GCL Installation Guide

Unlaminated GCL and Heavy Duty Laminated GCL systems

Issue 1 • Revision 4 | 3 November 2026

Practical guidance for installers, designers and asset owners. Confirm the grade and joint detail, maintain direct GCL contact and protect the liner until continuous compatible confinement is in place.

Use this guide with the project specification, issued drawings, order TDS and CQA plan. The drawings are typical schematics and do not replace project design.

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01 Use the right installation detail

A geosynthetic clay liner (GCL) relies on continuous bentonite, sound overlaps, compatible adjacent materials and confinement. This guide sets out the installation sequence and inspection requirements for Kontain GCL systems.

Scope and application

This guide covers Kontain GCL Standard (GCL-S), GCL Heavy (GCL-H) and GCL Polymer (GCL-P), plus Heavy Duty Laminated GCL HDL-GCL 020 and HDL-GCL 050. It applies to earth-lined ponds, containment cells, caps and similar buried systems. Use separate details for building waterproofing, permanent exposed liners and specialist vertical systems.

Four controls that apply throughout

- Confirm the actual product, face orientation, factory seam treatment, liquid chemistry and accepted installation schedule before opening rolls.
- Place GCL on accepted subgrade, flat and without tension. Keep plant off exposed GCL and protect against premature hydration.
- Maintain direct GCL-to-GCL contact at bentonite overlaps. For laminated material, follow the supplied overlap detail and keep polyethylene (PE) out of the specified GCL contact plane.
- Inspect seams and details before concealment, then place continuous, compatible confinement promptly. A loose laminate lap is not a welded membrane seam.

Project documents

Use the approved project specification, drawings, installation method, construction quality assurance (CQA) plan and order TDS with this guide. Resolve conflicting requirements with the designer and Kontain before work proceeds.

Reading the dimensions

Slope ratios are vertical:horizontal: 1V:4H means one metre vertically over four metres horizontally. Measure lap widths after alignment and movement. Apply the dimensions in this guide unless the approved project requires larger dimensions or a separately designed detail.

Document control

Kontain GCL Installation Guide • Issue 1, Revision 4 • 3 November 2026. Covers unlaminated GCL and the 0.20 mm LDPE and 0.50 mm LLDPE laminated options.

02 Select the construction and chemistry

Select the grade and bentonite formulation for the project. The order must identify the construction, declared properties, factory edge configuration and manufacturing lot.

Product families

Product	Construction and use	Installation consequence
GCL-S Standard	Unlaminated reinforced bentonite GCL with standard carrier construction.	Use fine, smooth contact surfaces and the accepted grade-specific protection schedule.
GCL-H Heavy	Unlaminated GCL with a heavy composite woven and nonwoven carrier.	Verify the exposed faces, puncture resistance and hydrated internal and interface shear performance.
GCL-P Polymer	Unlaminated polymer-modified natural sodium bentonite powder in a reinforced GCL.	Test the formulation against actual soil, hydration water and service liquid. Use compatible seam accessories.
HDL-GCL 020	Heavy composite carrier, ≥4,000 g/m² dry natural sodium bentonite powder excluding polymer, polymer modification and 0.20 mm LDPE film.	Place PE towards the contained liquid unless the project section specifies otherwise. Maintain direct GCL contact beneath the PE overlap. No extrusion sealing or wedge welding.
HDL-GCL 050	Heavy composite carrier, ≥4,000 g/m² dry natural sodium bentonite powder excluding polymer, polymer modification and 0.50 mm LLDPE film.	Maintain direct GCL contact beneath the PE overlap. Use a qualified extrusion-sealing procedure. No wedge welding.

Laminated construction requirements

Both HDL-GCL grades use natural sodium bentonite powder with polymer modification. PE is bonded to the upper nonwoven outside the 400 mm released longitudinal edge zones. The specified PE-to-nonwoven peel strength is ≥300 N/m in bonded areas.

The PE film is specified by nominal thickness and resin type.

Rolls and cores

A common roll format is 5 m × 30 m, providing 150 m² gross area before overlaps, cuts and waste. Confirm the ordered dimensions, gross roll mass, core clear bore and core condition before selecting lifting equipment. Plastic and steel cores require a handling system rated for the actual support arrangement.

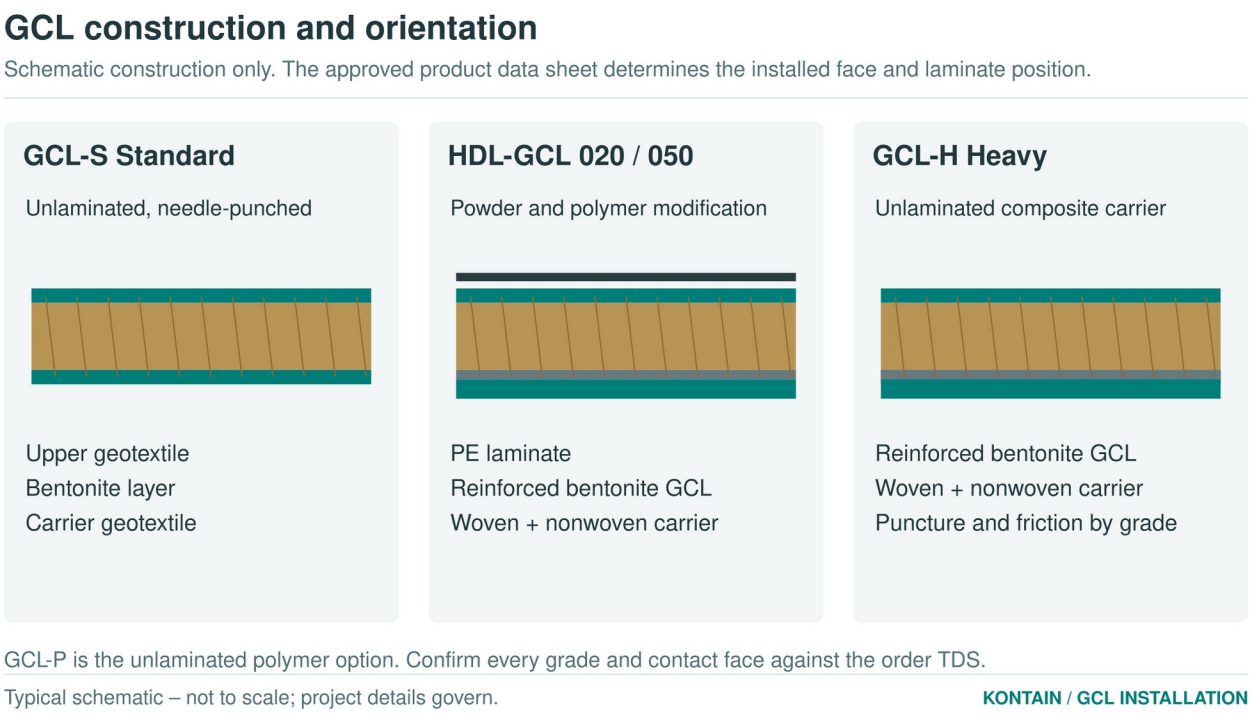
Granular or powdered bentonite

Unlaminated products are supplied to the bentonite formulation in the order TDS. HDL-GCL 020 and HDL-GCL 050 use powder with polymer modification. Handle bentonite and seam accessories in accordance with their safety data sheets (SDS).

