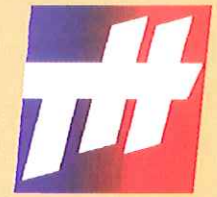


Multiplexx™ PVCP



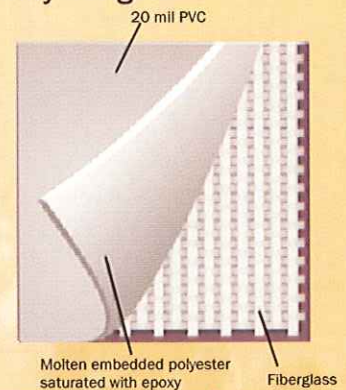
Cured-In-Place Liner System by Terre Hill Composites

INNOVATIVE, ECONOMICAL SOLUTION FOR DETERIORATING STRUCTURES

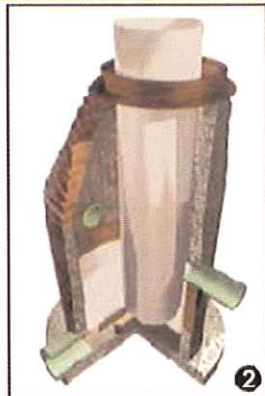


Terre Hill Composites' cured-in-place products safeguard your underground structures against groundwater infiltration and H₂S corrosion. Prolonged corrosive action by carbonic and sulfuric acids dissolves mortar and cement, and weakens steel, jeopardizing the present and future integrity of even new underground structures. This includes wet wells, manholes, vaults, chemical tanks, wastewater treatment plants, and virtually any type of exposed concrete. Suncoast Infrastructure, along with Terre Hill Composites, can now extend the life of your present system and add years of service without costly digging or lengthy interruption—all while conserving community budgets.

Multiplexx™ PVCP liner system forms a chemically stable barrier between corrosive gases and water infiltration. Unlike other adhesives or cementitious coatings, Terre Hill liners form a reinforced vessel that is designed to act in concert with the existing structure. Terre Hill Composites liners are easily applied to a range of various types and sizes of underground structures. Additional layers of fiberglass and polyester can be added to provide more thickness to withstand high ground water pressures and other factors affecting structural integrity. Performance is backed by a 10-year, non-prorated warranty.



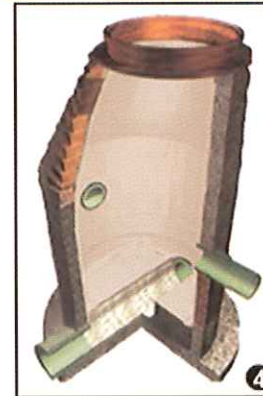
1 Multiplexx™ PVCP liners are prefabricated to structure size. On-site, structures are pressure cleaned and grouted where necessary, while steps and obstructions are removed.



2 Epoxy-coated PVCP liner inserted into manhole interior.



3 Flexible diaphragm is inflated. Heat introduced within the pressurized system cures the epoxy, forming a protective barrier within the structure. Curing under pressure



4 Structures are virtually renewed, sealed from further corrosion and infiltration. Manholes and pump stations can be fully rehabilitated in 4 to 8 hours, with little or no downtime.

