

State of Colorado  
**Oil and Gas Conservation Commission**

1120 Lincoln Street, Suite 801, Denver, Colorado 80203 (303)894-2100 Fax:(303)894-2109



FOR OGCC USE ONLY

**EARTHEN PIT REPORT/PERMIT**

This form is to be used for both reporting and permitting pits. Rule 903 describes when a Permit with prior approval, or a Report within 30 days, is required for pits. Submit required attachments and forms.

Complete the  
Attachment Checklist

**FORM SUBMITTED FOR:**  
**Pit Report Pit Permit**

Oper OGCC

OGCC Operator Number: \_\_\_\_\_  
Name of Operator: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Contact Name and Telephone: \_\_\_\_\_  
No: \_\_\_\_\_  
Fax: \_\_\_\_\_

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API Number (of associated well): \_\_\_\_\_ OGCC Facility ID (of other associated facility): \_\_\_\_\_  
Pit Location (QtrQtr, Sec, Twp, Rng, Meridian): \_\_\_\_\_  
Latitude: \_\_\_\_\_ Longitude: \_\_\_\_\_ County: \_\_\_\_\_  
Pit Use: Production Drilling (Attach mud program) Special Purpose (Describe Use): \_\_\_\_\_  
Pit Type: Lined Unlined Surface Discharge Permit: Yes No  
Offsite disposal of pit contents: Injection Commercial Pit/Facility Name: \_\_\_\_\_ Pit/Facility No: \_\_\_\_\_  
**Attach Form 26 to identify Source Wells and Form 25 to provide Produced Water Analysis results.**

**Existing Site Conditions**

Is the location in a "Sensitive Area?" Yes No **Attach data used for determination.**

Distance (in feet) to nearest surface water: \_\_\_\_\_ ground water: \_\_\_\_\_ water wells: \_\_\_\_\_

**LAND USE (or attach copy of Form 2A if previously submitted for associated well) Select one which best describes land use:**

Crop Land: Irrigated Dry Land Improved Pasture Hay Meadow CRP  
Non-Crop Land: Rangeland Timber Recreational Other (describe): \_\_\_\_\_  
Subdivided: Industrial Commercial Residential

**SOILS (or attach copy of Form 2A if previously submitted for associated well)**

Soil map units form USNRCS survey: Sheet No: \_\_\_\_\_ Soil Complex/Series No: \_\_\_\_\_  
Soils Series Name: \_\_\_\_\_ Horizon thickness (in inches): A: \_\_\_\_\_ ; B: \_\_\_\_\_ ; C: \_\_\_\_\_  
Soils Series Name: \_\_\_\_\_ Horizon thickness (in inches): A: \_\_\_\_\_ ; B: \_\_\_\_\_ ; C: \_\_\_\_\_

**Attach detailed site plan and topo map with pit location.**

**Pit Design and Construction**

Size of pit (feet): Length: \_\_\_\_\_ Width: \_\_\_\_\_ Depth: \_\_\_\_\_  
Calculated pit volume (bbls): \_\_\_\_\_ Daily inflow rate (bbls/day): \_\_\_\_\_  
Daily disposal rates (attach calculations): Evaporation: \_\_\_\_\_ bbls/day Percolation: \_\_\_\_\_ bbls/day  
Type of liner material: \_\_\_\_\_ Thickness: \_\_\_\_\_

**Attach description of proposed design and construction (include sketches and calculations).**

Method of treatment of produced water prior to discharge into pit (separator, heater treater, other): \_\_\_\_\_  
Is pit fenced? Yes No Is pit netted? Yes No

I hereby certify that the statements made in this form are, to the best of my knowledge, true, correct, and complete.

Print Name: \_\_\_\_\_ Signed: \_\_\_\_\_

Title: \_\_\_\_\_ Date: \_\_\_\_\_

OGCC Approved: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

CONDITIONS OF APPROVAL, IF ANY:

**FACILITY NUMBER:**

**COGCC FORM 15  
EARTHEN PIT PERMIT  
SUPPLEMENTAL INFORMATION**

**Pit Name – Specialty 41A-28-692  
API Number (of associated well) - 05-045-11841  
BILL BARRETT CORPORATION (Operator Number 10071)**

**October, 2010**

This supplement to the COGCC Form 15 for Bill Barrett Corporation's (BBC) proposed multi-well pit provides additional information required by COGCC Rules 902, 903, and 904. This information is identified in the following sections by reference to the applicable section of these rules.

This pit is a component of BBC's water management and reuse system. This pit is not used for the disposal of water. This pit is used to store produced and flow-back water for the reuse in well completions throughout BBC's operations. Water is transported to the pit via pipelines from producing well sites and flow-back of completed wells. The water is stored in the pit and then transported to other well sites for completions via pipeline. Ultimately, when the water managed with this pit is no longer needed for reuse, the water is piped to one of BBC's injection well facilities for disposal. Currently, BBC has four injection wells that could be used for the disposal of this water:

- GGU Rodreick (Facility 159176)
- Specialty 13A-28-692 SWD (Facility 159212)
- Circle B Land 33A-35-692 (Facility 159277)
- Scott 41D-36-692 SWD (Facility 159159)

A topographic map with the pit location is included in Figure 1.

