



Landfill Applications

www.polyfabrics.com.au

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1. Introduction	1
2. MQA	1
3. Shipping, Handling, and Storage	1
4. Site and Subgrade Preparation	4
5. Deployment	5
6. Lapping and Joining	10
7. Penetrations & Terminations	11
8. Anchorage	12
9. Hydration	13
10. Protection	15
11. Damage and Repair	16

1. Introduction

The following check lists are provided for the application of Geosynthetic Clay Liners (GCLs) for both stand-alone liners and when used as one component of composite liners, for the assistance of contractors and installers. Specific and individual site conditions will vary from those presented herein.

Polyfabrics Australasia Pty. Ltd. (PA) reserves the right to review the suitability of this material for any particular application. In that regard, should any unique or unusual conditions exist, PA should be contacted to provide any guidance or recommendations, to ensure that operations in no way damage the Bentoliner or otherwise compromise the performance of the material.

2. MQA

For MQA refer to separate document “POLYFABRICS **GCL MANUFACTURING QUALITY ASSURANCE AND QUALITY MANUAL**” Located in Appendix A.

For a typical MQA documents refer to Appendix B.

3. Shipping, Handling, and Storage

Bentoliner GCLs are shipped in rolls, which are protected by a plastic cover material. Nevertheless, during all stages of shipping, handling, and storage of these materials, care must be taken to prevent puncturing or other damage to the rolls, and to protect against wetting of the rolls. Under no circumstances should Bentoliner be dragged, lifted by one end only, rolled off flat truck or unloaded in a fashion that could damage the roll. The Bentoliner rolls should be stored on site in a secure location that will minimize the exposure to dirt or potential damage due to the proximity of working equipment, vandalism, etc.

Ensure that they are stored no greater than 4 rolls high in a flat, hard, dry, stable and free draining storage location is provided to store the rolls flat and continually supported.

In some cases, rolls can be marshaled at various locations to minimize transit distances and delays during deployment. In general, storage of materials at all times should provide protection of the rolls from equipment or other handling-related damage, precipitation, and surface accumulations of water. Protective coverings should only be removed immediately prior to deployment of materials.

STORAGE AND INSTALLATION QA CHECK LIST

Due to the nature of the product and its mechanism of function, any rolls of Bentoliner that are exposed to precipitation or are otherwise wetted should be set aside for examination by the Engineer and the Installer to establish the degree of damage. Prior to deployment, any rolls of Bentoliner that become contaminated with foreign materials shall be examined to ensure that the material has not been compromised. In some cases, the material may be salvaged, but significant wetting of the Bentoliner may complicate or even impede deployment and the normal course of action should be that the material is discarded.

<u>PACKAGING, TRANSPORTATION AND UNLOADING ON SITE</u>			
		YES	NO
Documents	= Delivery Docket	<input type="checkbox"/>	<input type="checkbox"/>
	= QA	<input type="checkbox"/>	<input type="checkbox"/>
	= MSD	<input type="checkbox"/>	<input type="checkbox"/>
Method of transportation to site	= Closed Container	<input type="checkbox"/>	<input type="checkbox"/>
	= Covered Trailer	<input type="checkbox"/>	<input type="checkbox"/>
	= Flatbed Truck	<input type="checkbox"/>	<input type="checkbox"/>
Method of unloading	= Spreader Bar	<input type="checkbox"/>	<input type="checkbox"/>
	= Carpet Prong	<input type="checkbox"/>	<input type="checkbox"/>
	= Slings at 1/3 points	<input type="checkbox"/>	<input type="checkbox"/>
Any visible sign of roll damage	=	<input type="checkbox"/>	<input type="checkbox"/>
Roll packaging impervious to moisture	=	<input type="checkbox"/>	<input type="checkbox"/>
Storage in well drained leveled area	=	<input type="checkbox"/>	<input type="checkbox"/>