Suncoast Infrastructure, Inc.
P. O. Box 397
Florence, MS 39073



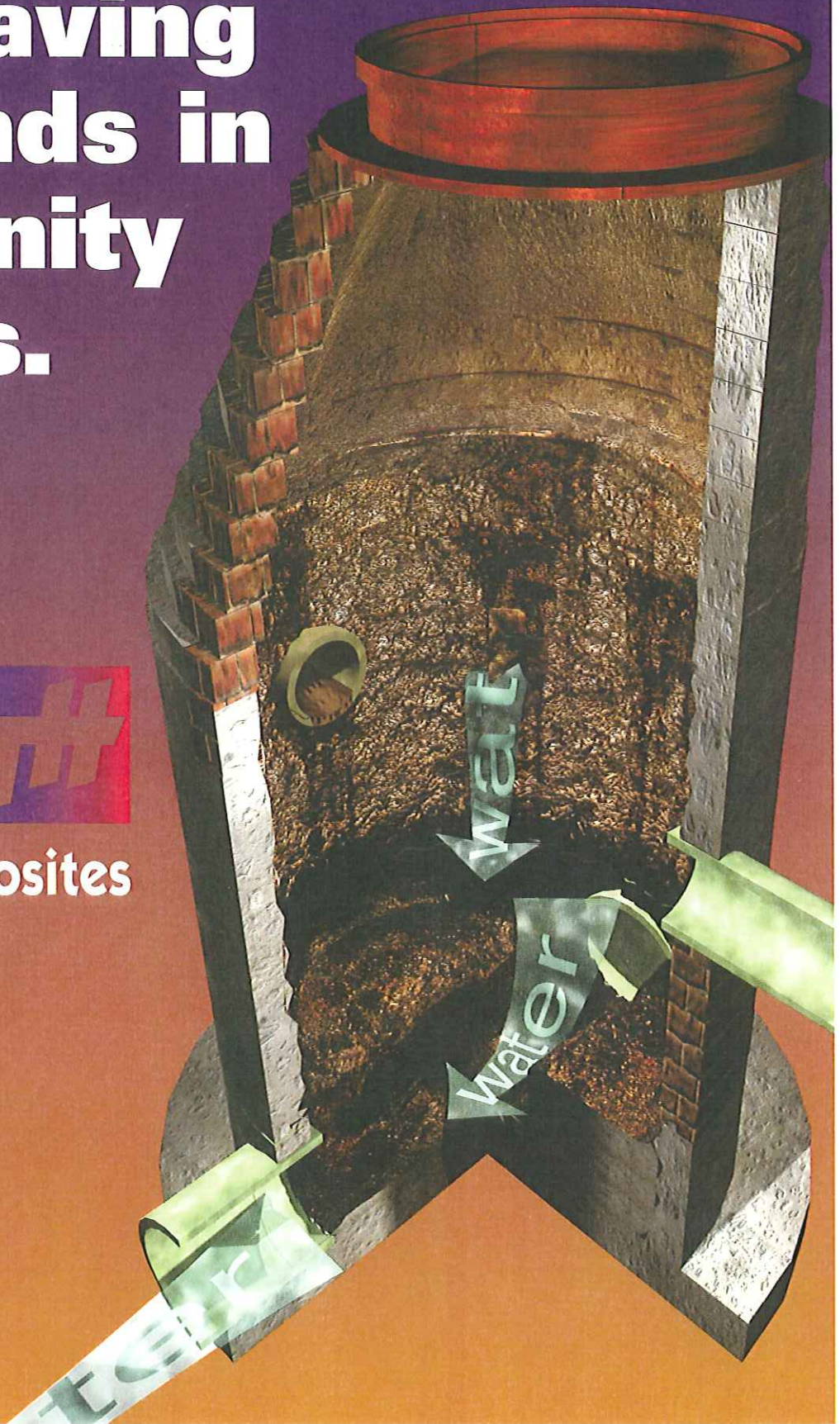
Toll Free: 800-746-4841
Phone: 601-420-9682
Fax: 601-420-9300
Email: info@suncoastinfrastructure.com

A Full Service Evaluation and Trenchless Rehabilitation Company

**We're adding years
to aging structures
while saving
thousands in
community
budgets.**



Terre Hill Composites



Innovative, economical for deteriorating structure

**What Works For Pipe Lining
Now Works For Manholes.**



Terre Hill Composites cured-in-place products safeguard your underground structures against groundwater infiltration and H₂S corrosion.

Prolonged corrosive action by carbonic acid and sulfuric acids dissolves cement and weakens steel, jeopardizing the present and future integrity of even new underground structures. This includes wet wells, manholes, vaults, chemical tanks, wastewater treatment plants and virtually any type of exposed concrete.

Now Terre Hill Composites, a new division of Terre Hill Concrete Products, can extend the life of your present system and add years of service without costly digging or lengthy interruption—all while conserving community budgets.