**902.a.**

The pit has been designed with features to prevent spills or leaks from impacting the environment. The implementation of BBC's Stormwater Management Plan, Permit (COR-039752; Attachment A) and the operational policies and procedures described in this supplement are designed to minimize risk to the environment and accommodate rapid response in the event of an accidental spill or release of fluids. All transfers of water into and out of the pit are monitored by personnel during the entire transfer operation to ensure that adequate freeboard (minimum of 2 feet) is maintained in the pit at all times. BBC has two fully-stocked spill response trailers staged at locations near all of our operations to facilitate response to any spills that may occur. The leak detection system in the pit is checked at least once per week and, in the event that a leak is detected, the pit will be drained as quickly as possible so that the source of the leak can be determined.

**902.b.**

BBCs pits have been designed to provide for a minimum of two (2) feet of freeboard at all times. Pit design, cross section details, and calculation details are included in Attachment B. Monitoring and maintaining free board is addressed above under Rule 902.a. Spills and releases will be reported in accordance with Rule 906. The COGCC Form 26 applicable to this and other BBC multi-well pits was submitted separately and will be updated periodically to reflect changes in the wells that are sources of water to be managed in this pit.

**902.c.**

The pit is checked by BBC staff at least twice each day and any accumulation of oil is removed immediately by skimming.

**902.d.**

The pit has been designed with a fence in accordance with recommendations of CDOW and COGCC to prevent wildlife from entering.

**902.e.**

This pit was originally constructed and operated by BBC under the COGCC's rules prior to the rule changes that went into effect on April 1, 2009. Under the previous rules, it was unclear whether multi-well pits were subject to the pit permitting requirements. Through subsequent discussions between BBC and COGCC, BBC agreed to permit all existing multi-well pits.

This pit was relined with a new liner and leak detection system, as described in Attachment B, on June 29, 2010. BBC is hereby requesting a variance from Rule 902.e so that the three year period for use of this pit begins on the date the pit was relined, June 29, 2010.

**902.h.**

All produced water that is stored in the pit is first treated by a 3-phase separator on the producing well and then cascaded through production tanks to give retention time for removal of additional sediment and hydrocarbons.

**902.i.**

The pit will be treated with biocide as necessary to control bacterial growth and related odors.

**903.a.(4)**

This supplemental information is being submitted with the COGCC Form 15 for a multi-well pit that is used to recycle and reuse produced water or completion fluids.

**903.d.**

Instructions contained in the COGCC Appendix I were used as a guide in the Form 15.

**904.a.(5)**

The multi-well pit was lined in accordance with Rule 904 and the materials used are described in Rule 904.c below.

**904.b.(1)**

The materials used to line the pit are 2-6 oz. double sided Geo composites, a 30 mil anti skid double E30WBS liner, and an additional 30 mil XR5 liner. The specifications of the material are included in Attachment C.

**904.b.(2)**

The pit liners were constructed, installed, and maintained in accordance with the manufacturers' specifications which are included in Attachment C. The pits have also been designed with good engineering practices.

**904.b.(3)**

Field seams have been installed and tested in accordance with manufacturer specifications and good engineering practices. The manufacturer specifications are included in Attachment C. Test results will be maintained at BBC's Silt office and will be provided to the Director upon request.

**904.c**

The pit has, from compacted native soil up, a 6 oz. double sided Geo composite on 100% of the pit from anchor ditch to anchor ditch, a 30 mil anti skid double E30WBS liner, a 6oz. double sided Geo composite between the liners with runners to the top of the anchor ditch and an additional 30 mil XR5 liner. The liner extends 3-4 feet out from the edge of the pit in all directions and is anchored in an anchor ditch that is a minimum of 8 inches deep.