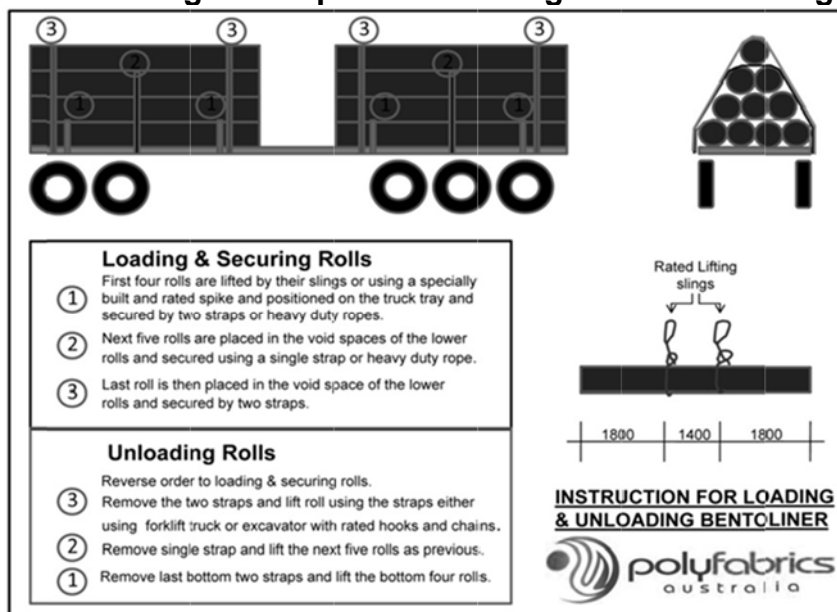


Unloading from Closed Container using a Carpet Prong attachment

STORAGE AND INSTALLATION QA CHECK LIST



Unloading from Open Truck using Forklift and Sling



Instructions for Loading, Unloading and Securing Rolls from Flat Bed Truck

4. Site and Subgrade Preparation

In cases where Bentoliner is to be deployed directly over soil materials, the surfaces should be cleared of all vegetation. In addition, all roots, debris, large (>25mm diameter) rocks, or other foreign materials at the surface of the subgrade, should be removed.

The subgrade should be graded and compacted in accordance with the Engineer's specifications, but in any event, should be compacted to at least 90 per cent of Modified Proctor maximum dry density (ASTM D1557). The final surface should be smooth – if compaction equipment with kneading lugs is employed, the final surface should be scarified to the lug holes, and finished with a smooth-drum compactor. Alternatively, a leveling layer of sand or fine soil can be used.

STORAGE AND INSTALLATION QA CHECK LIST

The condition (including testing) of the underlying soil should be confirmed prior to placement operations. The Engineer should prepare the appropriate documentation for the subgrade surface and certify or otherwise approve the condition of this prepared surface prior to the deployment of any Bentoliner.

Similarly, the Installer should ensure that all repairs have been made to any underlying layer(s) of geosynthetics prior to placement of Bentoliner. The Installer should also ensure that the Engineer has verified the completion of the underlying layers and has approved the areas for deployment of the material.

If however the subgrade can't meet these requirements consideration should be given to the use of cushion geotextiles (refer to Technical note on cushion geotextiles)

<u>Site and Subgrade Preparation</u>		YES	NO
Does the surface meet the minimum standard as per installation requirement =		<input type="checkbox"/>	<input type="checkbox"/>
Anchorage requirement for wall	= Anchor Trench	<input type="checkbox"/>	<input type="checkbox"/>
	= Material Run out Length	<input type="checkbox"/>	<input type="checkbox"/>
	= V-Trench	<input type="checkbox"/>	<input type="checkbox"/>
Anchorage requirement for floor	= Anchor Trench	<input type="checkbox"/>	<input type="checkbox"/>
	= Material Run out Length	<input type="checkbox"/>	<input type="checkbox"/>
Cushion geotextile requirement.	=	<input type="checkbox"/>	<input type="checkbox"/>

5. Deployment

Bentoliner materials should be deployed in strict accordance with good construction practice and in such a manner as to prevent any damage to the materials. In particular, the Installer and the Engineer should meet on site prior to the placement of any material, to ensure that these guidelines are generally followed and that the deployment orientation is consistent with the Engineer's design, and the project drawings.

