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Memorandum

To	**Bradley Africa**	**From**	**Jane Mahaba**
Copy	**Nikelwa Silimela**	**Reference**	**1008882**
Date	**2025-10-03**	**Pages (including this page)**	11
Subject	**194C BW-WP115: EA Steenbras WTP Access Road Repairs**		

Dear Bradley,

This memorandum outlines the construction method statements for the three slope stabilisation options proposed by Ingerop for the repair of slope failures along the access road to the Steenbras Water Treatment Plant (WTP).

1 Background and locality

The access road leading from the regional road R44 to the Steenbras WTP has recently experienced two major slope failures of its supporting embankment. One of these failures has since been repaired while the other still poses a significant risk to the stability of the road and surrounding drainage structures.

Three slope stabilisation methods were investigated and presented in the concept and viability report titled ‘CoCT Steenbras Water Treatment Plant Access Road: Slope Stabilisation and Repairs’ prepared by Ingerop in May 2024. The investigation was completed under Contract 194C/2020/21 BW-WP080. The concept and viability report termed the two failure locations ‘WTP Slope 1’ and ‘WTP Slope 2’ (henceforth Slope 1 and Slope 2) as indicated on the locality plan presented in the Figure 1-1.

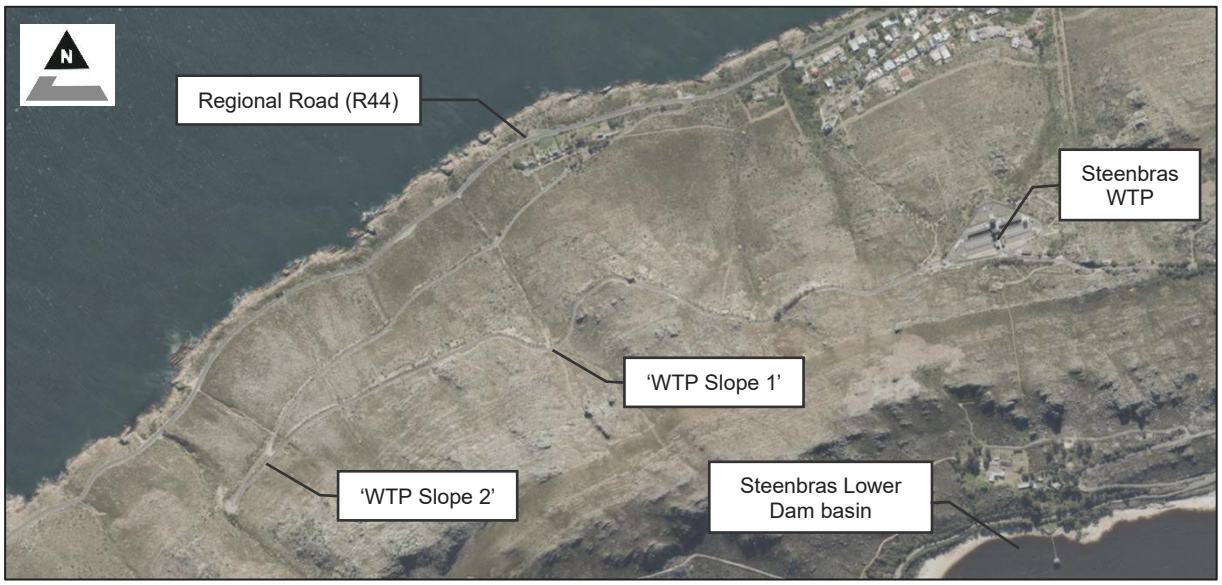

Figure 1-1: Location of slope stabilisation repair work sites

Slope 2 was repaired with a mix of concrete and gabion slope stabilisation and drainage structures. As such, this memorandum primarily focuses on the repairs to Slope 1 and outlines the construction methodologies envisaged for each of the proposed slope stabilisation methods.

2 Method statements for slope stabilisation options

2.1 General requirements applicable to all options

2.1.1 Safety considerations

► **Site safety:**

- Ensure that all personnel are trained and provided with proper PPE.
- Set up warning signs and barriers around the work area to protect workers from moving machinery and steep slopes or drop-offs.
- Use temporary barriers, safety fencing or other measures to prevent any soil, debris or construction equipment from falling down slope onto the roads below.