**904.e.**

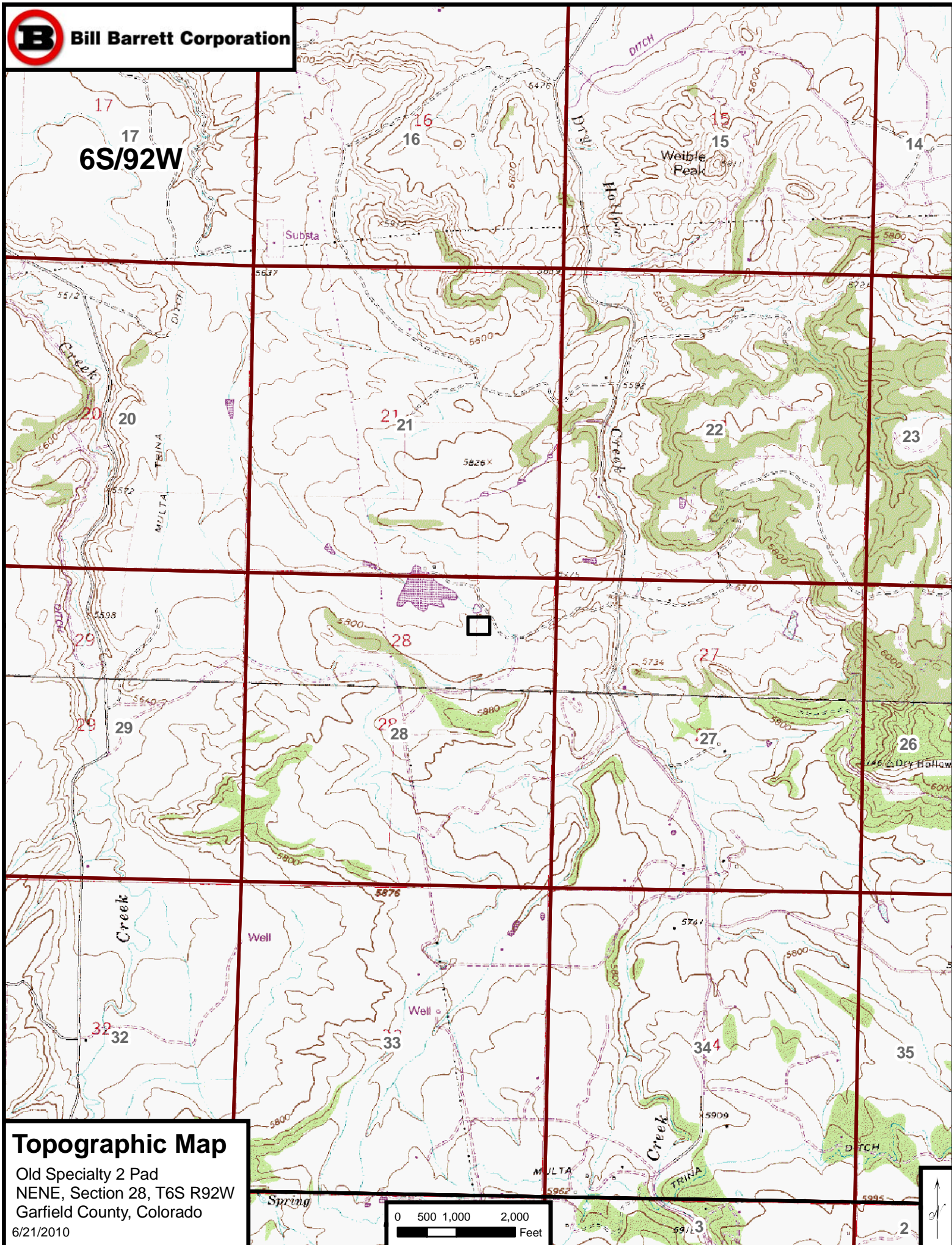
Since the facility is within 100' of the nearest surface water it is considered to be in a sensitive area. The pit has been designed with features that significantly reduce the potential for the facility to impact nearby surface and ground water. All material used in the determination is included in Attachment C. The pit has been double lined in the manner described above in 904.c and includes a leak detection system.

# Figures



Bill Barrett Corporation

17  
17  
**6S/92W**



## Topographic Map

Old Specialty 2 Pad  
NENE, Section 28, T6S R92W  
Garfield County, Colorado  
6/21/2010

0 500 1,000 2,000  
Feet



# Attachment A

Stormwater Permit (COR-039752)

# STATE OF COLORADO

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT  
WATER QUALITY CONTROL DIVISION  
TELEPHONE: (303) 692-3500



**CERTIFICATION TO DISCHARGE  
UNDER  
CDPS GENERAL PERMIT COR-030000  
STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION**

Certification Number **COR039752**

**This Certification to Discharge specifically authorizes:**

***Bill Barrett Corp.***

**LEGAL CONTACT:**

***Scot A. Donato,  
Bill Barrett Corp.  
1099 - 18th Street Ste. 2300  
Denver, CO 80202  
Phone # 303/312-8191  
jerry@billbarrettcorp.com***