The Installer should outline the methods of deployment of the Bentoliner materials to be used. Considerable freedom is available to the Installer in this regard, provided that the methods employed do not in any way damage the materials or any other soil. Procedures shall be discussed for acceptability during the pre-construction stage, and the agreed procedures documented at that time.

Prior to the placement of any Bentoliner materials, the Installer may marshal rolls in various locations so as to facilitate deployment. Particular emphasis should, however, be made for the requirement to keep these rolls dry at all times.

Prior to, during, and subsequent to deployment, the Installer should ensure that:

- Bentoliner is deployed using a rated purpose build dispenser or Spreader Frame.
- Deployment should always be from the highest point to the lowest;

STORAGE AND INSTALLATION QA CHECK LIST

- On slopes, deployment should be down, not across the slope;
- Bentoliner should be cut using approved cutters, and care taken to ensure that materials underlying them are not damaged during cutting; and
- Bentoliner should be kept as clean as possible at all times up to and including the time of placement of the next layer of material covering them.

Bentoliner Dispenser Brief Description

It comprises of a load spreading beam suspended by an A chain having a capacity greater than 2000kg.

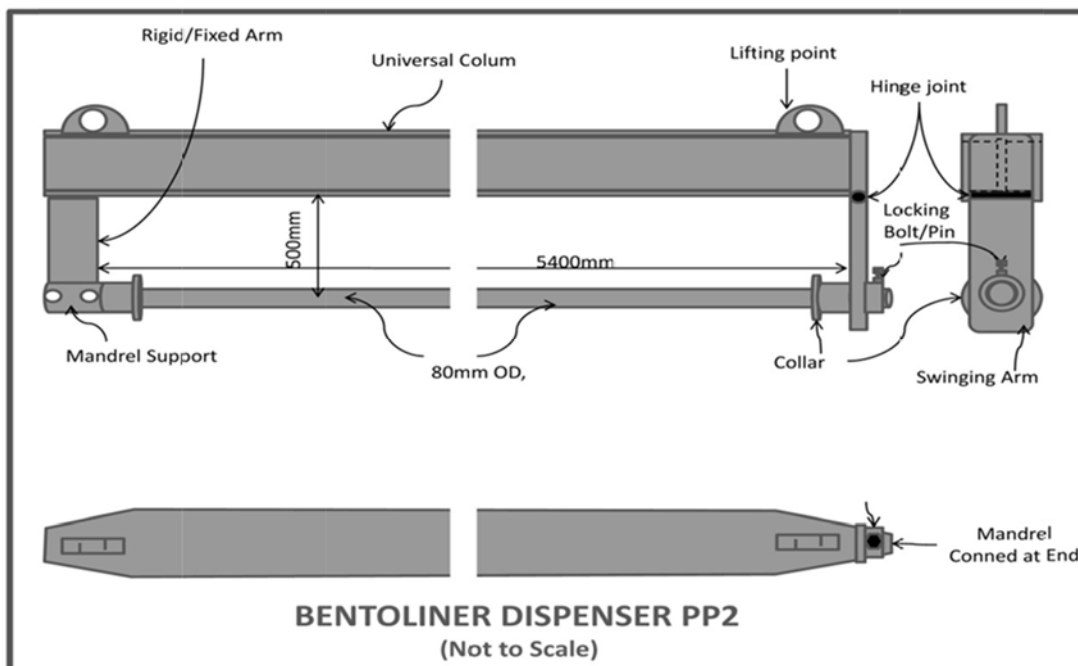
The beam has suspended arms:

1. Rigid Arm that holds the mandrel
2. Hinged/Swinging Arm that supports the other end of the mandrel.

The mandrel has two cone end plates that fit on either end of the Bentoliner roll to stop the roll from drifting along the mandrel.