1 MultiPlexx™ Liner – Economical cured-in-place installation restores long-term utility to deteriorating structures.

Underground structures with advancing deterioration compromise the life and capability of an entire system. The Terre Hill MultiPlexx Liner can rehabilitate such structures and arrest any further decay—economically and efficiently.

Tough MultiPlexx Liners are prefabricated to structure size. On-site, structures are pressure-cleaned and grouted where necessary, while steps and obstructions are removed. The liner is then bonded to wet or dry surfaces by epoxy resins and pressure-installed, then heat cured.

Structures are virtually renewed, sealed from further corrosion and against inflow and infiltration. Manholes and pump stations, for example, can be completely rehabilitated in 4 to 8 hours, with little or no downtime.

2 MultiPlexx Layup™ – Directly applied seal arrests corrosive deterioration.

Sometimes a structure has an odd shape, or contains interior pipes and difficult-to-remove hardware. The Terre Hill MultiPlexx Layup System allows rehabilitation of the structure while simply leaving the hardware and pipes in place.

This process is performed with fiberglass reinforcement, and is available in different systems, depending on the degree of deterioration.

Rehabilitation by means of our MultiPlexx Layup System is extremely durable and completely watertight.

HydroPoxxy™ – A two-component epoxy with superior underwater curing ability.

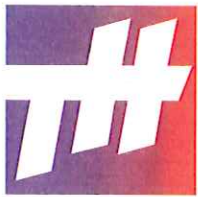
Terre Hill HydroPoxxy consists of two-component epoxy resins based on Bis-Phenol and Epylchlorohydrine in combination with selected curing agents. These curing agents provide this system with outstanding underwater curing capabilities. Perfect for use in manholes, vaults, pump stations, wet wells and other underground structures.

Mastic – A lightweight, two-component, troweling epoxy.

Addition of a unique combination of fillers provides easy mixing, simplified application, and outstanding thixotropic characteristics.

solutions

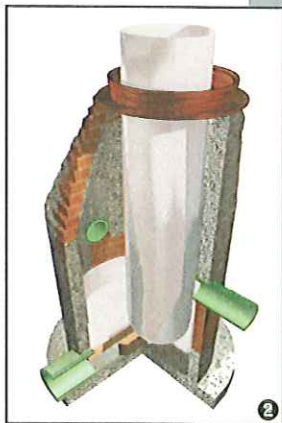
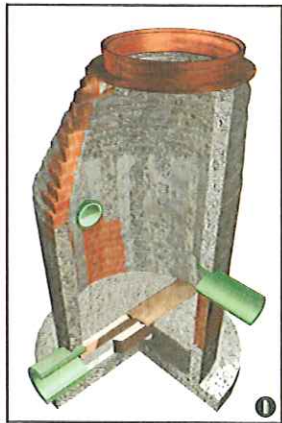
res.



Terre Hill Composites liners form a chemically stable barrier between corrosive gases and water infiltration. Unlike other adhesives or cementitious coatings, Terre Hill liners form a reinforced vessel that acts independently within the structure. Terre Hill Composites liners are easily applied to a range of various types and sizes of underground structures.

Hyder North America, Inc., has witnessed the hydrostatic pushoff tests of Terre Hill Composites products. Their independent report acknowledges the extraordinary properties of the MultiPlexx liner system.

Consequently, Terre Hill Composite products are recommended for the rehabilitation of sanitary sewer systems where acid conditions and infiltration is present. For a copy of the report, contact our office.