Dust and housekeeping

Handle accessory bentonite close to the work, avoid pouring from height and protect against wind. Follow the SDS for respirable dust and any crystalline-silica content, eye protection and respiratory controls. Do not suppress dust by wetting unconfined GCL or prepared seams. Keep bentonite out of drainage layers; wet spills are slippery.

Figure 1 Product construction and orientation



Confirm the actual upper and lower contact faces against the order TDS. HDL-GCL combines the heavy composite carrier, polymer-modified powder bentonite and nominated PE film.

03 Plan the work before delivery

Set the product, construction sequence and inspection hold points before the crew arrives. Most installation problems are easier to prevent at this stage.

Designer's requirements

- Confirm hydraulic duty, allowable leakage, maximum head, service life, seasonal exposure, groundwater uplift, gas generation and the role of each liner layer.
- Accept subgrade and cover materials, their chemistry, grading, particle shape, moisture condition, density, thickness and erosion controls.

- Check internal and interface shear, slope veneer stability, settlement, anchorages, toe restraint, drawdown and construction loading.
- Issue seam, penetration, structure, repair and transition details, plus any welding and membrane testing specification.
- Define hydration and commissioning requirements, including compatibility testing and any controlled prehydration.

Installer's preparation

- Provide a panel layout with roll direction, seam sequence, crest-to-toe panels, end-lap positions, anchor trenches and access routes. Stagger end joints; avoid four-panel junctions.
- Agree daily deployment limits based on weather, inspection availability and cover-placement capacity. Identify temporary runoff diversion and secure overnight protection.
- Prepare a task-specific lifting and deployment method: plant capacity at working radius, ground bearing, roll gross mass, rated accessories, core compatibility, exclusion zones and communication.
- Confirm trained personnel, cutting boards, spare blades, compatible bentonite, repairs, soft ballast, temporary covers and spill controls. Welding requires a qualified crew and approved procedure.
- Plan a representative trial where aggregate, compaction, equipment or seam geometry is unfamiliar. Inspect the GCL after trial loading before accepting the method.

Quality documentation

Retain current TDS and SDS, the roll and lot register, manufacturing quality records, conformance certificates and the adopted installation guide. Check that certificates identify the supplied grade and production lot.

Release of work

The installer checks and records the work. The nominated CQA inspector releases the agreed hold points; the designer resolves design departures. Kontain provides product-specific details. Record acceptance before covering the work.

04 Unload, handle and store rolls

Use lifting equipment rated for the roll mass, plant radius and actual core support arrangement.

Receiving inspection

- Check roll number, lot, product construction, laminate thickness, dimensions, gross mass and order schedule before unloading.
- Inspect wrapping, roll ends and accessible core bore for tears, water ingress, displaced material, crushing, cracks, corrosion damage, distortion or obstruction. Photograph defects against the roll number.
- Quarantine wet, damaged or unidentified rolls for a written disposition. Do not assume apparently dry external wrapping proves a dry core.

Safe lifting and deployment

- Use an engineered, rated spreader beam with a compatible full-length mandrel, or an approved core-prong system designed for its engagement and support arrangement. The lowest-rated component and the plant's capacity at the actual radius govern.
- Check mandrel outside diameter against the measured clear core bore, including ovality and insertion clearance. Do not force a mandrel through a damaged core.
- Keep the roll level, control swing and use the planned exclusion zone. No person may stand beneath a suspended roll or between the roll and a fixed object.
- Never improvise with a bare forklift tine, lift by wrapping, drag a roll, drop it from a truck or concentrate sling pressure on roll ends. Use forklifts only with approved handling attachments and the agreed method.
- Control the unrolling operation. Never allow a roll to free-run down a slope. Keep hands and clothing away from nip points.

Storage

- Store horizontally, chocked against rolling, on a smooth, firm, dry and drained surface with suitable continuous support or designed dunnage. Prevent point loading and ground moisture entry.
- Keep original wrapping intact until deployment and repair damage promptly. Use secure waterproof covers for outdoor storage, arranged to shed rain and prevent ponding.
- Use the stack arrangement and height specified in the documented product handling and lifting plan. Do not assume a universal number of rolls is safe.

- Separate from traffic, oils, chemicals, sparks and sharp objects. Keep accessory bentonite sealed, dry and traceable. Use older accepted stock first and reinspect after severe weather.

After use

Manage empty steel and plastic cores as heavy, rollable items. Stack securely and arrange reuse or recycling through an appropriate facility. Do not cut, weld or modify a loaded core or lifting assembly on site.

05 Accept the subgrade

The GCL must remain supported throughout. It must not bridge a rut, open crack, pipe trench or abrupt change in level.

Required surface condition

- Trim to the design lines and levels. Provide a firm, smooth, stable surface free of standing water, pumping, uncontrolled seepage, frost and ice.
- Remove vegetation, roots, rubbish, sharp stone, construction debris and protrusions. Fill cracks, voids and ruts with approved compacted material.
- Round changes in grade and anchor-trench corners. Compact pipe-trench backfill and local repairs to the project specification so later settlement does not strain the liner.
- Confirm groundwater and gas relief where needed. Do not create drainage beneath the GCL without the designer accepting its hydraulic and stability effects.
- Verify the accepted material remains chemically compatible. A smooth soil can still be unsuitable because of salts, lime or other constituents.

Moisture and compaction

The subgrade need not be oven-dry. It should be at the accepted compaction and moisture condition, with no free water or softened surface. Compatible, slightly moist soil can later supply hydration moisture under confinement. Complete compaction and inspection before deployment; do not attempt to compact the foundation through the GCL.

Granular subgrades and steep slopes

Use firm, well-graded material with a smooth trimmed surface and no projecting stones or open voids. Check particle shape, chemistry, hydration availability and internal stability. Where GCL forms the sole or primary hydraulic barrier, provide a sufficiently fine, close-textured surface to prevent bentonite migration into voids. Assess hydraulic support, puncture resistance and interface shear before changing the specified subgrade.

Protection layers

A fine soil cushion or purpose-selected geotextile may be required where subgrade particles or local stress could damage the GCL. Specify the protection through puncture assessment and a representative installation trial. A geotextile adds another potential slip plane and does not isolate bentonite from dissolved salts or calcium.

Hold point: subgrade release

Record the area, levels, surface condition, drainage, material acceptance, compaction results and photographs. Reinspect after rain, trafficking, erosion or a delay. Repair damaged areas before rolling out GCL; do not conceal defects beneath it.

06 Check soil and liquid compatibility

Check the subgrade, cover soil, hydration water and service liquid for compatibility with the selected bentonite formulation.