**LOCAL CONTACT:**

***Jesse Merry, Field Supervisor,  
Phone # 970/ 985-9061  
sdonato@billbarrettcorp.com***

**During the Construction Activity: Oil & Gas Production and/or Exploration  
Field**

**to discharge stormwater from the facility identified as Mamm Creek Field  
which is located at:**

**2438 CR 333  
Silt, Co**

**Latitude 39.496, Longitude 107.621  
In Garfield County**

**to: -- Mamm Creek**

**Anticipated Activity begins 03/30/2006 continuing through 12/31/2007  
On >5 acres (>5 acres disturbed)**

**Certification is effective: 07/01/2007**

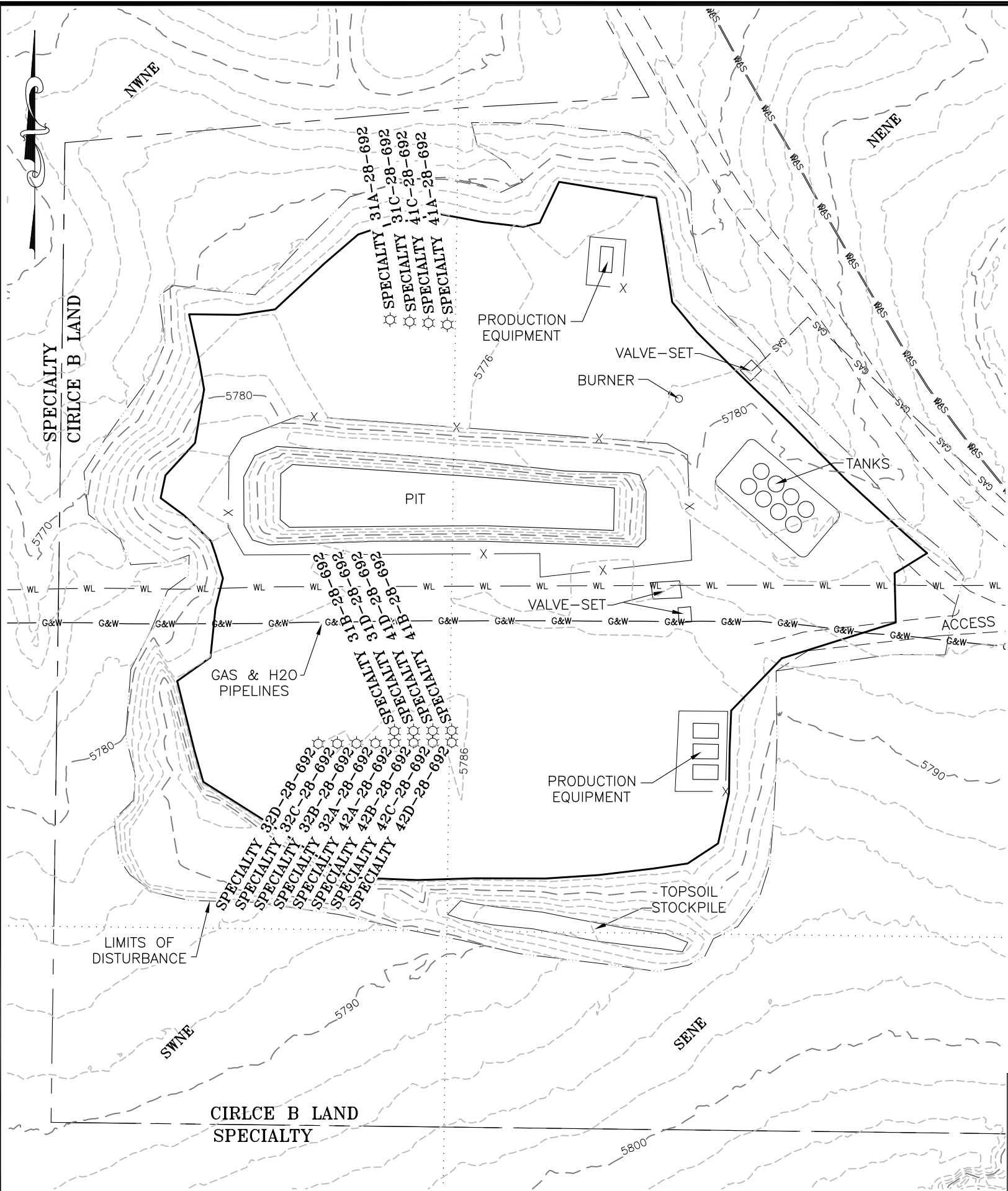
**Certification Expires: 06/30/2012**

**Annual Fee: \$245.00 (DO NOT PAY NOW – A prorated bill will be sent shortly.)**



# Attachment B

Site Diagram  
Pit Design and Cross Section  
Volume Calculations



**SPECIALTY PAD 4 AS-BUILTS**  
**NE ¼ SEC. 28, T. 6 S., R. 92 W., 6TH P.M.**  
**GARFIELD COUNTY, COLORADO**

PIT VOLUME CALC'S:

AREA OF TOP = 23,294 FT  
AREA OF BOTTOM = 12,115 FT  
AVERAGE AREA = 35,409/2 = 17,704.5 FT  
  
AVERAGE TOP ELEV. = 5784.3  
AVERAGE BOTTOM ELEV. = 5774.2  
AVERAGE PIT DEPTH = 10.1 FT

AVERAGE TOTAL VOLUME = 17,704.5\*15 = 265,567.5 CU FT OR 47,296 BBL  
AVERAGE WORKING VOLUME = 17704.5\*13 = 230,158.5 CU FT OR 40,990 BBL

TOTAL DISTURBED AREA:

AREA INSIDE LIMITS OF DISTURBANCE LINE = 247,002 SQ FT OR 7.97 ACRES

NOTES:

- 1) CONTOUR INTERVAL IS 2 FOOT
- 2) SURVEY DATE: 10/13/10
- 3) INSTRUMENT OPERATOR: T. BARNETT
- 4) PDOP MASK SET TO 6, ELEV MASK SET TO 15°
- 4) LATS AND LONGS ARE IN DECIMAL DEGREE FORMAT
- 5) DATUM IS COLORADO STATE PLANE, CENTRAL ZONE, NAD 83

| SURFACE LOCATION     |      |      |             |              |
|----------------------|------|------|-------------|--------------|
| WELL NAME            | FNL  | FEL  | LATITUDE    | LONGITUDE    |
| SPECIALTY 41B-28-692 | 1148 | 1318 | 39.502036 N | 107.666878 W |
| SPECIALTY 41D-28-692 | 1148 | 1333 | 39.502035 N | 107.666934 W |
| SPECIALTY 31D-28-692 | 1149 | 1350 | 39.502034 N | 107.666992 W |
| SPECIALTY 31B-28-692 | 1149 | 1366 | 39.502032 N | 107.667048 W |
| SPECIALTY 32D-28-692 | 1160 | 1429 | 39.501999 N | 107.667274 W |
| SPECIALTY 32C-28-692 | 1160 | 1413 | 39.502000 N | 107.667217 W |
| SPECIALTY 32B-28-692 | 1160 | 1397 | 39.502001 N | 107.667160 W |
| SPECIALTY 32A-28-692 | 1159 | 1381 | 39.502003 N | 107.667104 W |
| SPECIALTY 42A-28-692 | 1159 | 1365 | 39.502005 N | 107.667047 W |
| SPECIALTY 42B-28-692 | 1159 | 1349 | 39.502006 N | 107.666990 W |
| SPECIALTY 42C-28-692 | 1158 | 1333 | 39.502008 N | 107.666934 W |
| SPECIALTY 42D-28-692 | 1158 | 1317 | 39.502009 N | 107.666877 W |
| SPECIALTY 31A-28-692 | 804  | 1374 | 39.502979 N | 107.667090 W |
| SPECIALTY 31C-28-692 | 805  | 1357 | 39.502976 N | 107.667032 W |
| SPECIALTY 41C-28-692 | 806  | 1342 | 39.502974 N | 107.666976 W |
| SPECIALTY 41A-28-692 | 808  | 1326 | 39.502971 N | 107.666920 W |



