
24/09/19	1.5mm HDPE Smooth	411	1050m ²	13mm	91m ²	<i>MB</i>	<i>MB</i>
11	11	411	11	13mm	91m ²	11	11
11	11	411	11	13mm	91m ²	11	11
11	11	411	11	13mm	91m ²	11	11
11	11	411	11	13mm	91m ²	11	11
11	11	411	11	14mm	98m ²	11	11
11	11	411	11	14mm	98m ²	11	11
11	11	411	11	14mm	98m ²	11	11
11	11	411	11	16mm	112m ²	11	11
11	11	411	11	16mm	112m ²	11	11
11	11	411	11	16mm	112m ²	11	11
11	11	411	11	17mm	119m ²	11	11
11	11	411	11	17mm	119m ²	11	11
11	11	411	11	17mm	119m ²	11	11
11	11	411	11	18mm	126m ²	11	11
11	11	411	11	18mm	126m ²	11	11
11	11	411	11	20mm	140m ²	11	11
11	11	411	11	21mm	147m ²	11	11
24/09/19	1.5mm HDPE Smooth	411	1050m ²	21.5mm	149.8m ²	<i>MB</i>	<i>MB</i>
24/09/19	1.5mm HDPE Smooth	411	1050m ²	21.5mm	150.5m ²	<i>MB</i>	<i>MB</i>
24/09/19	1.5mm HDPE Smooth	411	1050m ²	21.9mm	153.3m ²	<i>MB</i>	<i>MB</i>

PANEL PLACEMENT LOG

QMF 10A

PAGE 1 OF 3 START DATE: 24/09/2019 GRID REFERENCE: _____

PROJECT NAME: GS19-15F & Rwd Marula PROJECT NO: FR 8156 MATERIAL DESCRIPTION: 1,5mm Haze Smooth Liner

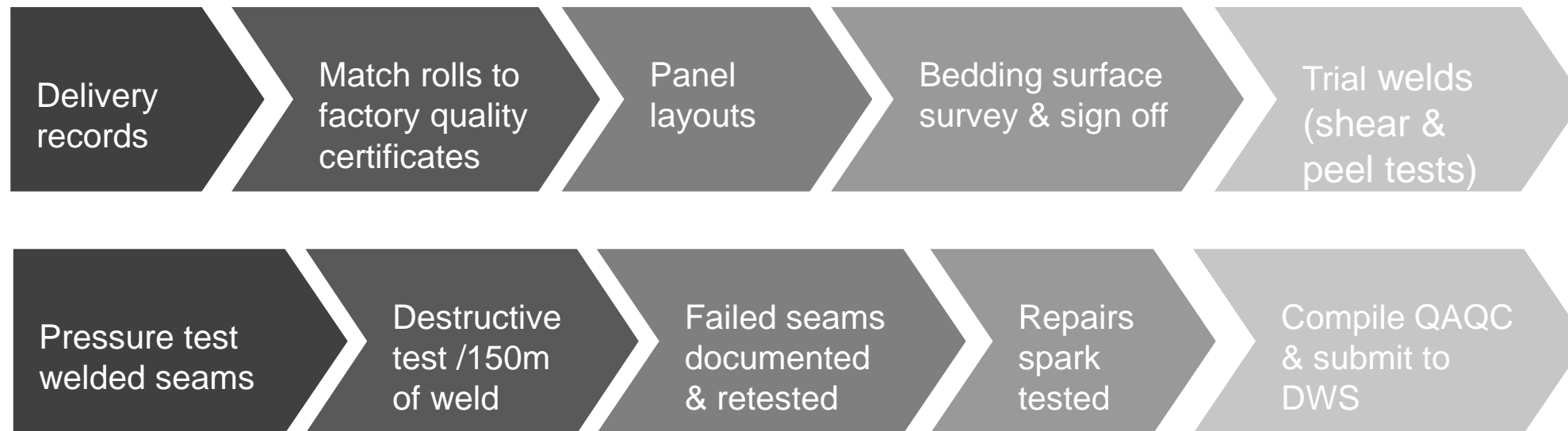
Pre
wel

PANEL LAYOUT	DATE	ROLL NUMBER	PANEL NUMBER	PANEL LENGTH	PANEL WIDTH	GROSS AREA m ²
	24/09/19	4M 459	3075	13m	7m	91m
	24/09/19	4M 459	3077	13m	7m	91m
	24/09/19	4M 459	3076	13m	7m	91m
	24/09/19	4M 459	3075	13m	7m	91m
	24/09/19	4M 459	3074	13m	7m	91m
	24/09/19	4M 459	3073	13m	7m	91m
	24/09/19	4M 459	3072	14m	7m	98m
	24/09/19	4M 459	3071	14m	7m	98m
	24/09/19	4M 459	3070	14m	7m	98m
	24/09/19	4M 459	3069	16m	7m	112m
	24/09/19	4M 443	3068	16m	7m	112m
	24/09/19	4M 443	3067	16m	7m	112m
	24/09/19	4M 443	3066	17m	7m	119m
	24/09/19	4M 443	3065	17m	7m	119m
	24/09/19	4M 443	3064	17m	7m	119m
	24/09/19	4M 443	3063	17.5m	7m	122.5m
	24/09/19	4M 443	3062	18m	7m	126m
	24/09/19	4M 443	3061	18m	7m	126m
	24/09/19	4M 443	3060	9.6m	7m	67.2m
	24/09/19	4M 443	3059	8.6m	7m	60.2m
	24/09/19	4M 443	3058	5.10m	7m	35.7m

