

SECTION 02500
LOW-PERMEABILITY BARRIER WALL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes placement of Low-Permeability Barrier Wall materials to encapsulate known PCB-contaminated soil.

B. Contractor will provide all equipment, labor, materials, and supplies required to perform the work in accordance with the Contract and Drawings.

1.02 SUBMITTALS

A. Submit detailed written work plans describing methodologies for performing all work-related items.

B. Submit samples for laboratory testing.

C. All materials shall meet the requirements set forth in these specifications.

1.03 MEASUREMENT AND PAYMENT

A. The work of this section will be paid by the linear foot of constructed low-permeability barrier wall, as determined by field measurement upon completion. (Estimated quantity is based on an average soil depth of 18-feet below existing surface grade).

B. Refer to Section 01025 - Measurement and Payment

PART 2 - PRODUCTS

2.01 LOW-PERMEABILITY BARRIER WALL

A. Barrier Wall material shall consist of one of the following materials:

1. Compacted Clay Barrier Wall: Clay soil with >50% P200 and maximum permeability of 1x10⁻⁷ cm/sec.
2. Slurry Clay Barrier Wall: Bentonite slurry with maximum permeability of 1x10⁻⁷ cm/sec.
3. Approved alternate.

PART 3 - EXECUTION

3.01 PREPARATION

A. Contractor shall submit his work plan for installation of the Low-Permeability Barrier Wall, including selection of compacted clay or slurry wall construction, or a combination thereof.

B. Contractor shall submit laboratory testing to verify that the selected material meets the requirements listed in these Specifications.

3.02 PLACEMENT

A. Contractor is responsible for coordinating the installation of the Barrier Wall with other work items. Contractor should minimize soil handling and arrange installation to take advantage of open excavations for scheduling.

B. Contractor shall describe installation methods in his work plan for installation of the Barrier Wall.

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TECHNICAL REFERENCE

BENTOMAT® 200R
CERTIFIED PROPERTIES

CETCO® Bentomat® 200R is a reinforced geosynthetic clay liner (GCL) consisting of a layer of sodium bentonite between a polypropylene woven geotextile and a polypropylene nonwoven geotextile, which are needle-punched together.

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY	CERTIFIED VALUES
Bentonite Moisture Content ¹	ASTM D2216	1 per 50 tonnes	12% max.
Bentonite Swell Index ²	ASTM D6890	1 per 50 tonnes	24 mL/Zg min.
Bentonite Fluid Loss ²	ASTM D5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area ²	ASTM D5993	40,000 ft ² (4,000 m ²)	0.75 lb/ft ² (3.7 kg/m ²) min.
Total Mass/Area ²	ASTM D5993	40,000 ft ² (4,000 m ²)	0.79 lb/ft ² (3.9 kg/m ²) min.
GCL Moisture Content	ASTM D5993	40,000 ft ² (4,000 m ²)	35% max.
GCL Grab Strength ³	ASTM D6768	200,000 ft ² (20,000 m ²)	30 lbs/in (5.3 kN/m) min.
GCL Peel Strength	ASTM D6496	40,000 ft ² (4,000 m ²)	1.0 lbs/in (1.75 N/m) min.
GCL Hydraulic Conductivity ⁴	ASTM D5887	250,000 ft ² (25,000 m ²)	5 x 10 ⁻¹¹ m/s max.
GCL Index Flux ⁴	ASTM D5887	250,000 ft ² (25,000 m ²)	1 x 10 ⁻⁶ m ³ /m ² /s max.
GCL Hydrated Internal Shear Strength ⁵	ASTM D6243	1,000,000 ft ² (100,000 m ²)	150 psf (7.2 kPa) typ @ 200 psf (9.6 kPa)

Notes:
¹ Bentonite property tests performed before the bentonite is incorporated into the finished GCL product.
² Reported at 0 percent moisture content.
³ All tensile strength testing is performed in the machine direction using ASTM D6768.
⁴ Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi (550 kPa) cell pressure, 77 psi (530 kPa) headwater pressure and 75 psi (515 kPa) tailwater pressure.
⁵ Peak values measured at 200 psf (9.6 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

www.CETCO.com | contact@cetco.com

IMPORTANT: The information contained herein supersedes all previous printed versions, and is believed to be accurate and reliable. For the most up-to-date information, please contact CETCO sales team. CETCO accepts no responsibility for this results obtained through application of this product. CETCO reserves the right to update information without notice.



