



# Standard Guide for Installation of Geosynthetic Clay Liners<sup>1</sup>

This standard is issued under the fixed designation D6102; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This guide covers directions for the installation of geosynthetic clay liners (GCLs) under field conditions typically present in environmental lining applications.

1.2 This guide contains general installation guidelines. It is not intended to replace project-specific installation requirements as found in the contract drawings or specifications. In the event of a conflict, the requirement of the project specifications will supersede the requirements of this guide.

1.3 This guide does not purport to establish specific procedure for all climatic, geographical, hydraulic, or topographical conditions that may exist at a site. Appropriate installation procedures under atypical field conditions should be modified as necessary to maintain the integrity of the GCL and adjacent lining system components.

1.4 Different GCLs have different materials of construction with different physical properties. The procedures contained in this guide, therefore, may not be universally applicable to all GCLs under all field conditions.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.04 on Geosynthetic Clay Liners.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[D4439 Terminology for Geosynthetics](#)

[D5888 Guide for Storage and Handling of Geosynthetic Clay Liners](#)

2.2 *GRI Document:*<sup>3</sup>

[GRI-GCL-5 Standard Guide for Design Considerations for Geosynthetic Clay Liners \(GCLs\) in Various Applications](#)

## 3. Terminology

3.1 *Definitions:* For definitions of other geosynthetic terms used in this guide, refer to Terminology [D4439](#). For definitions of soils terms, refer to Terminology [D653](#).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *fresh water, n*—water with a salinity less than 0.5 parts per thousand.

3.2.2 *geosynthetic clay liner (GCL), n*—a manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetics.

## 4. Significance and Use

4.1 For optimum performance, GCLs must be installed in a manner that does not impact their physical, mechanical, or hydraulic properties.

4.2 This guide identifies the proper installation procedures and equipment for use by GCL designers, inspectors, and installers.

## 5. Procedure

5.1 The methods and equipment used for placement of the GCL can vary, but the primary objective of the process is to minimize the potential for GCL damage. The placement methods and equipment should be evaluated appropriately within this context.

5.2 *Subgrade Preparation:*

5.2.1 For projects where the GCL is to be placed over an earthen subgrade, the subgrade surface must be prepared and approved prior to installation in accordance either with project specifications or with this guide. The surface should be firm and unyielding, with no abrupt elevation changes, voids and cracks, ice, or standing water.

<sup>3</sup> Available from Geosynthetic Institute, 475 Kedron Avenue, Folsom, PA 19033-1208, <http://www.geosynthetic-institute.org>.

5.2.2 The subgrade surface should be smooth and free of vegetation, sharp-edged rocks, stones, sticks, construction debris, and other foreign matter that could contact the GCL. The subgrade surface shall be compacted in accordance with the project specifications. At a minimum, the subgrade should be rolled with a smooth-drum compactor of sufficient weight to remove any excessive wheel ruts, footprints, or other abrupt grade changes. Excessive rutting should be clearly defined and quantified. In some cases 25 mm is the maximum rut depth allowed. Furthermore, all protrusions extending more than 12 mm from the subgrade surface shall either be removed, crushed, or pushed into the surface with a smooth-drum compactor.

### 5.3 GCL Placement:

5.3.1 All handling of the GCL at the job site should be conducted in accordance with Guide **D5888**.

5.3.2 GCL rolls are to be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging shall be carefully removed without damaging the GCL.

NOTE 1—The orientation of the GCL (that is, which side faces up) may be important and shall be in accordance with the engineer's requirements.

5.3.3 No equipment that could damage the GCL shall be allowed to travel directly on the GCL. Acceptable installation, for example, may be accomplished such that the GCL is unrolled in front of the backwards-moving deployment equipment, such as a front-end loader or bulldozer. If the equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

5.3.4 Care must be taken to minimize the extent to which the GCL is repositioned across the subgrade in order to minimize damage to the subgrade and to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

5.3.5 The GCL should be placed so that seams are parallel to the direction of the slope. Other industry-accepted practices for installing geosynthetics on slopes shall be followed where appropriate, to help ensure that the stability and performance of the GCL is adequate.

5.3.6 All GCL should lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels.

5.3.7 Only as much GCL shall be deployed per working day as can be covered in accordance with **5.8**. The GCL shall be covered overnight.

NOTE 2—If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project engineer, Construction Quality Assurance (CQA) inspector, and GCL supplier should be consulted for specific guidance if premature hydration is suspected to have occurred.