► **Traffic management:**

- Ensure that traffic management plans are in place to accommodate access to the Steenbras WTP.
- Ensure the safety of road traffic by providing clear signage, flagmen or traffic diversions as required.

► **Excavation safety:**

- Use proper shoring or sloping techniques when excavating deep trenches to prevent cave-ins.
- Ensure the excavation is properly graded to prevent water accumulation, which can undermine the stability of the excavation.

► **Lifting and handling:**

- Use mobile cranes or other mechanical means to lift and move heavy materials.
- Ensure all lifting equipment is inspected and rated for the weight material being lifted.

► **Personal Protective Equipment (PPE):**

- Ensure all workers wear appropriate PPE, including helmets, gloves, safety boots, and high visibility vests.
- Use of proper fall protection, such as harnesses and safety ropes, if working at heights or near steep drop-offs.

2.1.2 Environmental considerations

► **Dust control:**

Implement dust suppression measures (e.g. watering the site) to minimize dust generation during excavation and material handling.

► **Waste management:**

Properly dispose of any waste material such as unused backfill, broken geogrid or packaging material to approved disposal sites.

► **Erosion control:**

Install temporary erosion control measures like silt fences or stormwater bypass pipes for drainage during construction, especially if the retaining wall is near a water body or in a high-risk erosion area.

2.2 Option 1: Terramesh retaining wall

2.2.1 Overview and proposed cross section

This option involves using Terramesh baskets to build a retaining structure along the road edge. Terramesh baskets typically provide increased stability when compared with traditional gabion baskets due to the welded tail reinforcement. A portion of the existing roadway will need to be demolished to bench the 2 m long reinforcement tail into the slope, requiring lateral support to prevent destabilisation of the road. Excavation will pass through the talus under burden and proper shoring will be necessary. The final height of the Terramesh wall is expected to be between 4 m and 5 m based on the ground profile at the time of the investigation.

A conceptual cross-section of the Terramesh retaining wall option is provided in Figure 2-1.

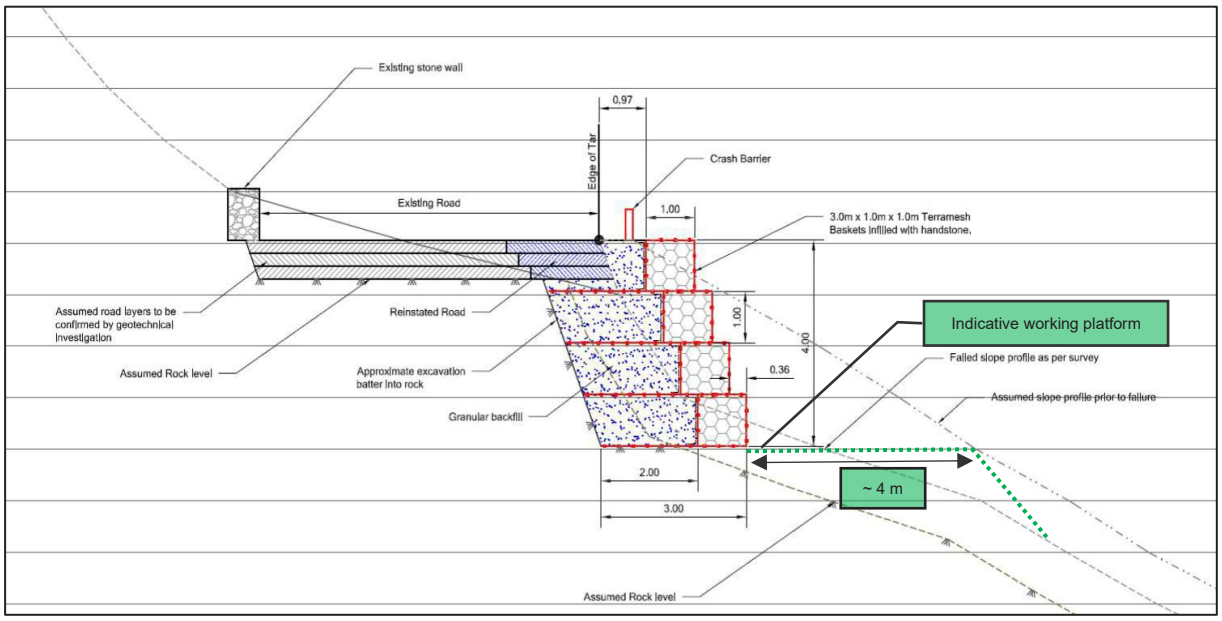

Figure 2-1: Terramesh retaining wall concept (Ingerop, 2024)