SECTION 02510
COVER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Contractor shall install a Cover System consisting of 2-feet of compacted clay with a flexible membrane liner (FML). Also includes 12-inches of protective cover soil and 2-inches of topsoil above FML.

B. Contractor will provide all equipment, labor, materials and supplies required to perform the work in accordance with the Contract and Drawings.

1.02 SUBMITTALS

A. Submit detailed written work plans describing methodologies for performing all work-related items.

B. Submit samples for laboratory testing.

C. Submit manufacturer certificates and material testing information for all products.

D. All materials shall meet the requirements set forth in these specifications.

1.03 MEASUREMENT AND PAYMENT

A. The work of this section will be paid by as a lump sum item, based on completion and acceptance of the work by the Engineer and Owner.

B. Refer to Section 01025 - Measurement and Payment

PART 2 - PRODUCTS

2.01 COVER SYSTEM

A. Contractor shall provide necessary laboratory and field testing to verify material suitability, such as:

1. Laboratory testing: gradation, permeability, modified Proctor, moisture content, etc.
2. Field testing: gradation, compaction, sampling, seep testing, etc.

2.02 FLEXIBLE MEMBRANE LINER (FML)

Flexible Membrane Liner shall consist of one of the following:

1. PVC Liner
2. 30-mil LLDPE or HDPE liner
3. Approved alternate

2.03 CLAY

Clay will shall meet the following requirements:

1. Maximum particle size 3 inches
2. Maximum permeability of 1x10⁻⁷ cm/sec.
3. Moisture content ± 5% of optimum as determined by modified Proctor test.

2.04 PROTECTIVE COVER SOIL

Protective cover soil shall consist of granular backfill (such as MDOT ZNS sand or Class II sand) with maximum particle size of 1 inch. May also consist of on-site cut materials which meet the requirements of this specification, and can be spread without excessive handling.

2.05 TOPSOIL

Topsoil shall consist of striped material from site clearing operations or imported topsoil material. Shall consist of organic material suitable for vegetative growth, free of clods and clumps and large rocks.

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7. Contractor shall employ precautions to (1) prevent worker contact with contaminated soil and (2) prevent exacerbation of contamination

F. Flexible Membrane Liner (FML):

1. Contractor shall place liner on prepared surface.
2. Contractor shall provide seaming equipment as recommended by the manufacturer for the selected liner type.
3. Contractor shall provide verification testing for each seam in the cover system.
4. Contractor shall prevent equipment and vehicle traffic from contact with the liner.
 - a. A minimum of 12-inches of cover soil shall be installed between liner and equipment tires.
5. Liner shall be installed in a relaxed condition to prevent tearing due to material expansion and contraction.
6. Contractor shall employ precautions to (1) prevent worker contact with contaminated soil and (2) prevent exacerbation of contamination.

G. Cover systems shall extend a minimum of 2-feet beyond PCB-contaminated area boundary (at least to outer edge of low-permeability barrier wall).

H. Anchor trenches: Liners shall be anchored in a 2' x 2' anchor trench. Trench backfill shall consist of cover soil material, compacted to 95% of the maximum density as determined by the modified Proctor method.

1. Anchor trench shall be constructed beyond the outside edge of the Low-Permeability Barrier Wall.

I. Protective Cover Soil:

1. Contractor shall place cover soils by dumping at the perimeter of the cover area and pushing soils onto the liner, maintaining 12-inch minimum soil thickness between liner and equipment tires.
 - a. Minimize traffic and soil handling to reduce risk of damage to liner.
2. Contractor shall remove oversized particles when observed during placement to prevent liner damage.
3. Final cover soil thickness shall measure 12 inches minimum thickness.
4. Contractor shall employ precautions to (1) prevent worker contact with contaminated soil and (2) prevent exacerbation of contamination.