5.3.8 The GCL should not be installed when it is frozen.

5.3.9 If GCL is placed over geosynthetic, care must be taken as to not damage underlying material with high ground pressure equipment directly on the geosynthetic.

### 5.4 Anchorage:

5.4.1 At the top of a slope, the end of the GCL roll may be placed in an anchor trench in accordance with the project drawings and specifications. The front edge of the trench should be rounded so as to eliminate any sharp corners that could cause excessive stress on the GCL.

5.4.2 If a trench is used for anchoring the end of the GCL, soil backfill should be placed in the trench to provide resistance against pullout. The size and shape of the trench, as well as the appropriate backfill procedures, should be in accordance with the project drawings and specifications.

### 5.5 Seaming:

5.5.1 GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. The overlap may require supplemental (powdered or granular) bentonite as directed by the project specifications. Geomembrane-based GCLs also may be welded together.

NOTE 3—Alternate seaming methods may be approved.

5.5.2 Unless otherwise specified, the minimum dimension of the longitudinal overlap should be 150 mm. End-of-roll overlapped seams should be constructed similarly but the minimum overlap should measure 500 mm. Care should be taken to maintain these overlap dimensions at the time of covering in all climatic conditions.

NOTE 4—It has been documented that GCLs may have some propensity for shrinkage if they are left under an exposed (that is, no soil cover or confining pressure) geomembrane for months or years. Additional information related to potential shrinkage mechanisms, as well as suggested measures to mitigate shrinkage, are provided in two documents from the Geosynthetic Research Institute, GRI White Paper #5 (2005)<sup>4,3</sup> and Standard Guide GRI-GCL-5 (2011). This issue is not envisioned to occur for the more common situation where soil cover is promptly placed over the geomembrane/GCL composite liner system.

5.5.3 Seams should be constructed such that they are shingled in the direction of the grade in a manner that prevents the potential for flow entering the overlap zone.

### 5.6 Sealing Around Penetrations and Structures:

5.6.1 Cutting the GCL should be accomplished using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the synthetic components of the GCL during the cutting process.

5.6.2 The GCL shall be sealed around pipe penetrations and structures embedded in the subgrade using granular bentonite, powdered bentonite, or bentonite paste, in accordance with the design drawings or as recommended by the manufacturer. Examples of these details are presented in **X1.1**.

5.6.3 Contact manufacturer regarding attachments to structures.

5.7 *Damage Repair*—If the GCL is damaged (torn, punctured, perforated, and so forth) either the entire GCL must be replaced or the affected area must be repaired by cutting a patch to fit above or below the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 300 mm is achieved around all parts

<sup>4</sup> Koerner, R. M., and Koerner, G. R., "In-Situ Separation of GCL Panels Beneath Exposed Geomembranes," 2005.

of the damaged area. Dry granular or powdered bentonite or bentonite paste should be applied around the damaged area prior to placement of the patch. It may be desired to use an adhesive or other approved means to affix the patch in place so that it is not displaced during cover placement.

#### 5.8 Cover Placement:

5.8.1 Cover soils shall be free of sharp-edged stones or other foreign matter that could damage the GCL. Cover soils should be an approved material with respect to particle size uniformity, moisture content, and chemical compatibility.

NOTE 5—Recommended cover soils typically have a well-graded particle size distribution ranging between fines and 25 mm. Soils with greater than 50 % of material (by weight) larger than 20 mm may require a field-scale test using the proposed subgrade surface, cover soil, and placement and compaction equipment. Following construction of the test pad, the GCL should be hydrated for a minimum of 48 h and subjected to the traffic loading necessary to simulate field conditions. The GCL then can be exhumed and inspected for any damage to the synthetic components of the GCL and for areas of bentonite displacement.

5.8.2 Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum of 300 mm of cover shall be maintained between the equipment tires/tracks and the GCL at all times during the covering process. The minimum thickness recommendation should be increased in frequently trafficked areas or roadways and for high ground pressure equipment. Construction of a test pad as described in 5.8.1 is recommended for these areas.

5.8.3 Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones.

5.8.4 A temporary cover consisting of a waterproof tarpaulin or plastic sheet to protect GCL end-of-roll until construction

the next day is acceptable, provided that the sheet is adequately ballasted and that water cannot enter from the sides.

5.8.5 When another geosynthetic material is placed over the GCL, care must be taken to avoid using equipment and construction practices that could damage the GCL.