**ECLIPSE**  
surveying

111 E. THIRD ST., SUITE 208, RIFLE, CO 81650  
(970) 625-3048

REV. DATE: \_\_\_\_\_  
SCALE: 1" = 100'  
DATE: 10/14/10  
SHEET: 1 OF 1  
PROJECT: SPEC4  
DFT: TAB

 Bill Barrett Corporation

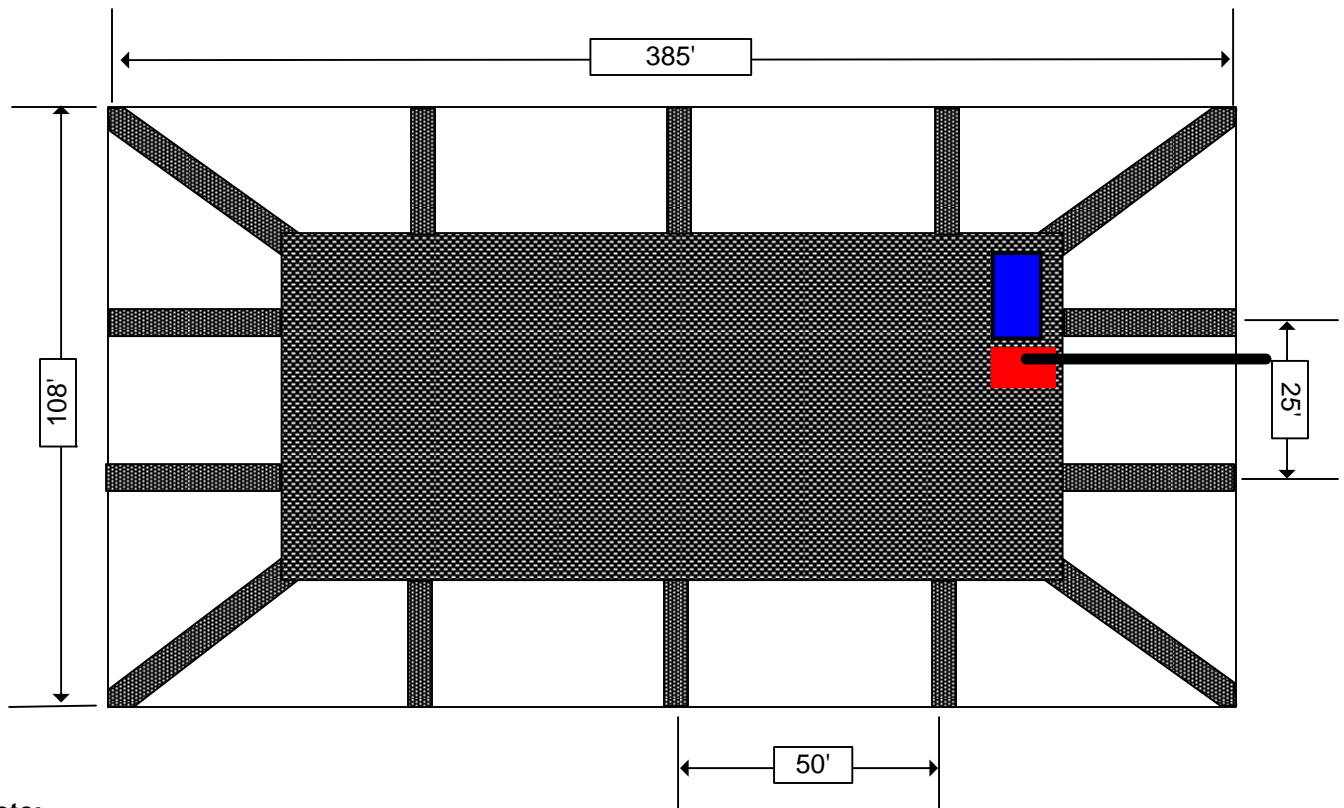
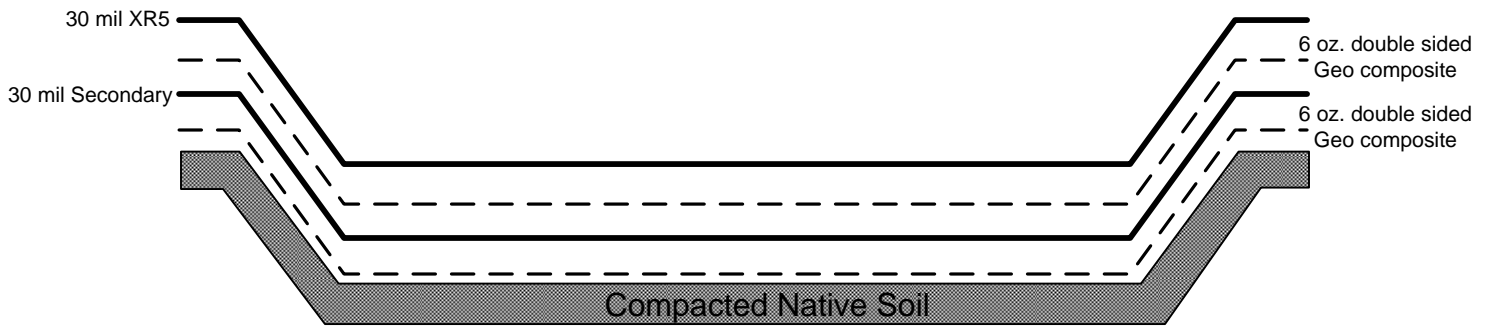
*SPECIALTY PAD 4*  
*SEC 28, T.6S., R.92W., 6TH P.M.*