J. Topsoil:

1. Contractor shall place a minimum of 2-inches of salvaged or imported topsoil over cover soils to provide a vegetative growth matrix.
2. Contractor shall apply topsoil at a rate of 2200/lb/acre.
3. Topsoil shall be stabilized with mulch erosion blanket.

K. ALTERNATE: Geosynthetic Clay Liner (GCL):

1. If approved, GCL may be considered as an alternate to replace the 2-foot thick compacted clay cover.
2. Contractor shall place liner on prepared surface.
3. Seams shall be developed as directed by the manufacturer.
4. Contractor shall provide additional bentonite powder for seaming as recommended by the manufacturer.

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C. Contractor shall provide suitable equipment:

1. to achieve necessary compaction for Compacted Clay Barrier Wall.
2. to trench, mix, and place bentonite slurry for Slurry Clay Barrier Wall.
3. to provide dewatering as necessary for the selected construction method.

D. Contractor shall relocate soil excavated for construction of Low-Permeability Barrier Wall within the encapsulation area. Relocated soil shall be compacted and graded as part of the PCB-contaminated soil unit.

1. Equipment shall be decontaminated to prevent cross-contamination or exacerbation.

2. Contractor shall employ Health and Safety measures to protect workers and prevent contact with contaminated soils.

E. For Compacted Clay Barrier Wall:

1. Material excavated for construction of Clay Barrier Wall shall be relocated within the encapsulation area.
2. Contractor shall place clay material in lifts not exceeding 9-inches in loose thickness.
3. Contractor shall apply compaction using suitable equipment (i.e. sheepsfoot roller) to achieve a homogeneous soil, minimizing air voids.
4. Contractor shall provide compaction testing on each lift of the barrier wall.
5. Contractor shall remove large stones or clods of soil which would negatively impact the uniform quality of the barrier wall.
6. Clay barrier wall shall be constructed a minimum of 2-feet thick and shall extend 2-feet into native soil below the PCB-contaminated fill.
 - a. Contractor shall provide dewatering to facilitate construction as needed.
7. Contractor shall employ precautions to (1) prevent worker contact with contaminated soil and (2) prevent exacerbation of contamination.

F. For Slurry Clay Barrier Wall:

1. Material excavated for construction of Clay Barrier Wall shall be relocated within the encapsulation area.
2. Contractor shall place slurry material in a manner to provide a homogeneous, continuous barrier surrounding the PCB-contaminated area.
3. Contractor shall periodically sample the slurry wall mixture to verify that the required permeability is achieved.
4. Slurry wall shall be constructed a minimum of 2-feet thick and shall extend 2-feet into native soil below the PCB-contaminated fill.
5. Contractor shall employ precautions to (1) prevent worker contact with contaminated soil and (2) prevent exacerbation of contamination.

3.03 VERIFICATION

Contractor shall provide copies of all verification testing to the Engineer for review.

-END OF SECTION-

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2.06 ALTERNATE: GEOSYNTHETIC CLAY LINER (GCL)

Geosynthetic Clay Liner material shall provide maximum permeability of 1x10⁻⁷ cm/sec. GCL cover soil shall consist of granular backfill (such as MDOT ZNS sand or Class II sand) with maximum particle size of 1 inch.

PART 3 - EXECUTION

3.01 PREPARATION

A. Contractor shall submit his work plan for installation of the Cover System, including selection of FML and GCL products and cover soils.

B. Contractor shall submit laboratory testing to verify that the selected material meets the requirements listed in these Specifications.

C. Contractor shall prepare the work area (including anchor trenches) by removing topsoil, vegetation, and excavate to design grade.