Lime and high-calcium materials

Do not use lime-treated or cement-treated soil, fresh concrete washout, or unassessed lime-bearing cover directly against conventional sodium-bentonite GCL. High dissolved calcium or magnesium can exchange with sodium and reduce swelling. High ionic strength and extreme chemistry can also affect performance.

Limestone is not the same as lime

Limestone, dolomite, gypsum, shell-rich fill and recycled concrete require chemical assessment; do not accept them merely because no lime stabiliser was added. Total carbonate content is a screening indicator, not a complete measure of the liquid that will reach the bentonite. Conversely, not all crushed rock contains limestone. Confirm the quarry source and representative soil leachate or pore-water chemistry.

What to test

- Assess subgrade, cover, groundwater, hydration water and service liquid, including expected seasonal or process changes.
- Screen pH, electrical conductivity or salinity, calcium, magnesium and process-specific contaminants.
- Test hydraulic compatibility using the intended hydration sequence, confinement and liquid. ASTM D6766 applies to geotextile-backed GCL specimens. For HDL-GCL, test a representative unlaminated GCL component within that method's scope and assess the assembled laminate and joints separately.
- Set hydraulic acceptance criteria and test duration in the project specification.

Polymer modification

Polymer modification is selected to improve saline-liquid performance and resistance to desiccation cracking during temporary exposure of the PE face. Use compatible polymer-modified seam accessories and assess the actual service liquid and hydration sequence.

Repeated wetting and drying can create wide cracks that do not close reliably after covering, particularly with saline hydration, high-calcium contact or aggressive acidic or alkaline liquids. Inspect cracking, shrinkage and bentonite condition before covering. Replace unacceptable material or follow an issued repair detail.

Specified swell requirements

ASTM D5890 applies to the unmodified natural sodium bentonite. Use hydraulic-compatibility testing to assess the intended service liquid.

Material and test fluid	Required swell	Test method
Unmodified base natural sodium bentonite in reagent water	≥24 mL/2 g	ASTM D5890
Polymer-modified natural sodium bentonite	>28 mL/2 g	
Polymer-modified bentonite in 20,000 ppm salt water	>22 mL/2 g	

PE face protection

The PE laminate provides an additional barrier over the GCL face. Liquid can reach bentonite at laps, terminations, defects and from below, so the contact materials must remain compatible.

Protective cushions

A soil cushion provides physical protection. Dissolved constituents can migrate through it, so use chemically compatible cover or verify the complete contact system.

07 Select the contact and cover materials

Particle size, angularity, chemistry, confinement and construction load act together. There is no single maximum stone size that fits every GCL.

Contact material requirements

Configuration	Direct contact material	Acceptance requirement
Standard GCL	Prefer fine, well-graded soil or selected sand/fine gravel. A 25 mm maximum is an upper screening limit, not automatic approval.	Use a smaller limit or cushion where the grade, angularity, loading or trial requires it. Remove sharp projections.
Heavier composite-base GCL	Crushed aggregate up to 25 mm may be placed directly on an accepted grade.	Require accepted chemistry with no lime-bearing contamination, puncture/protection assessment and a successful trial using actual aggregate, plant and lifts.
Laminated GCL	Follow both the GCL and PE protection requirements.	The laminate may be more vulnerable than the base GCL. Heavy base construction alone does not justify aggregate directly on a thin film.

Configuration	Direct contact material	Acceptance requirement
Coarser, open-graded or very angular material	No general direct-contact approval.	Design a finer protective layer or suitable geotextile, and verify puncture, interface stability and placement.
Aggressive or saline contact materials	No default acceptance for conventional bentonite.	Test compatibility; change the material, bentonite formulation or barrier design as necessary.

Confinement thickness

Provide at least 300 mm of accepted soil cover, or the greater project requirement. Frequent construction traffic commonly requires at least 600 mm. Design cover thickness for the actual plant, repeated loading, turning and braking, and verify the placement method by trial.

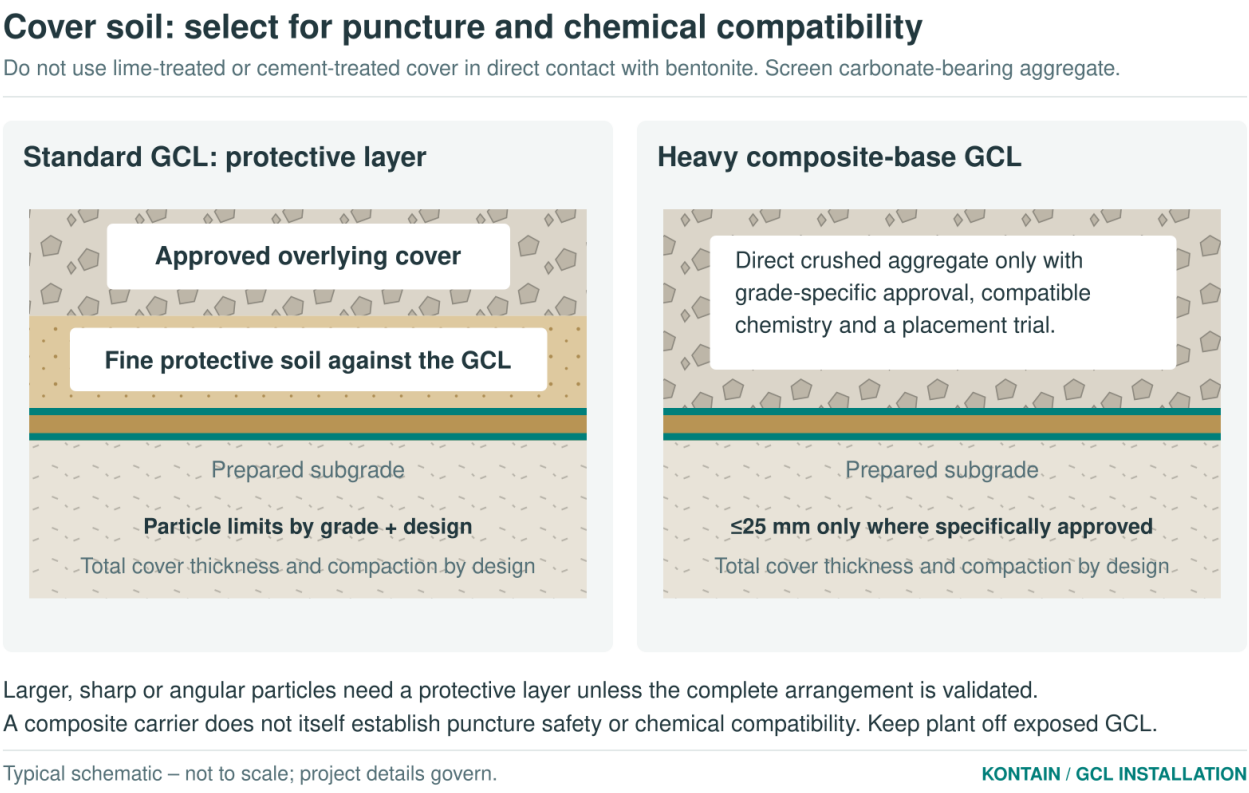
Grading and stability

Provide material that can be placed uniformly without segregation, bridging or displacement. Confirm density, moisture, drainage, filter compatibility and resistance to erosion or dispersion. Clean sand, highly plastic clay and angular crushed rock each have different risks; none is universally preferred. Do not assign long-term cohesion from appearance or dry apparent strength.