The construction footprint for the Terramesh slope stabilisation will vary based on the final height of the wall and slope conditions. A typical footprint should allow for the following:

- **Slope area**: Clear space behind the wall is required for excavation and installation. This area or footprint will be wider if the slope is steeper (an approximate 4 m wide working platform is indicated by the dotted green line in Figure 2-1).
- **Access roads**: Sufficient space for construction equipment to safely access the site including a safe path for machinery to transport excavation and backfill material as well as Terramesh units.
- **Material storage**: Designated areas should be allocated for storing fill material, Terramesh units and topsoil. These areas should be away from the slope face to prevent interfering with the installation activities.

2.2.2 Materials required

- **Terramesh units**: High-tensile galvanized steel mesh with welded mesh pockets for soil reinforcement.
- **Geogrid**: High-strength geogrid for internal reinforcement of the wall.
- **Granular fill**: Clean, free-draining granular backfill or other specified material.
- **Stone fill**: Clean, durable stones for filling the outer baskets.
- **Drainage material**: Geotextiles and perforated pipes for drainage.
- **Concrete**: For anchor foundation pads, drainage installations and road repairs as required.

- **Asphalt**: For road re-surfacing.

2.2.3 Equipment required

- Excavators, TLB's and dumper trucks.
- Compacting equipment e.g. rollers, plate compactors.
- Mobile cranes or lifting equipment for handling Terramesh units or placing machinery if required.
- Concrete mixer for small batching of foundation works (e.g. anchor pads, kerb installation etc.).
- Surveying tools e.g. dumpy level, total station or GPS.
- Welding equipment for Terramesh connections.
- Personal Protective Equipment (PPE) e.g. helmets, gloves, safety boots, high visibility vests and harnesses for working at heights.

2.2.4 Construction sequence

- **Site preparation**

  Survey and setting out:

  - Conduct a detailed survey of the site, including boundary lines, wall location including extents of access roads and working platform.

  Traffic control and access Road:

  - Set up traffic control measures to ensure road safety during construction, especially since the work area is near a road.
  - Create an access road or path for machinery to reach the work area without damaging the slope or road.

  Excavation:

  - Excavate the slope to foundation level with required width. Dispose of unusable material at approved dumping sites and stockpile useable materials at designated stockpile areas.
  - If the slope is extremely steep, temporary shoring or netting may be used during excavation to prevent soil slippage.
  - Ensure the trench base is level and stable.

  Drainage system:

  - Install drainage system, which typically consists of a perforated drainage pipe surrounded by gravel or a geotextile material.
  - The drainage should be sloped to avoid water accumulation behind the wall.

- **Foundation installation**

  Foundation preparation:

  - Place a layer of granular material at the base of the excavation for the foundation.
  - Compact the foundation material to ensure stability and mitigate future settlement (likely with a plate compactor or small roller).

  Terramesh unit installation (first layer):

  - Place the first Terramesh unit at the base of the foundation.
  - Ensure it is level and placed correctly in accordance with the design.
  - If using a geogrid, ensure it is placed in the designated pockets within the Terramesh unit.

► **Layered construction**

Adding layers:

- Stack additional layers of Terramesh units, making sure that each layer is aligned and levelled.
- Place and compact the granular fill material behind each layer of Terramesh. The layers should be compacted in layer thicknesses between 150 mm to 300 mm per lift.
- Place the stone fill in the outermost basket at the end of each lift before moving onto the installation of the next layer.

Reinforcement with geogrid:

- Place geogrid material on top of the compacted granular fill in each row before adding the next layer of Terramesh.
- Secure the geogrid at the base of each unit and extend it horizontally behind the slope.
- Ensure the geogrid overlaps with the fill material and is properly overlapped with the adjacent geogrid layer according to the suppliers' specifications.

Securing the mesh:

- Once the mesh is in place and filled, secure the ends and sides of the Terramesh units by tying the mesh to the adjacent rows using wire or fastening methods specified by the manufacturer.

► **Top layer and finishing**

Topmost layer:

- The top layer should be finished to the final height specified in the design and tie in with the reinstatement of the road layer works and drainage.
- Place any additional geotextiles and drainage materials as necessary.