- a. Work surface shall be graded smooth and sloped to drain.
- b. Protrusions, debris, and large particles shall be removed. Voids caused by excavation operation or by removal of large items shall be filled with clean backfill material.
- c. Excavated material from low-permeability barrier wall shall be placed above existing materials after the area is cleared, and compacted and graded smooth.

D. Excavated material from low-permeability barrier wall shall be placed above existing materials after the area is cleared, and compacted and graded smooth.

E. Cover System area shall be proof-rolled and compacted prior to placement of liners and cover soil to minimize future settlement and provide a smooth grade for liner placement.

3.02 PLACEMENT

A. Contractor is responsible for coordinating the installation of the Cover System with other work items.

B. Contractor should minimize soil handling and arrange installation to take advantage of open excavations for scheduling.

C. Contractor shall describe installation methods in his work plan for installation of the Cover System.

D. Contractor shall provide suitable equipment:

1. to achieve necessary compaction for Cover System soils.
2. to protect liner and prevent damage to cover system during construction (e.g. rubber-tired equipment for traversing above cover).

E. Compacted Clay

1. Clay shall be placed in lifts not exceeding 9 inches loose thickness.
2. Contractor shall provide suitable equipment to compact clay soil (i.e. sheepsfoot roller).
3. Contractor shall remove oversized particles during placement.
4. Clay shall be handled and placed in a manner to achieve optimum moisture (±5%) and density (95% or greater).
 - a. Contractor shall provide density testing during placement.
5. Clay shall be placed to provide a minimum 2-foot thick cover over the entire area, extending to the outer limit of the low-permeability barrier wall.
6. Surface shall be graded smooth to provide a base for FML installation.

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5. Contractor shall prevent equipment and vehicle traffic from contact with the liner.

- a. A minimum of 12-inches of cover soil shall be installed between liner and equipment tires.

6. Liner shall be installed in a relaxed condition to prevent tearing due to material expansion and contraction.

7. Contractor shall employ precautions to (1) prevent worker contact with contaminated soil and (2) prevent exacerbation of contamination.

3.03 VERIFICATION

A. Contractor shall provide copies of all verification testing to the Engineer for review.

-END OF SECTION-

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Venting System Specifications

Part 1 - General

1.01 Summary

- A. Contractor shall install a venting consisting of a low profile vapor collection system and associated vents.
- B. Contractor will provide all equipment, labor, materials and supplies required to perform the work in accordance with the Contract and Drawings.

1.02 Submittals

Submit product data for the venting system specified, including manufacturer's specifications.

Submit samples of the following for approval, if proposing material different from specifications:

1. Venting pipe
2. Venting accessories

1.03 Measurement and Payment

The work of this section will be paid by as a lump sum item, based on completion and acceptance of the work by the Engineer and Owner.

1.04 Quality Assurance

A pre-installation conference shall be held with the Contractor, Installer, and Engineer prior to installation of the venting system to assure proper site and installation conditions.

1.05 Delivery, Storage, and Handling

Deliver materials to project site as specified by manufacturer labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for handling.

Store materials as specified by the manufacturer in a clean, dry, protected location. Protect stored materials from direct sunlight.

Remove and replace damaged materials.

Part 2 - Products

2.01 Venting System Materials

Collection system shall be a low profile vapor collection system used in lieu of or in conjunction with perforated piping, as described below.

Geovent™ consists of a three dimensional vent core wrapped in a non-woven, needle punched filter fabric. Geovent™ is manufactured by CETCO, (847) 851-1800, www.CETCO.com.

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Geovent™ Physical Properties

ITEM PROPERTY	TEST METHOD	MINIMUM	MAXIMUM
Compression Strength	ASTM D 3052	1000 PSI	4,000 (1,000 for 100' depth)
Thickness	ASTM D 3777	1.0 in. (2.54 cm)	1.5 in. (3.81 cm)
Tensile (Trenchback grade 1 - 3)	ASTM D 4756	20 gpm/ft width (322 gpm/ft)	
ITEM PROPERTY <th>TEST METHOD</th> <th>MINIMUM</th> <th>MAXIMUM</th>	TEST METHOD	MINIMUM	MAXIMUM
ASX	ASTM D 4756	70 lbs force (31.2 kN)	
Stitch Tensile Strength	ASTM D 4802	300 lbs. (13.4 kN)	
CBM Perforation Strength	ASTM D 4802	250 lbs. (11.1 kN)	
Flexion	ASTM D 4802	20 gpm/ft (3.26 kN/m ²)	

Alternatively, Vapor-Vent™ consists of a three dimensional vent core wrapped in a filter fabric. Vapor-Vent™ is manufactured by Land Science, (949) 481-8118, landsciencetech.com.