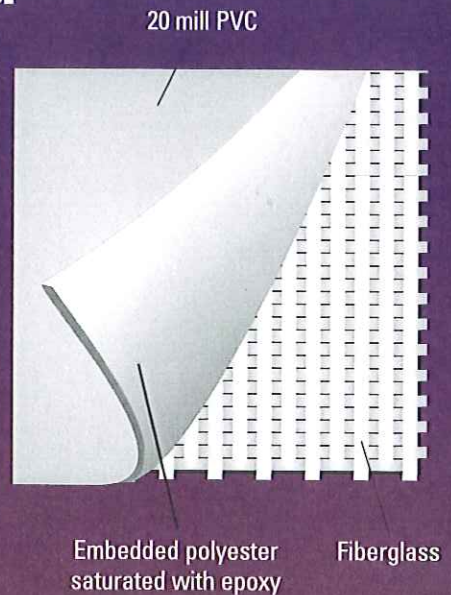
- 1 Manhole prepared, steps removed and channel bridge installed to allow continuous flow within channel.
- 2 Epoxy-coated liner inserted into manhole interior.
- 3 Flexible diaphragm is inflated. Heat introduced within the system cures the epoxy, forming a protective barrier within the manhole. Channel bridge removed.
- 4 Channel bridge removed, lateral openings trimmed. Chimney section trimmed at the cover support lip. All edges protected with mastic.



Durable protection for underground structures.

- Now available with MultiPlexx Liner PVCP* – polyvinyl chloride (PVC) for superior primary protection against corrosion by sewer gas and resistance to groundwater infiltration.
- Additional layers of fiberglass and polyester can be added to provide more thickness to withstand higher ground water pressures.
- Mill thickness is calculated using the formula $t = 3.32 \times R \times h$, where R = radius and h = hydrostatic head measured in feet.

*The MultiPlexx Liner System is protected by U.S. Patent No. 5,106,440
6,540,438
6,540,439



Terre Hill Composites.

What's more solid than our reputation?

Our results.

Township Supervisors, Sewer Authorities, Town Boards, and Consulting Engineers—those who have come to rely on Terre Hill, know they can depend on the products and know-how based on our more than 80 years of experience. Now this includes our pressurized cured-in-place rehabilitation technology to keep underground systems working better and longer than ever.

For a consultation, a free estimate, or just to answer a question, don't hesitate to call Terre Hill Composites for help with your rehabilitation problems. 1.800.242.1509. Sample specifications available upon request.

Warranty

All Terre Hill Composites liners have a non-prorated warranty, covering materials and labor.



Terre Hill Composites

PO BOX 10, 485 WEAVERLAND VALLEY ROAD, TERRE HILL, PA 17581
717.445.3100 / FAX 717.445.3108 / 1.800.242.1509



Before



After

Or contact your local Terre Hill Composites Representative:



TERRE HILL COMPOSITES

No better solution for infrastructure rehab.

400 West Main Street, Suite 105
Ephrata, PA 17522
Tel: 717-738-9164 Fax: 717-738-6946
www.thcomposites.com

Concept: In a virtual round structure such as a typical manhole or pump station the following formula is developed to estimate the required liner thickness to resist the design hydrostatic pressure for a given structure radius. The installation technique permits the assumption that the free body diagram of the liner retains its shape under load. In determining the thickness of the liner, we ignore the adhesion of the liner to the substrate. In reality adhesion occurs and is responsible for the watertight seal between the liner and the structure¹.

F'_{pu} = ULTIMATE COMPRESSIVE STRENGTH OF COMPOSITE = 12,225 PSI².

E_p = ELASTICITY MODULUS OF COMPOSITE = 1,000,000 PSI.