► **Quality checks**

- Visual inspection: Verify the alignment, levelling and interlocking of the Terramesh units.
- Compaction tests: Ensure the backfill meets compaction requirements typically by conducting field density tests (e.g. Troxler nuclear density test).
- Drainage check: Confirm that the drainage system is functioning as designed with no blockages or issues that could lead to water retention behind the wall.

2.3 Option 2: Anchored gabion wall

2.3.1 Overview and proposed cross section

This option involves a gabion wall founded 5 m from the road edge. To stabilize the wall on the steep slope, 25 mm to 32 mm steel anchors are to be installed, extending 6 m to 9 m into the underlying rock. Minimal disturbance to the existing road is expected and limited backfill will be required behind the wall. The gabion baskets can either be left exposed with a hand-placed stone finish or be grouted to achieve a solid concrete-like appearance. The wall is expected to be approximately 5 m high based on the ground profile at the time of the investigation.

A conceptual cross-section of the anchored gabion wall option is provided in Figure 2-2.

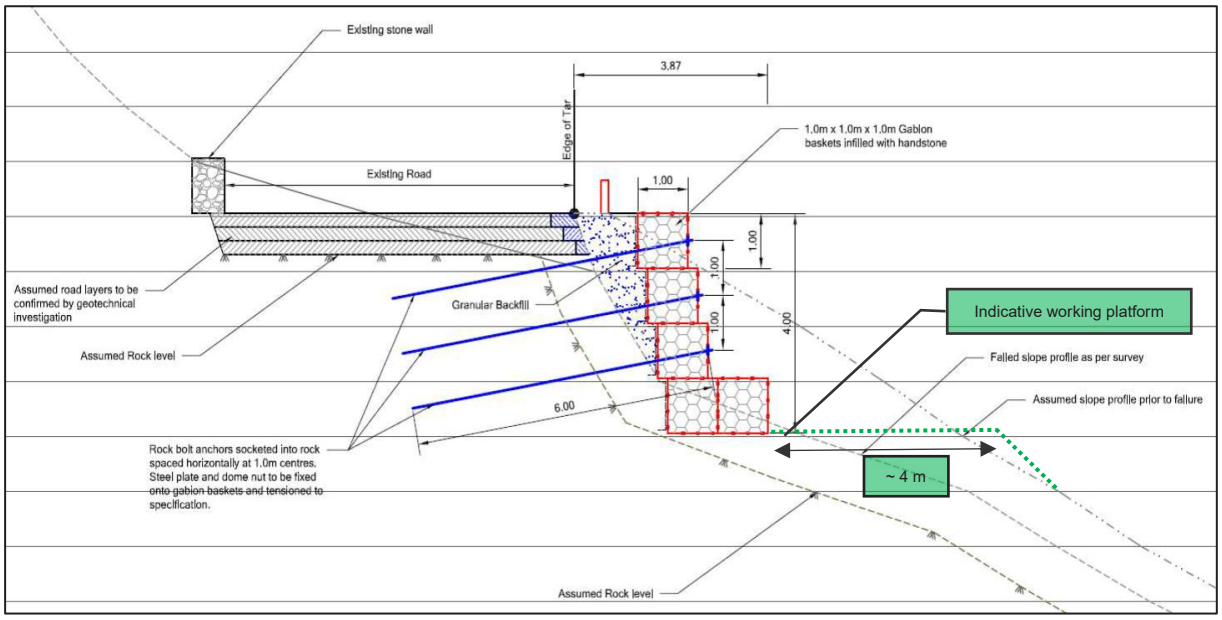

Figure 2-2: Anchored gabion wall concept (Ingerop, 2024)

The construction footprint for the anchored gabion wall is more predictable as the walls anchoring makes it less sensitive to changes in the sites surface material and slope. A typical footprint should allow for the following:

- **Slope area**: Clear space behind the wall is required for excavation and installation. This area or footprint will be wider if the slope is steeper (an approximate 4 m wide working platform is indicated by the dotted green line in Figure 2-2).
- **Access roads**: Sufficient space for construction equipment to safely access the site including a safe path for machinery to transport excavation and backfill material as well as gabion units.
- **Drilling area:** Ensure that a stable platform is provided for the establishment of the drilling rig and rods ensuring it is wide enough for safe operation.
- **Material storage**: Designated areas should be allocated for storing fill material, gabion units and topsoil. These areas should be away from the slope face to prevent interfering with the drilling and installation activities.