# PIT DESIGN PLAN AND CROSS SECTION

## Pit Location – Specialty 41A-28-692

From compacted native soil up:

1. 6 oz. double sided Geo composite on 100% of pit from anchor ditch to anchor ditch
2. 30 mil anti skid double E30WBS liner for secondary liner
3. 6 oz. double sided Geo composite on bottom of pit and runners to top of anchor ditch  
(50' span between on sides, 25' span on ends)
4. 30 mil XR 5 liner for primary liner
5. Vent pockets at top of every vent grid.



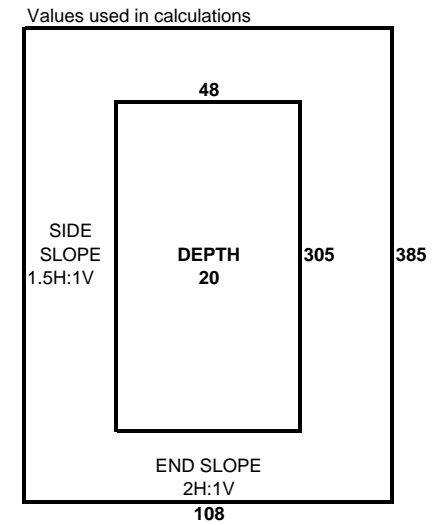
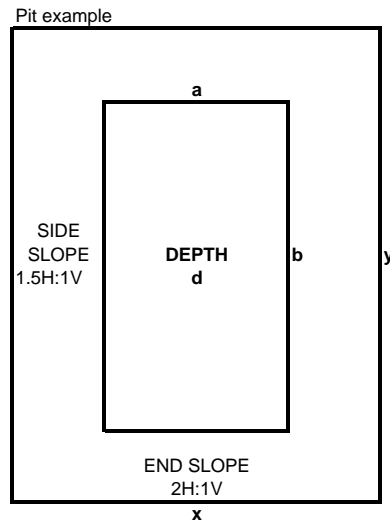
### Note:

Leak Detection Sump Placement ■  
Suction Line Sump ■

\* Construct suction line sump approximately 6 feet long and leave 2 feet of native soil between leak detection sump to separate.

**Calculation Details**  
**Specialty 41A-28-692 Pit**  
**API Number (of associated well) - 05-045-11841**  
**Facility Number (if assigned) -**

| POND VOLUME TABLE<br>ASSUME END SLOPE = 2H TO 1V<br>ASSUME SIDE SLOPE = 1.5H TO 1V<br>VOLUME BY PRISMODIAL FORMULA |                  |              |                      |                     |                        |         |
|--|------------------|--------------|----------------------|---------------------|------------------------|---------|
| Top Length<br>(y)  | Top Width<br>(x) | Depth<br>(d) | Bottom Length<br>(b) | Bottom Width<br>(a) | Pit Volume<br>(cu.yds) | Barrels |
| 385  | 108              | 20           | 305                  | 48                  | 20,822                 | 100,134 |



# Attachment C

Liner Material Specifications  
Manufacturers' Installation and Testing Specifications

# RUFECO® E-Series

Enhanced Grip Surface

# E30WBS

## PRODUCT DESCRIPTION

**Rufco® E-Series E30WBS** is a multi-layer, metallocene and linear low density polyethylene geomembrane with an enhanced grip surface on both sides. Fine N110 carbon black (black layer) and high performance U.V. stabilizers (white layer) provide long term protection from thermal oxidation and ultraviolet degradation. A combination of premium linear polyethylenes provide exceptional toughness, multi-axial elongation and impact resistance.

## PRODUCT USE

**Rufco E30WBS** is used in lining and cover applications requiring good outdoor weatherability, toughness and puncture resistance. A lightly textured surface provides enhanced grip for ease of installation and worker safety without the \*VELCRO® type adhesion that can make deployment over non-wovens difficult. The products ability to conform to uneven surfaces and resist puncture through multi-axial elongation allows it to be used in a wide variety of applications.

## SIZE & PACKAGING

**Rufco E30WBS** is available in various increments up to 30,000 square foot panels. All panels are accordion folded and tightly rolled on a heavy-duty core for ease of handling and time saving installation.