The rolls must not be lifted without the hinged arm secured on the mandrel.

The Bentonite Dispenser is designed to simplify installation and to eliminate man-handling of the heavy dispenser components during the loading of the Bentoliner rolls and the removal of the roll core.



STORAGE AND INSTALLATION QA CHECK LIST



Loading Roll using Bentoliner Dispenser PP2

Induction and Risk Assessment on the use of Bentoliner Dispenser PP2

STEP	WHAT ARE THE BASIC STEPS	POTENTIAL HAZARDS	HAZARD CONTROLS
1.	Brief all personnel on OH&S Issues.	Incorrect procedures being followed.	Wear High Visibility vest, hard hat safety boots, safety sun glasses, gloves, long trousers
2.	Ensure all the lifting equipment is in good order and the chains are not twisted, are of equal length and spacing on the spreader beam and correctly attached to the machine.	Injury to personnel	One personnel to act as a look out and to provide clear signals and instructions to the driver at all times.
3.	Guide mandrel into Bentoliner core using machine arm	Injury to personnel	Keep clear until mandrel protrudes.
4.	Before lifting the roll, secure the hinged arm to the mandrel and insert pin.	Damage/Shearing of mandrel	Make sure pin is secured
5.	Bentoliner roll secured close to ground.	Uncontrolled unravelling of roll	Keep close to the ground.
6.	Rise machine arm	Lifting too fast / tangle chains Uncontrolled dispensing of panel.	Rise in controlled manner with no personnel to go under lifted roll. Do not cut roll tape (around roll) until roll is in position and
7.	Move roll into start position.	Roll/frame jerking and swinging – injury to personnel.	Keep personnel clear, or use guide ropes so personnel can minimize roll swinging without standing beneath or near the suspended roll
8.	Place roll into position.	Lowering onto personnel.	Roll must be positioned and grounded.
9.	Deployment.	Sliding of dispensed material across the subgrade and 'up-ending following behind on di	Deploy at no faster than walking pace.
10.	Once roll is deployed, remove core from mandrel in a reverse order to 3 and 4.	Lowering onto personnel.	Keep clear from machine arm and frame using the guided ropes

In general, material deployment should not be carried out during any form of precipitation, in the presence of excessive moisture (e.g., fog or dew), in an area of stagnant water, or during periods of high winds. In addition, in the usual instance when these materials are to be covered by geomembrane or soil materials, only as Bentoliner should be deployed in a given shift as can be covered by geomembrane or soil in that shift. This will minimize the potential exposure of material to poor weather conditions.

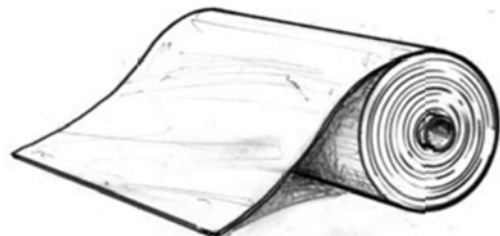
STORAGE AND INSTALLATION QA CHECK LIST

<u>Bentoliner Deployment</u>		YES	NO
Site Induction for all site personnel =		<input type="checkbox"/>	<input type="checkbox"/>
Risk analysis – SWMS =		<input type="checkbox"/>	<input type="checkbox"/>
Installation Equipment =	= Excavator	<input type="checkbox"/>	<input type="checkbox"/>
	= All terrain extendable forklifts	<input type="checkbox"/>	<input type="checkbox"/>
	= Spreader Frame/ Dispenser	<input type="checkbox"/>	<input type="checkbox"/>
	= Posy track	<input type="checkbox"/>	<input type="checkbox"/>
	= Bentonite granules or Paste	<input type="checkbox"/>	<input type="checkbox"/>
	= Trowel	<input type="checkbox"/>	<input type="checkbox"/>
	= Carpet knives	<input type="checkbox"/>	<input type="checkbox"/>
	= Broom	<input type="checkbox"/>	<input type="checkbox"/>
Roll orientation required =		<input type="checkbox"/>	<input type="checkbox"/>