2.3.2 Materials required

- **Gabion baskets**: Welded or woven steel wire mesh filled with durable stones.
- **Anchor rods or cables**: Steel cables or rods with necessary fixings, anchor plates and nuts.
- **Granular fill**: Clean, free-draining granular backfill or other specified material.
- **Stone fill**: Clean, durable stones for filling the gabion baskets.
- **Geogrid or geotextile**: Optional for additional reinforcement or drainage.
- **Concrete**: For anchor foundation pads, drainage installations or road repairs (if required).
- **Steel plates**: To fix anchors to the gabion wall.

2.3.3 Equipment required

- Excavators, TLB’s and dumper trucks.
- Drilling rig to install 6 – 9 m anchors.
- Compacting equipment e.g. rollers, plate compactors.
- Mobile cranes or lifting equipment for handling gabion units or placing machinery if required.
- Concrete mixer for small batching of foundation works (e.g. anchor pads, kerb installation etc.).
- Surveying tools e.g. dumpy level, total station or GPS.

- Personal Protective Equipment (PPE) e.g. helmets, gloves, safety boots, high visibility vests and harnesses for working at heights.

2.3.4 Construction sequence

- **Site preparation**

  Survey and setting out:

  - Conduct a detailed survey of the site, including boundary lines, wall location including extents of access roads and working platform.
  - Mark the footprint of the wall and anchor locations.
  - Mark out the drilling points along the wall for the anchors, spaced as per design specifications.

  Establish the construction footprint:

  - Clear the site of any obstructions, vegetation and debris along the construction zone.
  - Ensure access roads or paths for machinery are clear, especially to transport materials and drilling equipment.

  Traffic control and access Road:

  - Set up traffic control measures to ensure road safety during construction, especially since the work area is near a road.
  - Create an access road or path for machinery to reach the work area without damaging the slope or road.

- **Excavation and foundation**

  Excavation of foundation:

  - Excavate the slope to foundation level with required width.
  - If the slope is extremely steep, temporary shoring or netting may be used during excavation to prevent soil slippage.
  - Ensure the trench base is level and stable.

  Drainage system:

  - Install drainage system, which typically consists of a perforated drainage pipe surrounded by gravel or a geotextile material.
  - The drainage should be sloped to avoid water accumulation behind the wall.

  Foundation preparation:

  - Place a layer of granular material at the base of the excavation for the foundation.
  - Compact the foundation material to ensure stability and mitigate future settlement (likely with a plate compactor or small roller).

  Preparation of foundation for anchors:

  - At each anchor point, excavate or drill to the required depth (6 m - 9 m). If concrete pads are required for anchor fixation, excavate the pad area.
  - Ensure the area is prepared for the placement of anchor rods or cables.

- **Drilling and installation of anchors**

  Drilling of holes for anchors:

  - Use a suitable drilling rig capable of drilling to the required maximum of 9 m depth and ensure the drill is aligned perpendicular to the slope.
  - Drill the holes at specified anchor locations along the gabion wall. The holes should have a diameter slightly larger than the anchor rod or cable to allow for proper placement.

Placement of steel anchors:

- Place the steel rods or cables into the drilled holes. For rods, ensure they are anchored in the bedrock or soil by inserting them into the hole and securing them with steel plates and nuts.
- If using cables, secure the cable anchors at the base and top of the slope to ensure tensioning.

Tensioning of anchors:

- Tension the anchors to the specified force as per the design, ensuring the gabion wall is securely tensioned to the slope face.

► **Installation of gabion baskets**

Placement of gabion baskets:

- Start at the base of the slope and place the first row of gabion baskets on the foundation material.
- Align the baskets according to the setting out points, ensuring they are level and flush with the founding surface.

Filling the gabion baskets:

- Fill each gabion basket with clean, durable stone, ensuring the stones are packed tightly without gaps. The stone fill should meet the specified design size.

Securing the baskets:

- Once the baskets are filled, tie or weld the top and side meshes securely to close them.
- Check the integrity of each layer and ensure no basket is deformed or improperly secured.

► **Backfilling and securing the wall with anchors**

Securing the first layer of gabions to anchors:

- As the first layer of gabion baskets is installed, begin attaching the anchor cables or rods to the mesh of the baskets.
- Attach the anchor plates securely to the gabion mesh using nuts and bolts.
- Backfill the area behind the wall with suitable granular material. Compact each layer of backfill to reduce settlement
- Tighten each anchor to the required tension.