$F'_c = 0.4 \times f'_c = 1000$ PSI. (Match safety factor of concrete)³

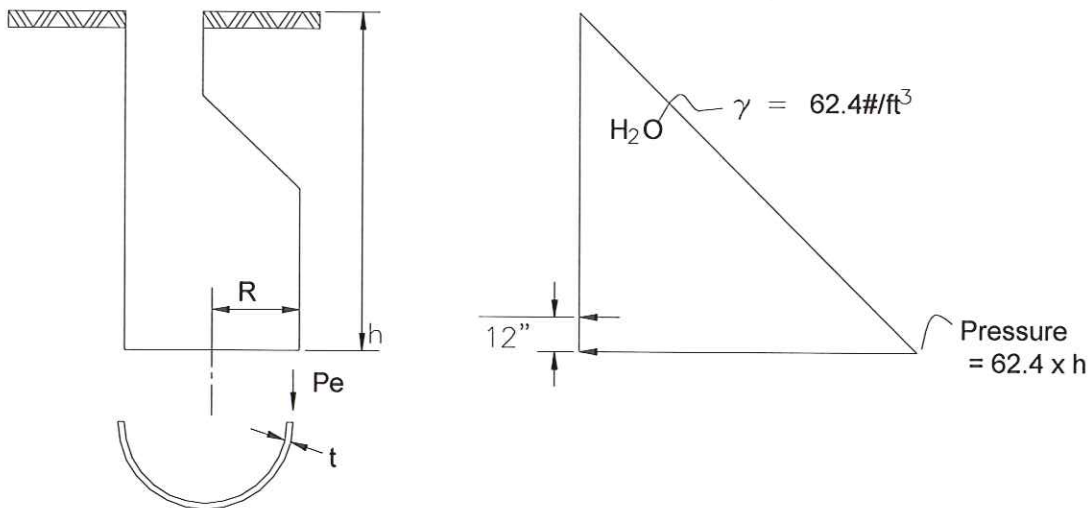
$E'_c = 57,000 \sqrt{f'_c} = 3,122,018$ PSI.

t = LINER THICKNESS IN MILS.

h = HYDROSTATIC HEAD IN FEET.

R = RADIUS OF THE STRUCTURE IN FEET.

γ = WATER DENSITY = 62.4 # / CUBICFOOT.



Allowable stress in the composite is:

$$F'_{pu} \therefore \frac{0.4 \times F'_{pu} \times E_p}{E'_c} = \frac{R \times \gamma \times h \times 1,000}{t \times 12} \text{ this means: } t = \frac{13,000 \times E'_c \times R \times h}{F'_{pu} \times E_p}$$

For above material value the thickness of the liner in mils is: $t = 3.32 \times R \times h$

¹ Comments from Hans de Bruijn, Sales Engineer.

² ASTM D-695

³ 1200 PSI but we assume 1000 PSI.

MULTIPLEXX LINER SYSTEM MODEL PVCP

BY

TERRE HILL COMPOSITES, Inc.
400 West Main Street, Suite 105
Ephrata, PA 17522

E-Mail: COMPOSITES@TERREHILL.COM

WEB ADDRESS: www.terrehill.com

TEL.: (717) 738-9164, FAX: (717) 738-6946

This specification is available on disk.

PART I- GENERAL

1.1 DESCRIPTION OF WORK

- A. This work shall include the furnishing of all labor, materials, and equipment for the rehabilitation of an existing manhole with a cured-in-place PVC composite liner.
- B. The manhole liner shall be manufactured to the shape of the manhole. The fibrous portion of the liner shall be saturated with a modified epoxy resin, then pressurized and cured in-place.
- C. A removable inflation bladder shall be pressurized between $\frac{1}{2}$ - 5 pounds per square inch. The bladder will be removed upon completion of the curing.
- D. The exposed surface of the liner shall be **white PVC**.

1.2 LINER PERFORMANCE REQUIREMENTS

- A. Liner shall be of the type that allows rehabilitation of a concentric, eccentric or flat top manhole without removing the manhole ring and top section or corbel.
- B. The liner shall be installed and cured in place via controlled curing by heat and pressurization in the manhole to complete the curing process.
- C. The lining of the manhole shall result in a structure to the shape and contour of the existing manhole. The liner shall be installed and substantially bond to the interior manhole substrate and be watertight, free of any joints or openings other than pipe inlets, outlets and the cover frame opening.
- D. Where indicated on the manhole schedule the lining shall be designed with

1 of 2

independent structural hoop strength for full height hydrostatic pressure as if the liner were a secondary vessel inside the existing manhole. The manufacturer shall design adequate liner thickness into the system with or without additional fiberglass layers.

- E. Where indicated on the manhole schedule the inverts shall be lined.

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following:
 1. ASTM D 695-96 Standard Test Method for Compressive Properties of Rigid Plastics.