The roll of Bentoliner is supported during its deployment so that the fabric designated as the upper surface faces out (natural orientation), away from the installation vehicle. The free end of the roll can then be secured (installers standing on edge) and the vehicle supporting the roll can slowly back away, deploying the Bentoliner as it moves. Alternatively, the free end can be dragged by a light vehicle such as a Positrack or manually pulled across an area to be lined by the installation crew while the equipment simply suspends the roll. The later methods are used to avoid surface damage caused by the installation vehicle.



(a) Unrolled “Natural” orientation



(b) Unrolled from top



Bentoliner should be covered by a minimum thickness of 300 mm of approved soil or gravel at the end of the construction day.

5. Lapping and Joining

GCL seams are constructed by overlapping adjacent panel edges and ends. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris.

STORAGE AND INSTALLATION QA CHECK LIST

The Bentoliner has self-seaming capabilities in their longitudinal overlaps due to the 300mm pre-coated edging strips. For pond applications, supplemental bentonite must be used in all longitudinal seams.

Panels of Bentoliner should be joined in accordance with the following requirements:

- Adjacent panels must be overlapped a minimum of 300 mm to 600mm along the side joints, and 600 mm at end joints;
- Applications for which Bentoliner comprises the bottom component of a Geomembrane/GCL composite liner, other than the required overlap, no further treatment of the joints is recommended;
- Whenever Bentoliner GCLs are employed as the sole component of a liner (standalone liner), the properly overlapped joints should be further treated by the addition of powder bentonite or granular bentonite (i.e. sodium Bentonite as used inside the product);
- Special applications in which Bentoliner is deployed underwater, the required overlap for all edges is 1000 mm, with no further treatment of the joints required; and,
- When more than one layer is installed by stacking, the joints shall be staggered, where possible.
- In locations where stacking of Bentoliner is required, each layer should be deployed at right angles to the underlying layer.



Seaming Bentonite Granules placed on Bentoliner EB (a) using dispenser or (b) using plastic watering bucket

STORAGE AND INSTALLATION QA CHECK LIST



Seaming Bentonite Paste used on transverse joins

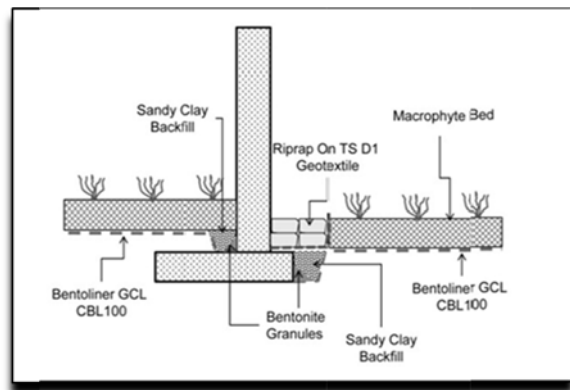
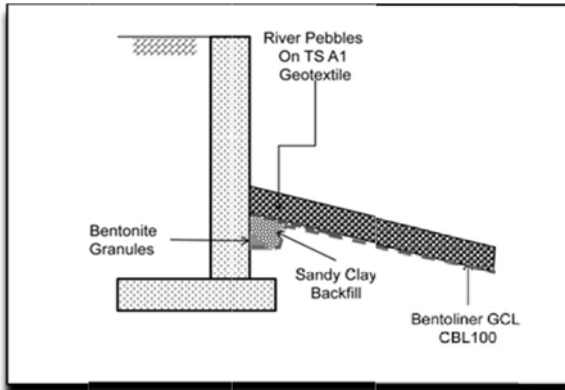
<u>Lapping and treatment Requirement</u>			YES	NO
Additional Joint treatment required			<input type="checkbox"/>	<input type="checkbox"/>
	= Granules		<input type="checkbox"/>	<input type="checkbox"/>
	= Paste		<input type="checkbox"/>	<input type="checkbox"/>
Lapping Requirement	= Standard lapping		<input type="checkbox"/>	<input type="checkbox"/>
	= Special lapping		<input type="checkbox"/>	<input type="checkbox"/>