Where a cushion is used

Specify its accepted material, thickness and placement method separately. Check both sides of every added geotextile for stability. Maintain total confinement across seams, repairs, slopes and penetrations. Keep sharp erosion-control rock away from the GCL unless the complete protection system is verified.

Figure 2 Cover material profiles



The 300 mm confinement baseline is not a pavement design. Confirm chemistry, puncture protection, interface stability and the placement trial for the actual materials.

08 Design the slopes and anchorages

A slope ratio is a starting geometry, not a product rating. Stability must cover installation, filling, operation and drawdown.

Indicative geometries

Design each slope using hydrated internal and interface shear properties. A 1V:4H layout is a common starting geometry; a 1V:2H layout requires a project-specific stability design. The composite carrier or tensile strength alone does not establish a permissible slope.

What the stability check must include

- Hydrated GCL internal shear and every interface, including PE-to-soil, geotextile-to-soil, added cushions and adjacent geomembranes.
- Representative normal stress, density, moisture, hydration history, drainage and shear displacement. Select peak, large-displacement or residual strength for the actual failure mechanism.
- Cover thickness and weight, pore-water pressure, seepage, rapid drawdown, construction loads, toe support, settlement and seismic loading where relevant.
- Long-term reinforcement behaviour, anchor-trench pull-out and the sequence of covering and filling. Do not rely on tensile strength or anchorages to stabilise an otherwise sliding cover veneer.

Granular contact layers

Well-graded granular materials above and below a composite-base GCL can be useful where friction governs. Their use must be verified with the actual exposed geotextile faces. A smooth PE laminate on top can still control stability even when the underside has high friction. Change the subgrade or cover only through an approved design; protect against puncture and confirm chemistry.

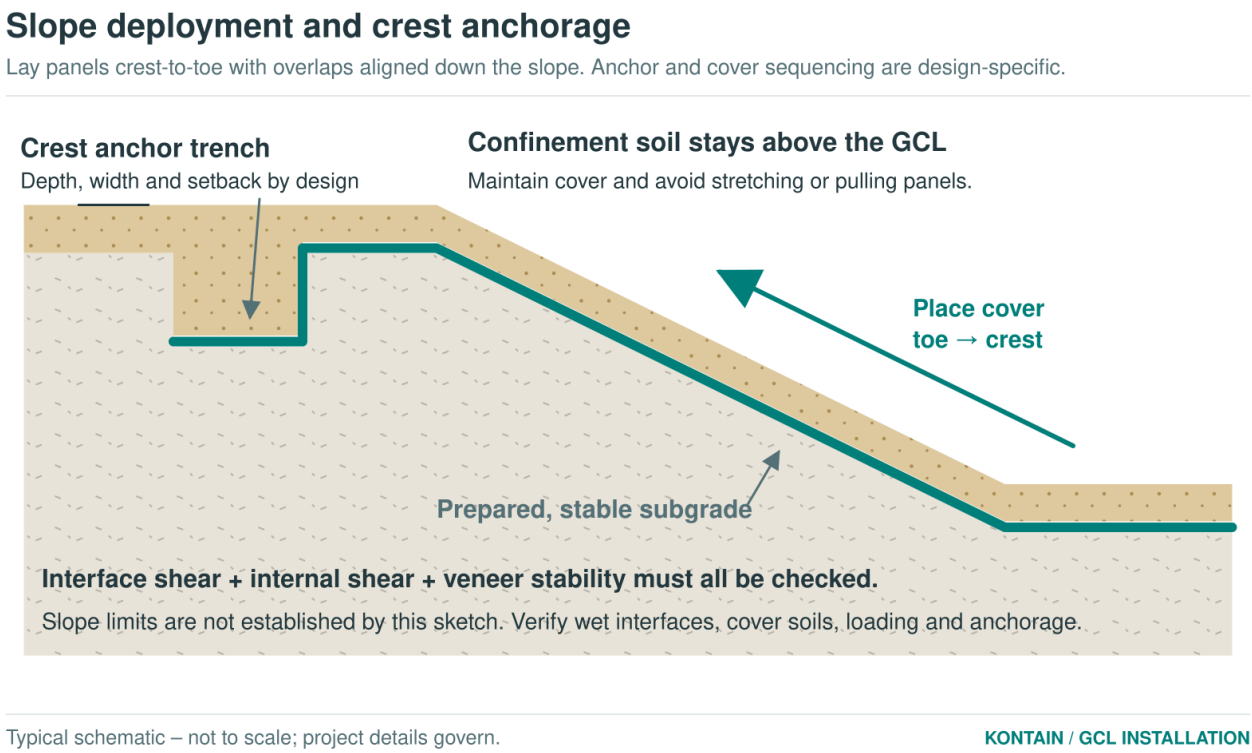
Slope installation

Use continuous panels from crest to toe with longitudinal seams running down the slope. Avoid end laps on slopes. Any unavoidable transverse joint needs a specific overlap, location, restraint and inspection detail; do not apply the flat-base end-lap value automatically. Avoid joints at abrupt crest and toe transitions.

Anchorage

Use the designed crest setback, rounded trench profile, liner run-out, backfill and compaction. Secure the panel before releasing deployment support. Keep GCL in intimate contact with the trench, without bridging or sharp folds. Inspect before backfill. Do not pin through the hydraulic liner or copy a generic trench dimension without checking pull-out and slope stability.

Figure 3 Slope deployment and anchorage



Keep longitudinal seams down the slope. Crest setback, anchor geometry and cover stability require design for the actual hydrated interfaces and loads.

09 Deploy panels without damage or tension

Plan the route for both the deployment plant and the cover plant. Each completed panel needs a clear path to inspection and protection.

Deployment sequence

- Confirm subgrade release, weather window, panel layout and the roll's identity. Open wrapping immediately before use with controlled cuts that cannot reach the GCL.
- Verify which face belongs against the subgrade. For laminated systems the PE normally faces the contained liquid; follow the project section where the arrangement differs.
- Unroll under control from the approved lifting arrangement, usually by feeding from the underside of the suspended roll so it lays naturally. Keep plant on the approved access route.
- Place flat, with sufficient slack to conform to grade changes but without folds. Do not stretch, drag over abrasive surfaces or use soil to pull out wrinkles.
- Align overlap marks and verify the actual lap width along the complete seam. Keep edges clean and dry; complete seam treatment while accessible.
- Stagger end joints and avoid four-way intersections. At approved T-joints, maintain full contact and the required lap of every panel; provide the detail's additional treatment or patch.
- Protect every cut with a sacrificial board or offcut underneath. Use a sharp knife; avoid cutting underlying GCL, PE or other geosynthetics. Remove all loose trimmings.
- Record the panel and roll numbers immediately. Inspect before any cover, geomembrane or detail makes the work inaccessible.