Auxiliary materials such as Geovent™ End Outlets or Vapor-Vent™ Pipe Reducer shall be used in accordance with manufacturer recommendations.

Four-inch diameter, Schedule 40 PVC piping shall be used to connect Geovent™ or Vapor-Vent™ as identified on project drawings.

Gravel shall be placed around the Schedule 40 PVC, connections, and Geovent™ or Vapor-Vent™ materials during installation.

2.02 Vent Risers

Vent risers shall be constructed with four-inch, Schedule 40 PVC piping to 6-inches above grade, followed by 12-inches of slotted Schedule 40 PVC and a 4-inch PVC cap.

Vent risers shall be placed in a trench surrounded by 12-inches of gravel for support.

Vent risers shall be covered with an appropriately sized faux stone above final cover grade.

Part 3 - Execution

3.01 Examination

Examine substrate, areas, and conditions under which venting system will be installed, with Installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 Venting System Installation

General Contractor shall be responsible for excavating the trenches and placement of gravel base. A minimum or 2-inches of gravel base should be placed beneath the vent material.

Install over substrate material where designated on drawings in accordance with manufacturer's recommendations.

3.03 Placement of Overlying and Adjacent Materials

All overlying and adjacent material shall be placed or installed using approved procedures and guidelines to prevent damage to the vent.

3.04 Vent Riser Installation

Vent risers shall be placed by the installer per the Engineer's project specifications.

Vent risers will be installed within the interior of decorative rock by the General Contractor. Vent risers will extend in length to 2-feet above final finish grade, based on the final cover design (refer to section 02510). Vent risers shall be constructed in accordance with accepted industry standards for PVC piping.

3.05 Quality Assurance Quality Control

The Engineer shall provide oversight during installation of the venting system. The General Contractor shall notify the Engineer a minimum of one week prior to commencement of installation activities. The Engineer's oversight shall not affect the General Contractor and installer's obligation to comply with the project specifications, nor shall it provide relief from full administration of the warranty.

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At areas where venting systems intersect, cut and fold back fabric to expose the dimpled core. Arrange the strips so that the top strip interconnects into the bottom strip. Unfold fabric to cover the core and use reinforcing tape, as approved by the manufacturer, to seal the connection to prevent sand or gravel from entering the core.

Place vent risers per the Engineer's project specifications. Connect venting material to the appropriate end outlets and seal with fabric reinforced tape.

Equipment shall not be directly driven over and stakes or any other materials may not be driven through the vent.

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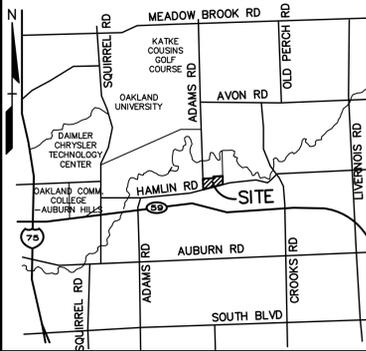
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LOCATION MAP - NOT TO SCALE

NO.	BY	CHK	DESCRIPTION	DATE
1	RLS	RLS	REVISED ENCLOSURE AREA	11-2-18
2	RLS	RLS	REVISED PER CITY REVIEW	11-2-18
3	RLS	RLS	REVISED ENCLOSURE AREA & CITY REVIEW	12-2-18
4	RLS	RLS	REVISED ENCLOSURE AREA & CITY REVIEW	12-2-18

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