6. Penetrations & Terminations

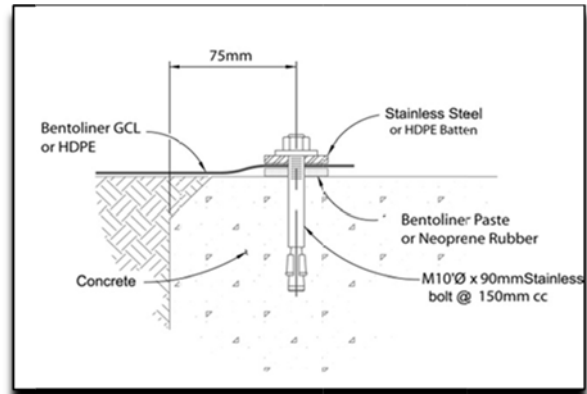
Conventional sealing of penetrations including concrete footings, walls, rock abutments and termination points are totally reliant on the confining pressure of the cover placement. This is classified as a soft option. The interface between the GCL and the surface is treated with additional Bentonite granules or Bentonite paste prior to confining pressure applied.

If in the case during the life of the project this confining pressure is removed due to erosion etc. a more structural option should be used such as stabilizing the surrounding soil with cement or lime or in the case of preformed concrete walls and footings, a more rigid option can be used such as gluing or using HDPE or Stainless Battens and bolting.

STORAGE AND INSTALLATION QA CHECK LIST



Soft Option Termination



Rigid termination

		<u>Termination</u>	
		YES	NO
Conventional Termination (soft option)	=	<input type="checkbox"/>	<input type="checkbox"/>
Rigid Termination	=	<input type="checkbox"/>	<input type="checkbox"/>

7. Anchorage

At the perimeter of the installation, as well as at the top of slopes, Bentoliner should be anchored into a trench. This anchor trench should be located at least 600 mm beyond the crest of the slope, and should be a minimum of 450 mm deep. Bentoliner should be placed into this trench extending down the inside face secured by the controlled placement and compaction of backfill into the trench in such a manner as to not damage the composite. When installed in conjunction with other geosynthetics, the same anchor trench can be used to secure all of the geosynthetics, provided that some vertical separation is provided between layers in the trench, by layers of the backfill soil.

STORAGE AND INSTALLATION QA CHECK LIST



Standard Anchor Trench



V-Trench



Horizontal Trench

In all cases, appropriate anchorage should be provided to prevent the ingress of any surface runoff beneath the Bentoliner, in addition to securing the GCL for stability and performance during loading and long-term.

	<u>Anchorage</u>	YES	NO
Standard trench	=	<input type="checkbox"/>	<input type="checkbox"/>
V-trench	=	<input type="checkbox"/>	<input type="checkbox"/>
Horizontal predetermined length	=	<input type="checkbox"/>	<input type="checkbox"/>

8. Cover Placement.

Provide cover soils that are free of angular stones or other foreign matter that could damage the GCL. Cover material for use in placing on top of GCLs is to consist of hard, durable, clean sand, gravel, crushed stone or other material specified on the plans, and that is free from organic matter, clay balls, or other deleterious matter. Unless otherwise shown on the plans, crushed limestone will not be permitted. Cover soils with high concentrations of calcium (e.g., limestone, dolomite) are not acceptable.

Typical gradation for cover material is shown in Table below by percent composition of weight.