Traffic and personnel

Do not drive on exposed GCL. Keep walking to the minimum needed, with clean footwear and care around seams. Never walk on wet, slippery bentonite or use exposed GCL as an access track. Place tools on protective pads; do not push wheelbarrows or drag equipment across the liner.

Adjacent geomembranes

Place the overlying geomembrane promptly after GCL acceptance when specified. Use an approved slip sheet or handling method where textured geomembrane could pull fibres or move seams. Remove temporary slip sheets unless they are part of the designed system. An overlying membrane provides weather protection but does not, by itself, provide the required confinement.

Stop and correct

Stop for rain, uncontrolled wind, poor visibility, softening subgrade, misidentified rolls, damaged cores, seam contamination, bridging or tension. Mark the affected area and obtain the required inspection. Cover placement is not a repair method.

10 Form unlaminated GCL overlaps

The hydraulic joint relies on clean geotextile-to-geotextile contact, enough overlap, the correct bentonite treatment and continuous confinement.

General seam schedule

Location	Minimum overlap	Treatment
Factory longitudinal edge	At least 300 mm actual overlap.	No additional site bentonite is required on intact factory-treated self-sealing edges identified in the supplied seam detail.
Roll ends and field-cut seams on a base	At least 600 mm actual overlap.	Apply the approved accessory bentonite treatment; cut edges are not automatically self-sealing.
Approved end seam on a slope	Project-specific; avoid where practicable.	Designer defines larger overlap, restraint, location and treatment.
Repairs	Patch extends at least 500 mm beyond all damage.	Approved perimeter treatment, full contact and inspection.
Penetrations and structures	Use the issued detail.	Compatible bentonite/sealant, collars and confinement; see detail sections.

Self-sealing long edges

Check the factory treatment is present, intact, correctly orientated and identified in the supplied product documentation. The self-sealing mechanism activates as bentonite hydrates under confinement. It does not seal a gap, contaminated overlap, displaced panel or unconfined edge. Do not assume both sides, both ends or every product family carries the same treatment.

Making the lap

- Remove soil, debris and standing water without stripping bentonite or damaging fibres. Do not brush away an embedded factory treatment.
- Overlap to the accepted width and keep the contact surfaces flat. Shingle upper/upgradient panels over lower/downgradient panels where drainage and placement direction require it.
- At untreated seams, apply compatible accessory bentonite continuously at the rate specified in the supplied seam-treatment detail.
- For treated seams record the accessory lot, mass used and length treated. Recheck after wind or panel adjustment. Keep material out of drains and underdrain geocomposites.
- Inspect lap width, continuity, orientation and cleanliness before cover. Do not use nails, staples or through-pins to hold the hydraulic seam.

Bentonite paste

Where the issued detail specifies paste, use the designated bentonite, compatible water and mix ratio. Use polymer-compatible accessories for polymer-modified GCL. Keep paste within the required contact zone and clear of drainage layers.

11 Form Heavy Duty Laminated GCL overlaps

Form direct GCL-to-GCL contact below and a 300 mm PE overlap above. The 400 mm released film zones apply to factory longitudinal edges.

Longitudinal edge sequence

- Check the 400 mm factory released PE zones. Film remains attached to each roll and bonded beyond the released zone. Do not strip bonded film.
- Lift the loose PE and overlap the adjacent GCL edges to provide at least 300 mm of direct GCL-to-GCL contact. Keep PE out of the GCL contact plane.
- Use the factory seam treatment or specified compatible accessory bentonite. Keep the full contact width clean, flat and supported.
- Return the loose films over the joint to form a 300 mm PE-to-PE overlap. Measure the finished GCL contact width and PE overlap separately, without stretching the film. Keep the joint within the released zones.
- Inspect both layers before concealment, then place the specified protection and continuous compatible confinement.

Roll ends field cuts and repairs

Use the issued HDL-GCL end or transition detail for roll ends and field cuts. Provide at least 600 mm of direct GCL contact on a base and the specified PE coverage. The 400 mm longitudinal release does not form this end joint.

Plan panel lengths and end details before cutting or deployment. Do not peel bonded film or place a GCL patch over intact PE to form the mineral seal. Replace damaged panels unless a Kontain-issued engineered repair detail applies.

Avoid transverse seams on slopes. Use a specific design for any unavoidable slope joint, including its location, overlap and restraint.

When extrusion sealing is appropriate

Extrusion sealing is limited to HDL-GCL 050 with 0.50 mm LLDPE film. Qualify the procedure on the actual laminate, compatible extrudate and supported joint before production sealing. No extrusion sealing is permitted on HDL-GCL 020.

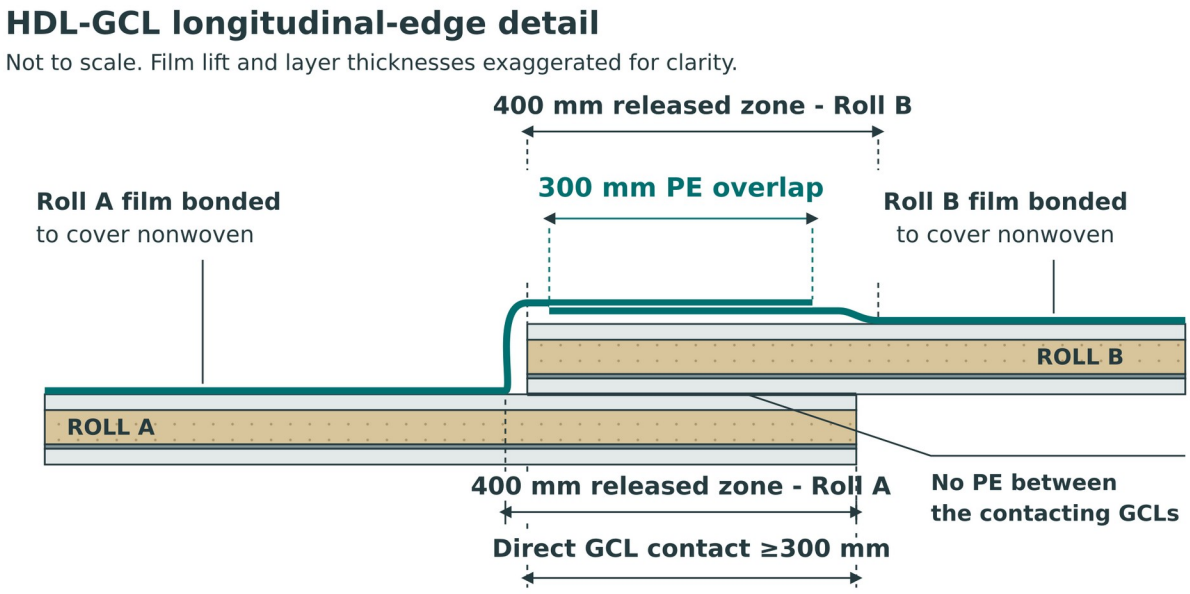
Use the qualified preparation, equipment settings, support and personnel. Inspect and test the seam to the approved procedure, record repairs and retain the weld map. Maintain the direct GCL overlap beneath the sealed PE.