\*VELCRO® is a registered trademark of Velcro Industries B.V.

| Product     | Part Number |
|-------------|-------------|
| Rufco ..... | E30WBS      |

## COMMON APPLICATIONS

**Containment Liners**

**Canal Linings**

**Oilfield Plt Liners**

**Decorative Ponds**

**Fish Hatchery Liners**

**Farm Ponds**

**Remediation Liners**

**Brine Ponds**

**Leachate Collection Ponds**

**Interim Landfill Covers**

**Outdoor Covers**



# RUFECO<sup>®</sup> E-Series

Enhanced Grip Surface

# E30WBS

| PROPERTIES                    | TEST METHOD                   | TYPICAL AVG  | MINIMUM AVG  | METRIC AVG           | METRIC MIN AVG       |
|-------------------------------|-------------------------------|--------------|--------------|----------------------|----------------------|
| APPEARANCE                    |                               | White/Black  | White/Black  | White/Black          | White/Black          |
| THICKNESS, MIL (NOMINAL)      | ASTM D 5199                   | 33 mil       | 30 mil       | 0.84 mm              | 0.76 mm              |
| WEIGHT / AREA                 |                               | 150 lbs/msf  | 130 lbs/msf  | 732 g/m <sup>2</sup> | 635 g/m <sup>2</sup> |
| TENSILE STRENGTH              | ASTM D 6693                   | 130 lbf/in   | 114 lbf/in   | 578 N/cm             | 507 N/cm             |
| TENSILE ELONGATION            | ASTM D 6693                   | 800 %        | 750 %        | 800 %                | 750 %                |
| TEAR RESISTANCE               | ASTM D 1004                   | 17 lbf       | 14 lbf       | 76 N                 | 62 N                 |
| PUNCTURE RESISTANCE           | ASTM D 4833                   | 60 lbf       | 46 lbf       | 267 N                | 205 N                |
| MULTI-AXIAL TENSION           | <b>ASTM D 5617</b>            | <b>130 %</b> | <b>100 %</b> | <b>130 %</b>         | <b>100 %</b>         |
| IMPACT RESISTANCE             | ASTM D 1709                   | 3600 g       | 2600 g       | 3600 g               | 2600 g               |
| CARBON BLACK<br>(Black Layer) | ASTM D 1603 or<br>ASTM D 4218 | 2.5 %        | 2.0 %        | 2.5 %                | 2.0 %                |
| MAXIMUM USE TEMPERATURE       |                               | 180° F       | 180° F       | 82° C                | 82° C                |
| MINIMUM USE TEMPERATURE       |                               | -70° F       | -70° F       | -57° C               | -57° C               |

Rufco E30WBS properties are based on Rufco E30BS (Black) test data and may change as new data is available.



RUFECO E30WBS is a multi-layer membrane consisting of premium metallocene and linear low density polyethylene. Carbon black is added to the black layer and UV additives and thermal stabilizers are added to the white layer to assure outdoor longevity and extended service life. An enhanced grip surface is added to both sides providing for ease of installation and job site safety. RUFECO E30WBS is not a textured geomembrane to be used for slope stabilization.

Note: To the best of our knowledge, unless stated otherwise, these are typical property values and are intended as guides only. **RAVEN INDUSTRIES MAKES NO WARRANTIES AS TO THE FITNESS FOR A SPECIFIC USE OR MERCHANTABILITY OF PRODUCTS REFERRED TO**, no guarantee of satisfactory results from reliance upon contained information or recommendations and disclaims all liability for resulting loss or damage.



**RAVEN INDUSTRIES, INC. / Engineered Films Division**  
P.O. Box 5107 • Sioux Falls, SD 57117-5107  
Ph: (605) 335-0174 • Fx: (605) 331-0333  
Toll Free: 800-635-3456



**ISO 9001:2000**  
**CERTIFIED MANAGEMENT SYSTEM**

[www.ravengeo.com](http://www.ravengeo.com)