1.4 SUBMITTALS

- A. Copies of the manhole dimensions, installation instructions, and manufacturer's product data sheet to be submitted for the Engineer's review.
- B. If required, calculations for the round manhole lining that demonstrate hoop strength under maximum hydrostatic conditions. The calculation shall assume zero liner adhesion to the existing structure, but assume lateral support from the existing wall. The calculated hoop stress shall be less than 11% of the compressive strength as determined by appropriate ASTM test method.

PART 2-PRODUCTS

2.1 MATERIALS

- A. Manhole interior walls and benches shall be patched with cementitious patching/plugging compounds as manufactured by Tamms, Inc., or approved equal.
- B. Channel reconstruction cement shall be speed-crete as manufactured by Tamms, Inc., formed Portland cement concrete of 4,000-psi compression strength, or approved equal.
- C. As a minimum the manhole liner systems shall be composed of a multiple layered composite. The primary layer shall be manufactured from 20 mils PVC with 10 ounce per square yard polyester fleece. The surface hairs of the fleece must be embedded in the molten PVC during the manufacturing process of the PVCP laminate. Glued laminates are not allowed.

- D. The fibrous body will be impregnated with a modified epoxy resin. Add fiberglass and resin, for additional liner thickness.
Multiplexx Liner™ PVCP:
PVCP20-10=86 mills. (20 mill PVC & 10 oz Fleece). (i.e. no fiberglass)
PVCP20-28=88 mills. (20 mill PVC, 10 oz Fleece & 18 oz Fiberglass).
PVCP20-34=110 mills. (20 mill PVC, 10 oz Fleece & 24 oz Fiberglass).
PVCP20-custom mills (20 mill PVC, 10 oz Fleece & Fiberglass as required).
- E. Liner Thickness: The anticipated hydrostatic head "h" in feet above the bottom of the invert and the Radius "R" in feet of the structure shall determine the necessary liner thickness "t" in mills.

2.2 APPLICABLE MANUFACTURERS

- A. Products specified by named manufacturers are specified as a standard of quality.
1. PVCP, Multiplexx™ Liner System.
 2. Approved equal.

2.3 ACCEPTABLE LINER INSTALLERS.

- A. Licensees of Terre Hill Composites, a division of Terre Hill Concrete Products, Terre Hill, PA, is the supplier of the PVCP Multiplex Liner System. U.S. Patent number 5,106,440, 6,540,438 B2 and 6,540,439 B2. Phone: (717) 738-9164, Fax: (717) 738-6946.
- B. Approved equal.

PART 3-EXECUTION

3.1 MAINTAINING WASTEWATER FLOWS

- A. The OWNER shall be fully responsible for restricting the normal sewage flow through the manhole where the specified rehabilitation work demands such flow restriction. The CONTRACTOR will plan his work in order to maintain flows and not interrupt sewer service. This may include night work. The cost of any night work required will be included in the contract price of the applicable item. The CONTRACTOR shall not perform work to manholes until plans for bypass pumping or flow restriction have been submitted by the OWNER and accepted by the CONTRACTOR. Additionally, no plugging of existing Utility System Gravity Mains will be made without the approval of the Utilities Department.

- B. Unlined flow channel. Install a bridge or flow through tube and cut the liner bottom near the flow line in the channel to expose the flow channel and give access to the pipes. Plug the pipes entering the manhole through the wall and trim the pipe opening to restore flow.
- C. Lined flow channel. Plug the pipes entering the manhole and line the flow channel to the edge of the pipe. Trim all pipe openings and restore the flow.

3.2 PRE-INSPECTION

- A. In general, the OWNER assumes responsibility for the structural integrity of existing structure. Prior to beginning work, the manhole shall be visually inspected and any areas of apparent structural damage shall be reported to the OWNER for restoration.