Compile QAQC & submit to DWS

Quality Assurance

Quality control & assurance for liner

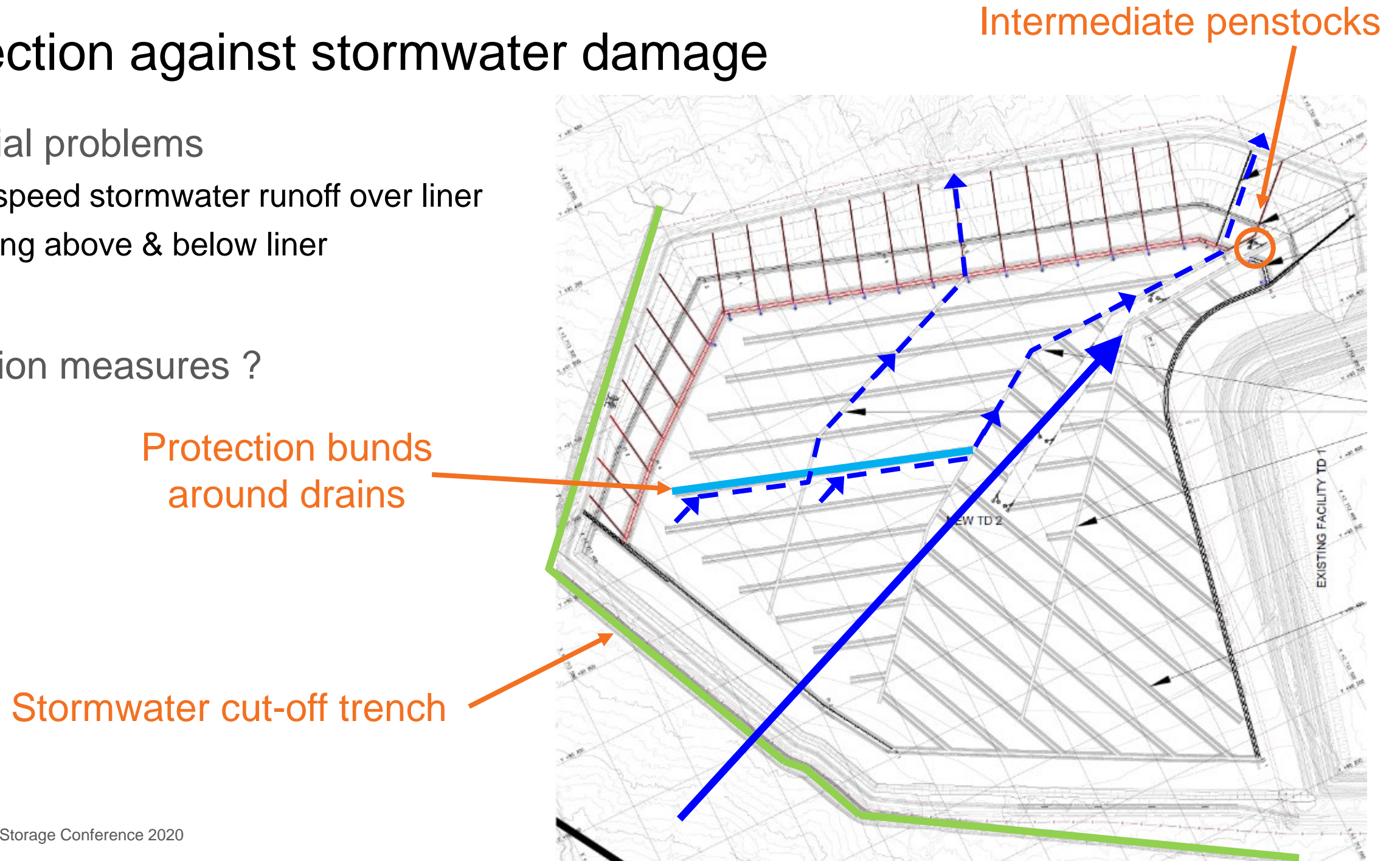


Protection against stormwater damage

Potential problems

- High speed stormwater runoff over liner
- Ponding above & below liner

Mitigation measures ?



Protection against stormwater damage



Other challenges

Trafficking over liner

Concurrent construction of liner and drains

Storage of materials

Commissioning



In conclusion:

Although there are many environmental benefits to the inclusion of a liner in a tailings dam, this does increase the **complexity** of the design, construction and operation of the tailings dam.