Continue layering and anchor installation:

- Continue installing subsequent layers of gabion baskets, ensuring each layer is filled and secured in the same way.
- At each level, install additional anchors as specified in the design.

► **Final layer and wall completion**

Final anchor lightening:

- Once all layers are completed, complete top layer works including tie-in with the roadway and drainage system.
- Perform a final check on the anchors, ensuring they are tensioned to the design specification.

► **Quality checks and inspection**

Visual inspection:

- Perform a visual inspection of the wall to check for alignment, proper stone filling and any possible gaps in the mesh.

2.4 Option 3: Green Terramesh slope reinstatement

2.4.1 Overview and proposed cross section

The Green Terramesh system (GTMS) is similar to the Terramesh concept but replaces the stone fill on the outer face with a topsoil infill. The system's front face promotes plant growth and the final structure is expected to be 5 m to 6 m in height, with a slope batter of about 40 degrees. The solution aims to stabilize the slope rather than act as a traditional retaining wall.

A conceptual cross-section of the green Terramesh slope remediation option is provided in Figure 2-3.

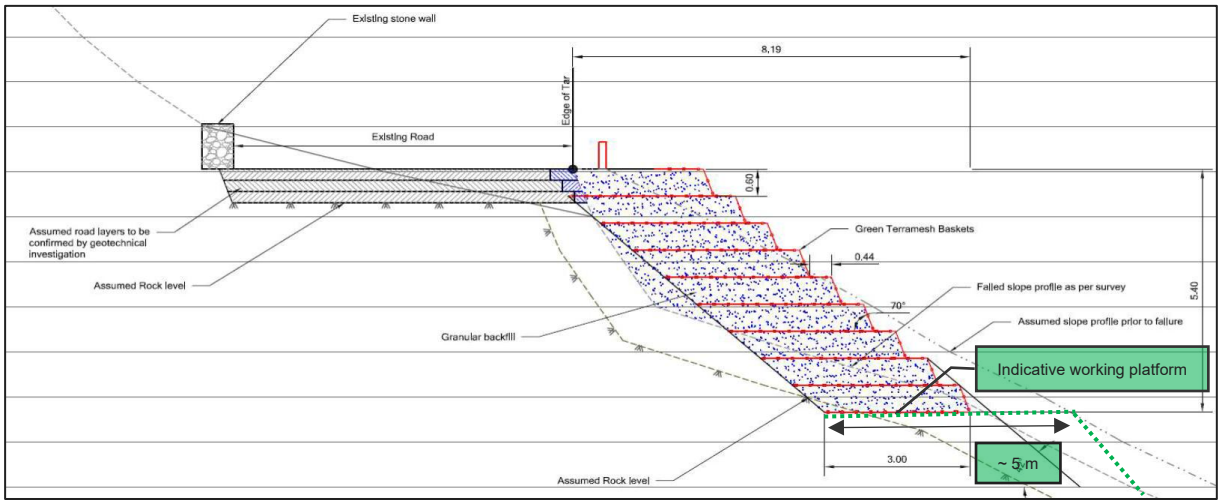

Figure 2-3: Green Terramesh slope remediation concept (Ingerop, 2024)

The construction footprint for the green Terramesh slope stabilisation will vary based on the final height of the wall and slope conditions. A typical footprint should allow for the following:

- **Slope area**: Clear space behind the wall is required for excavation and installation. This area or footprint will be wider if the slope is steeper (an approximate 5 m wide working platform is indicated by the dotted green line in Figure 2-3).
- **Access roads**: Sufficient space for construction equipment to safely access the site including a safe path for machinery to transport excavation and backfill material as well as Terramesh units.
- **Material storage**: Designated areas should be allocated for storing fill material, Terramesh units and topsoil. These areas should be away from the slope face to prevent interfering with the installation activities.

2.4.2 Materials required

- **Terramesh units**: High-tensile galvanized steel mesh, pre-assembled with soil pockets for vegetation growth.
- **Geogrid**: High-strength geogrid for internal reinforcement of the wall.
- **Granular fill**: Clean, free-draining granular backfill or other specified material
- **Topsoil**: Suitable soil for planting, providing nutrients and good drainage for plant growth.
- **Vegetation**: Grass, shrubs and other specified plants for slope coverage.
- **Hydraulic mulch, erosion control blanket or eco soil logs**: To protect the soil from erosion and promote vegetation establishment.
- **Irrigation system**: Drip irrigation for vegetation establishment.
- **Drainage material**: Geotextiles and perforated pipes for drainage.
- **Concrete**: For anchor foundation pads, drainage installations or road repairs (if required).