3.3 CLEANING

- A. All surfaces of the manhole shall be cleaned with a high-pressure water-jet sprayer with an operating pressure of at least 3,500 psi. Pressure wash the manhole to remove all dirt, grease, sand, and surface contaminants on the wall and floor leaving a clean damp surface.
- B. Badly deteriorated and pitted pre-cast manholes and brick manholes, with missing bricks and grout, shall be muddied back to form a smooth compatible surface for the liner.

3.4 PLUGGING RECONSTRUCTION

- A. The stopping of active hydrostatic infiltration shall be accomplished by using Tamms cementitious products Speed Crete and Powder X, as manufactured by Tamms Industrial, Division of LaPorte Construction Chemicals, Mentor, Ohio, Hydro-gel by prime resins or approved equal.
- B. Water infiltration can also be stopped using expansion type grouts such as 3M or Avanti.

3.5 CHANNEL RECONSTRUCTION

- A. Remove all loose grout and rubble of existing channel. Rebuild channel if required by shaping and repairing slope of shelves or benches. Work shall include alignment of inflow and out flow ports in such manner to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and

entering branch or branches shall have a true curve of as large a radius as the size of the manhole will permit. Channels shall be shaped to allow entrance of maintenance equipment into pipes including buckets, TV camera, etc.

- B. Inverts shall only be lined where indicated on the plans "lined inverts".

3.6 LINER INSTALLATION

- A. Installation shall be by an installer that is qualified by the liner manufacturer. The CONTRACTOR shall include the furnishing of all materials, equipment, tools, and labor as required for the rehabilitation of the manholes selected, including the installation of the interior liner.
- B. The installation of the approved liner system shall be in strict accordance with the manufacturer's instructions. This shall include the preparation, installation, inflation, curing, and finishing operations, required for the completion of the manhole rehabilitation process.
- C. All safety rules and regulations applicable laws and insurance requirements shall be observed in storing, handling, use and application of the liner materials, resins and any solvents.
- D. Ventilation shall be provided to the workers at all times.

PART 4-WARRANTY, MEASUREMENT AND PAYMENT

- A The CONTRACTOR shall warrant to the OWNER in writing the installation, fabrics, and resins to be free of defects in workmanship and materials for a period of ten years.
- B Payment for the rehabilitation of the structure shall be made at the contract vertical foot price and shall include all necessary labor, material and equipment to clean, seal off any water infiltration, prepare the walls, provide and install the fiberglass liner complete. The vertical foot measurement is defined as the distance between bottom of invert and top of cover. Payment value is the product of vertical foot price and vertical foot measurement.

END OF SECTION

Subject: **Limited Warranty** ⁽¹⁾

Reference:

File number:

To Whom It Concerns:

Terre Hill Composites, Inc. provides a ten-year performance Limited Warranty ⁽²⁾ that the MultiPlexx™ Liner PVCP:

- a. Will stop deterioration of the lined surfaces ⁽³⁾ by sewer gas induced corrosion;
- b. Will prevent infiltration ⁽⁴⁾ of ground water into the collection system through the lined surfaces;

This Limited Warranty will commence upon completion of the installation of the MultiPlexx™ Liner PVCP.

Respectfully submitted,
Terre Hill Composites, Inc.

William E. Oberti
VP/General Manager

¹ THIS WARRANTY IS LIMITED BY AND UNDER SUBJECT TO THE TERMS AND CONDITIONS ON THE REVERSE HEREOF, WHICH ARE INCORPORATED HEREIN BY REFERENCE.

² The licensed installer shall separately provide a general "One Year" warranty and shall pass through any extended warranty provided by the manufacturer. Terre Hill Composites provides this limited manufacturer's warranty in conjunction with the Licensed installer. This Limited Warranty is not available as a bonded warranty underwritten by a surety company.

³ The definition of the "lined surfaces" is the area within the boundaries of the liner edges. All cut edges will be coated with mastic. We exclude secondary intensions such as satisfactory appearance, voids behind the liner, folds and other claims that do not directly affect the ten-year performance warranty.

⁴ Neither Terre Hill Composites nor its installer certify the structural integrity of the host structure or claim that the lining system enhances the structural integrity of the host structure sufficiently to comply with ASTM C478 design and other applicable specifications. Additionally any breach arising out of movement of the host structure is expressly excluded.