STORAGE AND INSTALLATION QA CHECK LIST

Typical Gradation for Cover Material

COVER MATERIAL COMPOSITION	
SIEVE SIZE	% RETAINED ON SIEVE
3/4 in.	0
3/8 in.	10-20
No. 4	5-20
No. 8	5-20
No. 100	10-20
No. 200	10-20
< No. 200	< 5

The cover soil thickness should be at Least 300mm or approximate 6kPa of confining pressure.

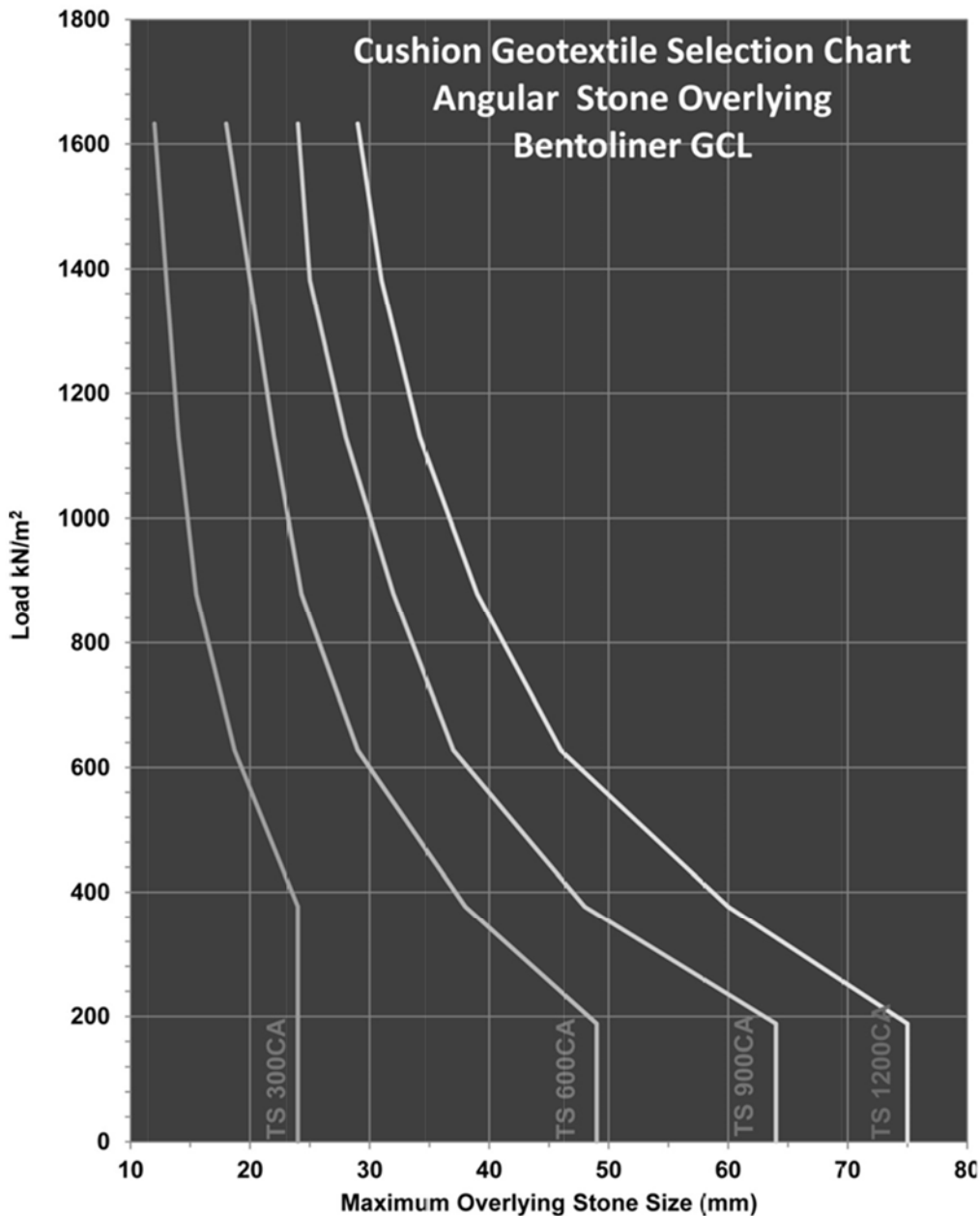
If the cover material doesn't meet these requirements consideration should be given on the use of a cushioning layer of finer soil that meets the requirement and coarser material on top.