Neither current HDL-GCL grade is wedge weldable.

Match the design duty

Where the design requires a separate welded geomembrane, specify and install that layer to its own seam and testing requirements.

Figure 4 HDL-GCL longitudinal edge overlap



The drawing applies to longitudinal edges only. The PE remains bonded outside the 400 mm released zones. Measure the GCL contact and PE overlap separately. Use issued details for end joints and repairs.

12 Control weather and premature hydration

Deploy only what can be seamed, inspected and protected within the available weather window. Lamination improves face protection but does not remove weather risk.

Conditions for deployment

- Do not deploy in rain, standing water, snow or ice, onto frozen or softened subgrade, or where runoff can enter beneath the liner.
- Stop when wind prevents safe lifting, panel control or clean seam treatment. Use the lifting plan’s limits; a roll is a large sail.
- In hot, dry weather, limit exposure and inspect for curling, shrinkage and PE movement. In cold conditions, follow the material and welding procedure limits; never handle a frozen hydrated GCL as if it were a dry roll.
- Arrange drainage and daily work limits so accepted panels can normally be covered in the same shift. Do not leave unprotected work overnight.

If rain is forecast or work pauses

Complete and inspect the accessible seams, then place permanent cover where possible. Protect unfinished edges, ends, penetrations and stored rolls with secure waterproof sheeting that sheds runoff away. Extend protection around leading edges to prevent water entry beneath. Use smooth ballast or sandbags that cannot puncture the liner; do not drive stakes through it. Temporary sheeting is not permanent confinement.

How laminate helps

The PE face reduces direct rain entry and evaporation through the upper surface. Protect unfinished laps, roll ends, penetrations and defects, and divert runoff from beneath the liner.

Polymer modification improves resistance to desiccation cracking. Keep exposure short, inspect the bentonite and laminate before concealment, and provide prompt confinement. Use a separate design for permanent exposed service.

After unexpected wetting

- Stop deployment and isolate the affected area. Do not drag, lift, traffic or conceal swollen or slippery GCL.
- Check bentonite loss, extrusion, delamination, displaced overlaps, trapped water, soft subgrade and contaminated seams. Inspect hidden low points and likely flow paths.
- Have the nominated inspector and designer determine whether the material remains acceptable, can be confined promptly, needs repair or must be replaced. A damp appearance alone does not decide acceptance.
- Record the event, extent, photographs and written disposition. Reinspect seams and subgrade after temporary covers are removed and before permanent cover.

Keep water out of the system

Do not deliberately pre-wet exposed GCL to speed work. Avoid repeated wet-dry cycling and long exposure beneath an unconfined geomembrane. Keep runoff carrying bentonite away from surface water, drainage layers and sumps.

13 Place and compact confinement soils

The first protective lift is critical. The objective is uniform support and confinement without moving the GCL, opening overlaps or punching stones through it.

Before the first lift

Release panels, overlaps, repairs, penetrations and any membrane welds through the agreed CQA hold point. Confirm the cover material source, chemistry, grading and moisture. Use the approved plant, lift thickness and trial method. Recheck that wind or adjacent operations have not displaced the work since inspection.

Placement method

- Keep plant on already placed cover or another designed working platform. Maintain the accepted minimum separation beneath tracks, wheels and blades at all times.
- Place the first lift gently. Do not end-tip sharp aggregate directly onto exposed GCL, drop large lumps, or drag a bucket or blade across it.
- Spread progressively without shoving the GCL or rolling seams. On slopes normally work from the toe towards the crest, placing or pushing cover upslope under the approved method.
- Do not turn sharply, brake hard or spin tracks on thin cover. Increase protection or change equipment if rutting, pumping, lateral movement or aggregate punching occurs.
- Maintain full thickness at seams, changes of grade, edges and structures. Keep construction heaps and stockpiles within the checked load case.
- Prevent aggregate segregation and inspect exposed leading edges repeatedly. Stop if there is evidence of displaced panels, emerging bentonite or damaged laminate.

Compaction requirements

Follow the project dry-density ratio, compaction reference, moisture window, lift thickness, plant and acceptance testing. Verify that the selected method reaches the specified density without moving or damaging the liner.

Compaction over the first lift

Validate vibration and compaction plant through a representative placement trial. Stop and correct pumping, rutting or displacement before continuing.

After covering

Measure and record the minimum completed cover thickness by a method that does not puncture the GCL. Mark restricted traffic areas, protect against erosion and prevent later excavation into the liner. Any suspected installation damage requires investigation and an accepted repair before commissioning.

14 Hydrate and commission under control

Confinement restrains swelling and supports the low-permeability bentonite seal. Commission the whole containment system, including overlaps and terminations.

Normal hydration

Hydrate after acceptance and confinement using compatible subgrade or cover moisture, or the specified water supply. Set the hydration sequence for the actual soil contact, laminate and confining stress.

Controlled prehydration

Where aggressive or non-aqueous liquid is expected, the design may require hydration with accepted clean water before service. Define water quality, application method, confinement, time and evidence of completion through compatibility testing. Prehydration can help some formulations but does not guarantee lasting chemical resistance after ion exchange or repeated exposure.

Laminated systems

A laminate can slow moisture entry from its upper face, so hydration may rely more on the subgrade or deliberately detailed routes. Confirm adequate hydration without trapping free water or destabilising the cover. Do not puncture the laminate to introduce water or use process liquor for initial hydration unless the design and tests support it.

Before filling or process service

- Close all installation non-conformances and approve the as-built panel plan, repairs, CQA records, cover thickness and any weld testing.
- Verify penetrations, valves, sumps, terminations and interfaces with concrete or other liners are complete and accessible for the required checks.
- Confirm erosion protection, overflow routing, groundwater/gas relief and the minimum confining pressure for every operating water level.
- Fill or introduce liquid at the design-approved rate. Inspect settlement, seepage, cover movement and unusual turbidity or bentonite migration.
- Do not remove cover, draw down rapidly or allow the system to dry out contrary to the design. Maintain restrictions on traffic and excavation.

Operation and maintenance

Keep an as-built liner plan available to operators. Inspect after major rain, filling/drawdown cycles and maintenance works. Repair erosion before confinement is lost. Manage vegetation and roots for the design, prevent burrowing damage where relevant, and use a controlled permit before digging near the liner. A future repair must restore the GCL, laminate if present, and cover system.