2.4.3 Equipment required

- Excavators, TLB's and dumper trucks.
- Compacting equipment e.g. rollers, plate compactors.
- Mobile cranes or lifting equipment for handling Terramesh units or placing machinery if required.
- Concrete mixer for small batching of concrete works (e.g. anchor pads, kerb installation etc.).
- Surveying tools e.g. dumpy level, total station or GPS.
- Watering equipment.
- Welding equipment for mesh connections.
- Personal Protective Equipment (PPE) e.g. helmets, gloves, safety boots, high visibility vests and harnesses for working at heights.

2.4.4 Construction sequence

- **Site preparation**

  Survey and setting out:

  - Conduct a detailed survey of the site, including boundary lines, wall location including extents of access roads and working platform.

  Traffic control and access Road:

  - Set up traffic control measures to ensure road safety during construction, especially since the work area is near a road.
  - Create an access road or path for machinery to reach the work area without damaging the slope or road.

  Excavation:

  - Excavate the slope to foundation level with required width.
  - If the slope is extremely steep, temporary shoring or netting may be used during excavation to prevent soil slippage.
  - Ensure the trench base is level and stable.

  Drainage system:

  - Install drainage system, which typically consists of a perforated drainage pipe surrounded by gravel or a geotextile material.
  - The drainage should be sloped to avoid water accumulation behind the wall.

- **Foundation installation**

  Foundation preparation:

  - Place a layer of granular material at the base of the excavation for the foundation.
  - Compact the foundation material to ensure stability and mitigate future settlement (likely with a plate compactor or small roller).

  Terramesh unit installation (first layer):

  - Place the first Terramesh unit at the base of the foundation.
  - Ensure it is level and placed correctly in accordance with the design.
  - The green Terramesh units should be laid to ensure that the mesh faces back into the slope (leaning into the hillside) to provide adequate support and mitigate erosion.
  - If using a geogrid, ensure it is placed in the designated pockets within the Terramesh unit.

► **Layered construction**

Adding layers:

- Stack additional layers of Terramesh units, making sure that each layer is aligned and levelled.
- As you move upward, the units should slightly lean back, ensuring that the wall steps back into the slope, providing stability and mitigating erosion of the topsoil.
- Place and compact the granular fill material behind each layer of Terramesh. The layers should be compacted in layer thicknesses between 150 mm to 300 mm per lift.
- The outermost basket should be filled with topsoil material and compacted to a lesser density as specified by the design.

Reinforcement with geogrid:

- Place geogrid material on top of the compacted granular fill in each row before adding the next layer of Terramesh.
- Secure the geogrid at the base of each unit and extend it horizontally behind the slope.
- Ensure the geogrid overlaps with the fill material and is properly overlapped with the adjacent geogrid layer according to the suppliers' specifications.

Securing the mesh:

- Once the mesh is in place and filled, secure the ends and sides of the Terramesh units by tying the mesh to the adjacent rows using wire or fastening methods specified by the manufacturer.

► **Vegetation and soil stabilisation**

Topsoil application and vegetation:

- On the topmost row of Terramesh units, apply a layer of topsoil that is suitable for planting.
- Plant the specified vegetation into the topsoil. Ensure the vegetation is appropriate for the local climate and soil conditions.

Mulching and erosion protection:

- Apply a layer of mulch over the topsoil to help retain moisture, reduce erosion and support plant growth.
- Use netting, erosion control blankets or soil eco logs to protect the topsoil from erosion while vegetation establishes.

Watering and irrigation:

- Install a drip irrigation system (or equivalent) to ensure the plants receive sufficient moisture during their establishment period.
- Ensure the irrigation system is connected to a water source and properly functioning to distribute water evenly across the plants.

3 Conclusion

The construction method statements contained in this memorandum should be updated in future design stages to incorporate the additional design details. For example, the details of the temporary and permanent drainage designs are not yet complete and thus were not included in this memorandum.

Similarly, the expected construction footprints will need to be refined based on the option selected, updated topographical survey data and confirmation of the contractors access and safe working space requirements.