Alternative design a cushion geotextile to protect the GCL (refer to Technical note on cushion geotextiles)

Only the amount of Bentoliner® that can be anchored, inspected, and covered should be installed the same day. It should be covered with the specified 300 mm thickness of cover topsoil immediately following deployment. The soil cover should be placed within 800 mm of the leading edge of the Bentoliner®. The leading edge can then be covered with plastic sheeting that is folded under the exposed edge approximately 300 mm. Sand bags or suitable ballast should be placed on the protected liner to hold the plastic in place and to partially confine the Bentoliner®. The next morning the ballast and the plastic can be removed and subsequent rolls of Bentoliner® placed as described in Section 4. In dual lining (GCL/HDPE) systems when the Bentoliner is used as a secondary liner

<u>Cover Placement</u>		YES	NO
Soil cover meets requirements	=	<input type="checkbox"/>	<input type="checkbox"/>
Cushion Layer	= Sand	<input type="checkbox"/>	<input type="checkbox"/>
	= Cushioning Geotextile	<input type="checkbox"/>	<input type="checkbox"/>
Dual Lining System	=	<input type="checkbox"/>	<input type="checkbox"/>

STORAGE AND INSTALLATION QA CHECK LIST



9. Hydration

Bentoliner GCLs are supplied with deliberate partial hydration of up to 30%. This has no effect on its mechanical properties and is designed to assist in the dust management and help performance in the short term especially when installed in dry subgrade or in the case of evaporation ponds with high ionic strength in the brine.

Whenever Bentoliner is employed as the bottom component of a geomembrane / GCL composite liner, pre-hydration of Bentoliner should not be undertaken.

Whenever Bentoliner comprises a single component liner, it should be hydrated after installation. As the bentonite swells upon the addition of water, this should be accomplished after the placement of the cover soils, wherever feasible, to confine the material and inhibit any potentially deleterious swelling. The resulting controlled

STORAGE AND INSTALLATION QA CHECK LIST

hydration and swelling of Bentoliner will be sufficient to mobilize the low hydraulic conductivity of the material.

In most single liner application, the containment fluid is acceptable as a hydrating medium. Engineers are encouraged to contact PA to determine hydration requirements.

<u>Pre-Hydration</u>			
		YES	NO
Additional pre-hydration	=	<input type="checkbox"/>	<input type="checkbox"/>

10. Protection

Swelling of the bentonite layer occurs when the material is contacted by water. Care should be taken to avoid the exposure of Bentoliner to precipitation, stagnant water, or any other source of water prior to placement and cover. Although needle punching provides some protection from unconfined swelling, it is recommended that full hydration be avoided prior to cover soil placement. This overlying layer of soil or geosynthetics should be placed within the same shift as the deployment of Bentoliner. Should this immediate covering not be possible for any reason, the Installer should take appropriate measures to prevent the wetting of the composites during the period of exposure.

Alternatively, the use of Bentoliner with the membrane up will provide temporary protection from precipitation.

11. Damage and Repair

All areas requiring repair due to damage during shipping, handling, or manufacturing flaws in the materials should be appropriately marked. In cases where the material is pervasively damaged and repair is impractical, the material so affected shall be marked accordingly, removed, and set aside or removed from the site so as to avoid use.

All repairs made by the placement of a patch of the same material over the flaw or damaged area should extend at least 300 mm beyond the flaw or damage in every direction. Further, a bead of granular bentonite shall be placed between the patch and the original Bentoliner, similar to the overlap treatment