Uplift and gas

A GCL does not eliminate uplift from groundwater or gas beneath the liner. Provide relief or ballast only as designed, with filter and drainage details that do not form uncontrolled leakage paths. Stop commissioning if uplift, heave or loss of contact occurs.

15 Detail penetrations through slopes

Support the pipe and surrounding liner continuously where a penetration crosses a lined embankment. Use the issued penetration detail for the selected GCL and pipe geometry.

Sloping-face penetration sequence

- Install and support the pipe through the embankment. Compact the trench and form a smooth supported slope around it; allow for pipe movement, thrust and differential settlement.
- Form the designed annular seal pocket at the pipe/liner crossing. Fill it fully with compatible bentonite or the specified sealant; it is a seal, not a pipe support.
- Use the approved product-specific collar detail to maintain the specified GCL contact around the pipe. Fit the collar flat, apply the compatible bentonite treatment and maintain the issued overlap.
- For laminated products, obtain a supported, compatible product-specific penetration and termination detail. Maintain the required GCL contact and do not strip bonded film to improvise a connection.
- Select the penetration detail for the supplied thin laminate or unlaminated GCL. Any separate geomembrane needs its own designed termination and installation procedure.
- Place confinement around the pipe and over the slope without impact or dragging the collar. Support the boot transition as detailed and photograph each hidden stage before covering.

Collar and support dimensions

Follow the issued penetration drawing for collar extent, seal-pocket geometry, supporting material and clamp or boot dimensions. Design for pipe movement, hydraulic head and the slope intersection.

Other penetration arrangements

Vertical risers, inclined pipes, corrugated pipes and irregular penetrations require their own sections. Do not use a smooth-pipe detail on corrugations or cable bundles. Use a designed smooth sleeve, puddle flange or other suitable transition, and address water tracking along the trench separately.

Inspection before concealment

Check complete pipe support, the packed annular seal, direct collar-to-GCL contact, laminate continuity, clamp/flange engagement, movement allowance and confinement. Test any welds as specified. Do not accept a detail from its visible top surface alone.

16 Terminate at concrete and other liners

A termination must prevent water bypassing the GCL and accommodate movement. Anchoring an edge and sealing an edge are different functions.

Concrete interface

- Use sound, cured and suitably prepared concrete. Remove laitance, sharp projections and contamination; repair voids and honeycombing.
- Provide the designed rebate, chase or bentonite seal pocket. Do not place conventional bentonite directly against fresh cementitious contamination or washout.
- Continue GCL into the accepted termination with direct contact and compatible bentonite or sealant. Use the specified mechanical termination, gasket or clamping arrangement where required.
- For laminated GCL, terminate the PE separately to an approved cast-in profile, flange, batten/boot or compatible membrane connection. A bentonite strip is not a PE weld.
- Locate fixings only within the designed termination zone. Do not puncture the field liner to solve a fitting problem.
- Maintain cover/confinement up to the termination, protect the exposed edge and allow for differential movement.

Other transitions

Connections to existing GCL, separate geomembranes, sumps, anchor trenches and drainage structures require a specific detail. Confirm the existing material is identifiable, sound, clean and compatible. Define how the mineral barrier and polymer barrier each remain continuous. Do not rely on unverified adhesive tape as the hydraulic seal.

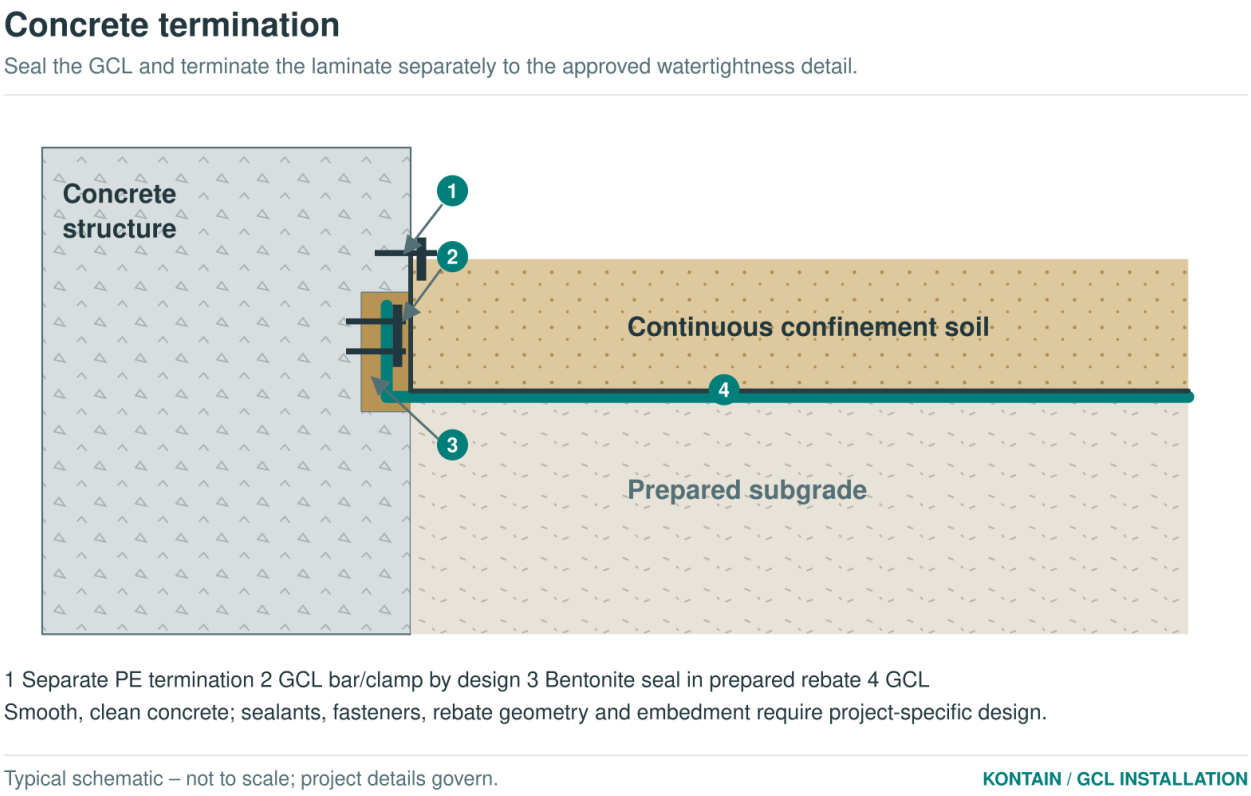
Corners and changes in level

Avoid excessive folding and stacked ridges. Use shaped panels and approved patches to maintain contact. Stagger joints away from concentrated stress and water flow. Where a vertical face cannot retain permanent confinement, use a separately designed system rather than adapting a buried-earth detail.

Hold point

Inspect the prepared substrate, seal pocket, GCL contact, membrane termination, fixings, movement allowance and confinement in sequence. Record photographs before each hidden layer. Where a structure joint can move or transmit water, its own waterstop and joint-seal design must also be complete.