NOTE 6—Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles (such as 4-wheel all-terrain vehicles) may be used to facilitate the installation of the overlying geosynthetic. It is recommended that a test pad be constructed on a site-specific basis to evaluate the feasibility and effect of direct vehicular traffic. The project engineer should be contacted with specific recommendations on the appropriate procedures in this situation. A test pad need not be constructed if the project engineer determines that there is already sufficient information available to allow the use of the direct vehicular contact proposed for the project.

NOTE 7—When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet may be used to minimize friction during placement and to allow the textured geomembrane to be more easily moved into its final position.

#### 5.9 Hydration:

5.9.1 In cases where the containment of non-aqueous liquids is required, it may be necessary to hydrate the covered GCL with fresh water prior to use. Hydration may be accomplished (provided that the clay component of the GCL is covered by permeable materials) by introducing water into the containment area, either by flooding or by the use of sprinklers. The GCL supplier should be contacted for specific procedures if manual hydration is necessary.

## 6. Keywords

6.1 GCL; geosynthetic clay liner; installation

## APPENDIX

### (Nonmandatory Information)

#### X1. GCL DRAWINGS

X1.1 Figs. X1.1-X1.4 depict methods that can be employed to connect a GCL to penetrations and structures. It is the engineer's responsibility to modify and adapt the drawing as necessary to account for project-specific products and condi-

tions. In the event of any conflict between these drawings and the project drawings and specifications, the project-specific information shall supersede the information in this appendix.