A. THIS LIMITED WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ANY AND ALL OTHER WARRANTIES, WHETHER THEY ARE WRITTEN, ORAL, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE, AND WHETHER CREATED STATUTORILY, OR OTHERWISE. THERE ARE NO OTHER WARRANTIES, LIMITED, EXPRESS, OR IMPLIED, WHICH EXTEND BEYOND THOSE CONTAINED HEREIN.

B. This warranty is valid under normal use of the manhole. Material changes, such as holes or cuts, void the warranty unless authorized in writing by the Manufacturer.

C. When the liner is required to retain ground water pressure, consult with Manufacturer to assume proper liner thickness.

D. This Limited Warranty does not cover damage to the liner resulting from: misuse or abuse of the liner or wreck less negligent acts of any person; acts of God (including, but not limited to, earthquake and flood); damage caused by the host structure or other materials or components installed in the host structure.

E. 1. All claims for breach of this Limited Warranty contained herein shall be made in writing to the Manufacturer within ten (10) days of the time the breach is discovered or should have been discovered after reasonable diligence.

2. THE MANUFACTURER WILL NOT HONOR ANY WARRANTY CLAIM MADE PRIOR TO PAYMENT IN FULL BY THE PURCHASER OR GENERAL CONTRACTOR FOR THE WARRANTED PRODUCT.

3. Warranty service must be performed by the Manufacturer or the Manufacturer's authorized agent. Upon validation by the Manufacturer of any claim for breach of the Limited Warranty contained herein, the Manufacturer will, as its sole and exclusive option perform one of the following:

- a. repair the failed or defective liner;
- b. deliver a replacement liner to the point of original delivery by the Manufacturer; or
- c. refund the original purchase price of the liner as was collected by the Manufacturer.

4. The provisions contained in the section constitute purchaser's sole and exclusive remedy under any claim or theory of liability, including any claim based upon failure of, or defect in, the liner, whether such claim, however instituted, is based upon contract, indemnity, warranty, tort (including negligence), strict liability or otherwise.

a. The Manufacturer shall not be liable for direct, indirect, consequential or incidental claims, damages or costs of any nature including, without limitation, labor costs of any kind relating to the removal of a failed or defective liner and/or installation of replacement liner or damages, claims or costs otherwise arising from, or in connection with, breach of this Limited Warranty.

b. The manufacturer shall not be liable for any pollution or other adverse environmental claims arising out of the failure of the liner or from consequential damages related thereto.

F. 1. This Limited Warranty is extended to the original purchaser of the liner from the Manufacturer only and may not be assigned by such purchaser to a third party without prior, written authorization of the Manufacturer. Assignment of this Limited Warranty without prior, written authorization of the Manufacturer will void the Limited Warranty.

2. In order for the Manufacturer to perform warranty service or repairs, the host structure must be reasonably accessible. The manufacturer will not be responsible for costs or damages to the liner or to purchaser's property as a result of liner inaccessibility for warranty repair or service.

G 1. The adjudication of any dispute arising under this Limited Warranty must be commenced no later than one (1) year from the date the breach is discovered or should have been discovered. Any adjudication shall be governed by the law of the Commonwealth of Pennsylvania and venue shall be exclusively in the Court of Common Pleas, Lancaster County, Pennsylvania or the US District Court of Eastern District of Pennsylvania.

H. This Limited Warranty contains the complete understanding of the Manufacturer and purchaser and may be modified only in writing signed by the President of Terre Hill Composites.

Terre Hill Composites Multiplexx™ PVCP Lining System

Grand Rapids, MI – City of Rockford, White Pines Trail Acid Corrosion



Grand Rapids, MI –Rockford, White Pines Trail Acid Corrosion & Coal Tar Peeling



Terre Hill Composites Multiplexx™ PVCP Lining System

Grand Rapids, MI – City of Rockford PVCP Lined MH



Grand Rapids, MI – City of Rockford PVCP Lined MH