Figure 5 Concrete termination



Seal the GCL and terminate the PE separately using the issued detail. Fixings, rebate geometry, movement capacity and structure joint waterstops require project design.

17 Repair defects and manage departures

Mark defects while they are visible. A patch must restore the hydraulic function and support of the complete system.

Unlaminated GCL damage

- Record the location and roll number; photograph the defect and identify its cause. Remove sharp objects and correct the subgrade or handling issue before repair.
- Use an accepted patch of the same specified construction and compatible bentonite formulation. Extend at least 500 mm beyond the full damaged area in all directions, or farther if required by the project.
- Place the patch flat with the correct orientation and direct GCL contact. Apply the specified compatible accessory bentonite continuously around the affected area beneath the patch.
- Keep patch corners and transitions flat, without folds or bridging. Repair any field cuts used for access. Record dimensions and accessory quantities.
- Replace the panel or obtain an engineered repair where there is widespread hydration damage, bentonite loss, contamination, distortion or an uncertain extent of damage.

Laminated GCL repairs

Replace a damaged HDL-GCL panel unless a Kontain-issued engineered repair detail applies to the defect. The repair must restore the GCL seal, PE barrier, support and confinement.

Do not strip bonded film or cut fibres to create a contact zone. A patch placed over intact PE does not provide direct GCL-to-GCL contact. The 400 mm longitudinal released zone is not a general repair detail.

Use extrusion sealing only under a qualified HDL-GCL 050 repair procedure. No extrusion sealing is permitted on HDL-GCL 020, and no wedge welding is permitted on either grade.

Seam movement or contamination

Reopen only dry, controllable seams where this can be done without damage. Restore the correct overlap and treatment, then reinspect. Hydrated seams, missing factory treatment, inadequate flap width or peeled laminates need a recorded disposition. Do not accept an under-width lap on the assumption that bentonite will swell across the gap.

Damage found after covering

Isolate traffic and agree an excavation method that will not enlarge the defect. Expose enough surrounding liner to verify the extent, restore the full detail, inspect and replace cover under the accepted method. Document the repaired position on the as-built plan.

Non-conformance control

Record the requirement, defect, affected area, repair and approving person. Close the record after inspection and required retesting. Do not conceal unresolved damage or substitute a product, seam accessory or cover material without acceptance.

18 Inspection hold points and records

CQA records connect the delivered roll to the installed panel and the finished confinement. Keep them current each day.

Minimum hold-point schedule

Hold point	Accept before proceeding	Record
Delivery	Identity, dimensions, gross mass, core and wrapping; dry and undamaged condition.	Roll register, certificates, photos, quarantine decisions.
Subgrade	Levels, smooth support, drainage, chemistry, compaction and moisture.	Area release and test references.
Trial	Actual aggregate, GCL, plant, lift and compaction method perform without damage.	Trial method, exposure inspection and acceptance.
Panels and seams	Orientation, measured GCL overlap, seam treatment and accessories. For HDL-GCL, verify direct GCL contact and 300 mm PE overlap; inspect ends and repairs to their issued details.	Panel plan, seam log, widths and photos.
Details and repairs	Approved geometry, sealing, movement allowance and membrane integrity.	Detail/repair log and inspection stages.
Welds, if specified	HDL-GCL 050 extrusion procedure qualified; specified inspection and seam tests passed; repairs closed. No extrusion on HDL-GCL 020 and no wedge welding.	Weld map and testing records.
After weather	No unacceptable swelling, displacement, contamination, washout or softened foundation.	Event, inspection and disposition.
Cover release	All hidden work accepted; material, thickness and method confirmed.	Signed area release, placement record.
Commissioning	Complete confinement, as-built records, closed departures and hydration plan.	CQA completion and designer/owner release.

Daily record

Record date, work area, weather, roll/lot and panel IDs, seam and patch locations, edge treatment, actual lap widths, accessory lots/quantities, weld records, inspection decisions, photographs, cover material and minimum thickness, plant used, and the time between deployment and covering. Include any temporary protection and reinspection.

Testing framework

Use ASTM D5888 for storage and handling guidance, ASTM D6102 for installation guidance, ASTM D6243 for GCL internal and interface shear, and ASTM D5887 for index flux within their applicable scopes. The project inspection and test plan sets the tests, frequency and acceptance criteria.

19 Site checklist and quick decisions

Use this page at the pre-start and before releasing an area to cover. The project inspection and test plan remains the controlling record.

Before deployment

- Correct grade, laminate and bentonite formulation; approved TDS and seam detail available.
- Actual roll mass and core checked; lifting gear, plant radius and access accepted.
- Subgrade inspected and released; chemistry and drainage confirmed.
- Forecast, daily area, crew, CQA and cover resources aligned.
- Accepted cover material, thickness, plant and compaction trial confirmed.

Before concealment

- Panel IDs recorded; liner flat, supported, untensioned and undamaged.
- Side and end laps measured; factory treatment intact or correct accessory treatment applied.
- HDL-GCL joints provide direct GCL contact and 300 mm PE overlap; end joints and repairs match their issued details.
- Welds, penetrations, terminations and repairs inspected and tested where specified.
- Weather-related areas reinspected; no unresolved hydration or subgrade damage.
- Continuous cover and plant separation maintained; release signed before work is hidden.

Quick decisions

Question	Action
Can crushed aggregate touch the GCL?	Only for the accepted grade and tested contact/placement system. No lime-bearing contamination; verify chemistry, particle shape and puncture risk.
Is a composite base suitable at 1V:2H?	Use a project-specific stability design based on hydrated internal and interface shear tests.
Are all overlaps self-sealing?	Only accepted factory-treated edges as detailed. Ends, cuts and repairs need the approved accessory treatment.
Can a damp roll or panel be used?	Isolate and inspect. Acceptance depends on hydration, integrity, bentonite retention and ability to confine.
Can lime-bearing rock sit above a clay cushion?	A cushion is not proof of chemical isolation. Test the contact system or change the material.
Can the current HDL-GCL range be wedge welded?	No. Use a qualified extrusion-sealing procedure for HDL-GCL 050 only.
Can the 400 mm edge zone form every seam or repair?	No. It applies to longitudinal edges. Use issued end-joint details and replace damaged panels unless an engineered repair detail applies.

Project-specific details

Send Kontain the selected GCL, liner section, slope geometry, liquid chemistry, soil grading, quarry source, loading and penetration drawings. Contact ben.lewis@kontainsolutions.com or +61 405 812 770.

20 Contact and technical resources

Use this guide with the approved project documents listed in Section 1.

Kontain technical support

Kontain Pty Ltd • Australia-wide geosynthetic supply and technical support. Contact ben.lewis@kontainsolutions.com or +61 405 812 770.

Referenced information

GRI-GCL3: GCL manufacturing quality-control framework

Manufacturing quality-control framework for geosynthetic clay liners.

Kontain GCL systems

Current product range, technical data sheets and installation guide.