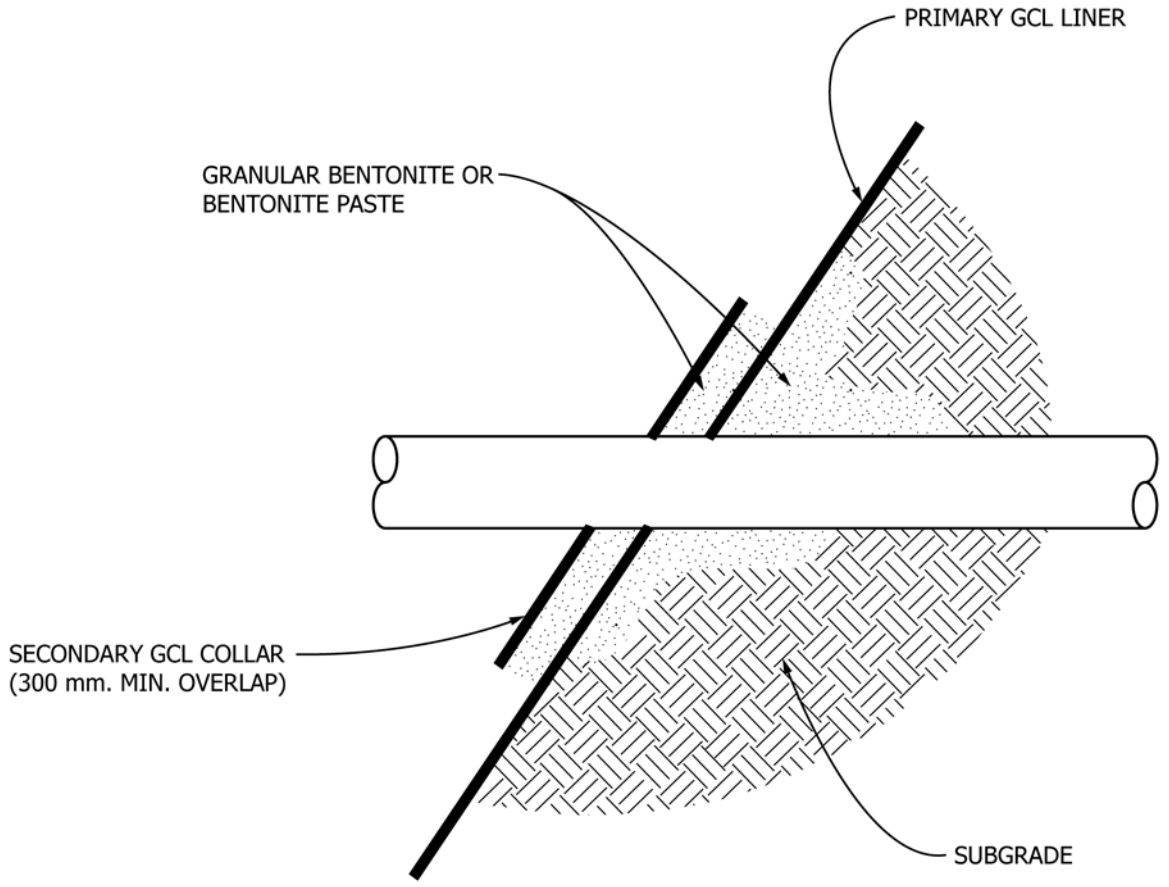


FIG. X1.1 Pipe Penetration Cross-Section

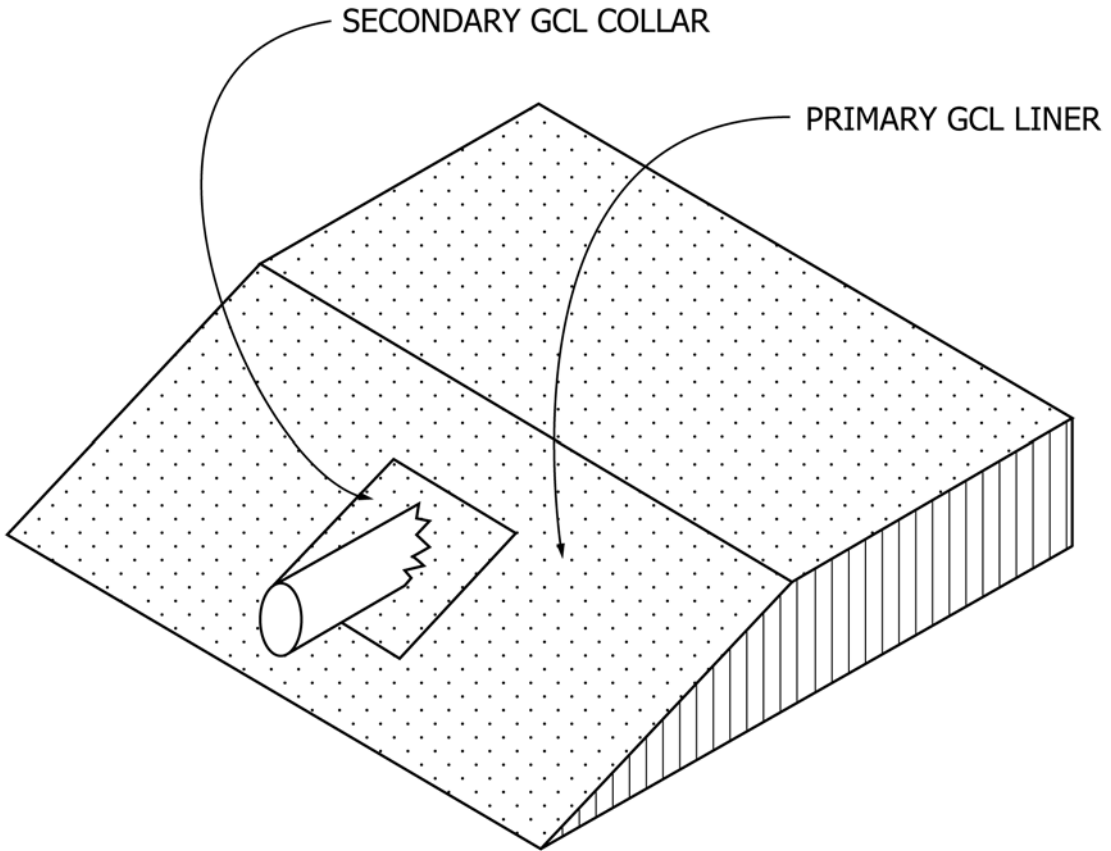
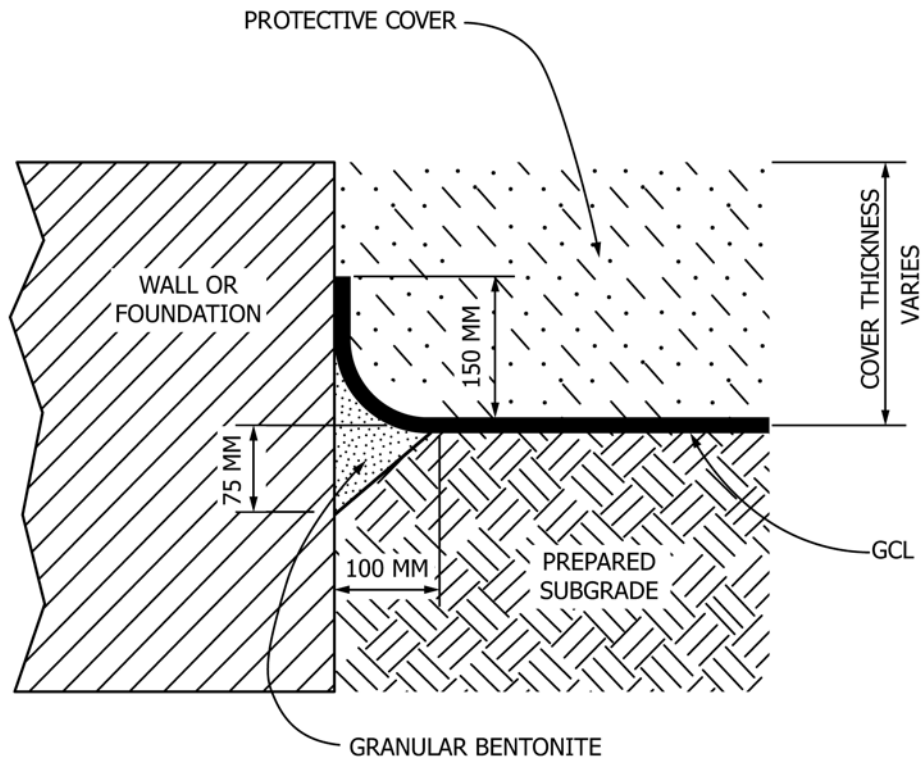


FIG. X1.2 Pipe Penetration Isometric View

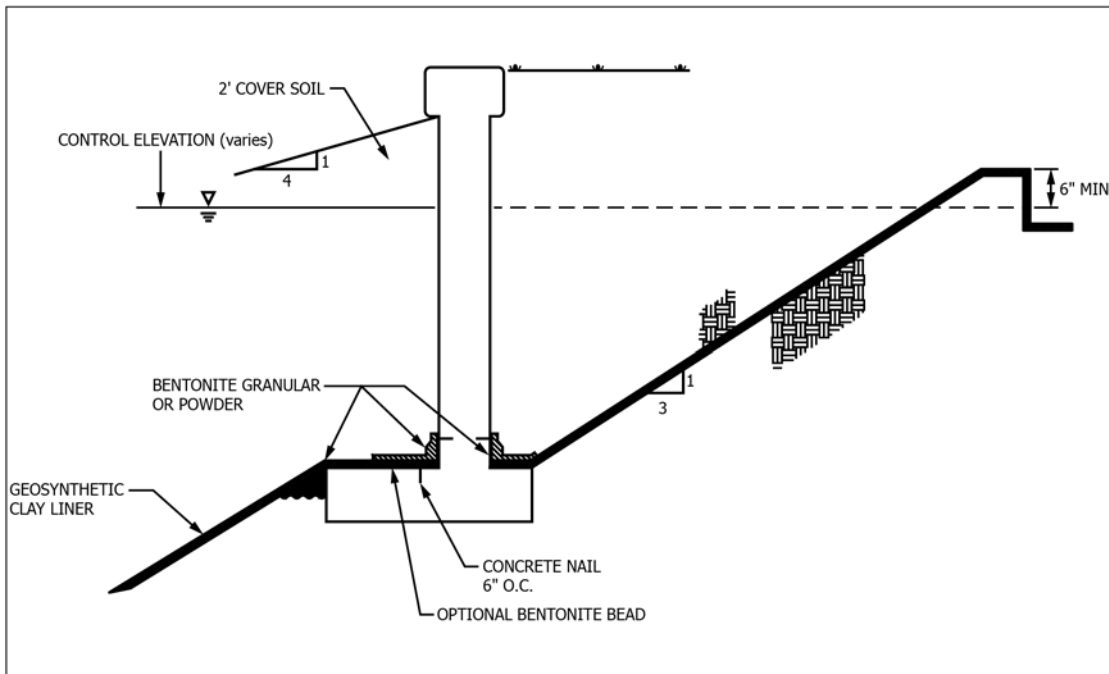


## GCL WALL SEAL – CROSS SECTION

NOTE:

PROTECTIVE COVER IN AREA SHOWN ABOVE SHOULD BE PLACED CAREFULLY TO ENSURE GCL IS CONFINED DIRECTLY AGAINST WALL. BATTEN STRIPS MAY BE USED TO FASTEN GCL.

FIG. X1.3 GCL Wall Seal-Cross Section



**FIG. X1.4 Attachments to Footings**

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