## WESTERN ENVIRONMENTAL LINER

### High Performance XR-5 8130 Reinforced Geomembrane SPECIFICATION SHEET

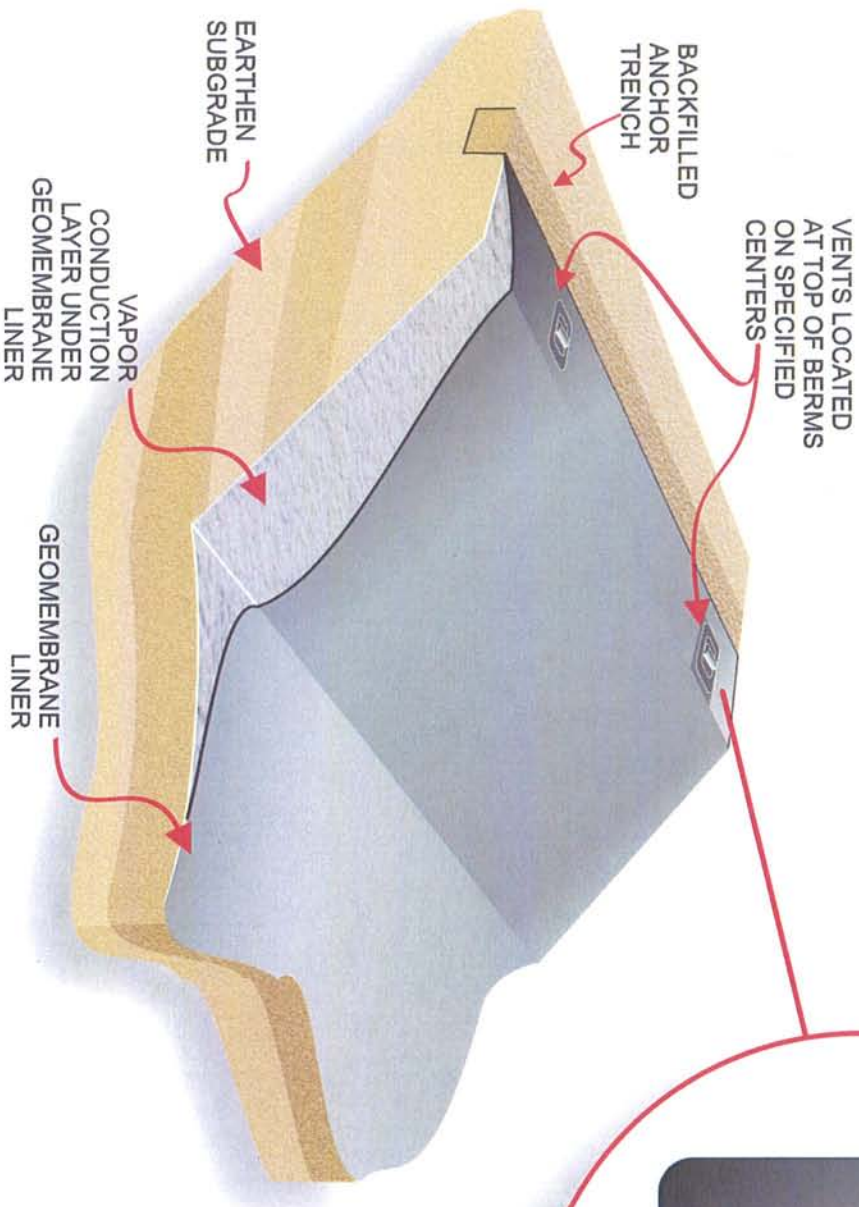
| XR-5® 8130 Reinforced                            | Test Method                                   | Standard  | Metric   |
|--|---|---|--|
| Base Fabric Type<br>Base Fabric Weight (nominal) |   | Polyester<br>6.5 oz/yd2   | Polyester<br>220 g/m2  |
| Thickness  | ASTM D 751                                    | 30.0 mils min   | 0.75 mm min  |
| Weight   | ASTM D 751                                    | 30.0 ± 2 oz/yd2   | 1020 ± 70 g/m2   |
| Tear Strength                                    | ASTM D 4533<br>Trapezoid Tear                 | 35/35 lb min  | 155/155 N min  |
| Breaking<br>Yield Strength                       | ASTM D 751<br>Grab Tensile<br>Procedure A     | 550/550 lb min  | 2450/2450 N min  |
| Low Temperature                                  | ASTM D 2136<br>4 hr - 1/8" mandrel            | Pass @ -30° F   | Pass @ -35° C  |
| Dimensional Stability                            | ASTM D 1204<br>212° F - 1 hr                  | 1.5% max<br>each direction  | 1.5% max<br>each direction                                   |
| Adhesion<br>Heat Sealed Seam                     | ASTM D 751<br>Dielectric Weld                 | 35 lb/2 in min  | 150 N/5 cm min   |
| Dead Load<br>Seam Shear Strength                 | ASTM D 751<br>4-hour test                     | 2 in seam, 1 in strip<br>210 lb @ 70° F<br>105 lb @ 160° F                    | 5 cm seam, 2.5 cm<br>strip<br>935 N @ 21° C<br>465 N @ 70° C |
| Bursting Strength                                | ASTM D 751<br>Ball Tip                        | 650 lb min<br>800 lb typical  | 2890 N min<br>3560 N typical                                 |
| Hydrostatic Resistance                           | ASTM D 751<br>Method A                        | 800 psi min   | 540 N/sq cm min  |
| Blocking Resistance                              | ASTM D 751<br>180° F/82° C                    | #2 Rating max   |  |
| Adhesion - Ply                                   | ASTM D 413<br>Type A                          | 15 lb/in min<br>or Film Tearing Bond  | 65 N/2.5 cm min<br>or Film Tearing Bond                      |
| Bonded Seam Strength                             | ASTM D 751<br>Grab Test Method<br>Procedure A | 550 lb min  | 2450 N min   |
| Abrasion Resistance                              | ASTM D 3389<br>H-18 Wheel<br>1000 g Load      | 2000 cycles (min) before fabric exposure<br>50 mg/100 cycles max weight loss  |  |
| Weathering<br>Resistance                         | ASTM G153<br>(Carbon-Arc)                     | 8000 hrs (min)-No appreciable changes<br>or stiffening or cracking of coating |  |
| Water Absorption                                 | ASTM D 471<br>Section 12<br>7 Days            | 0.025 kg/m2 max @ 70° F/21° C<br>0.14 kg/m2 max @ 212° F/100° C               |  |
| Wicking  | ASTM D 751                                    | 1/8 in max  | 0.3 cm max   |
| Puncture Resistance                              | ASTM D 4833                                   | 250 lb min  | 110 N min  |
| Coefficient Of Thermal<br>Expansion/Contraction  | ASTM D 696                                    | 8 x 10-6 in/in/°F<br>max  | 1.4 x 10-5 cm/cm/°C<br>max                                   |

**Seaming: Thermal welding methods are recommended. No glues or solvents are suggested.**

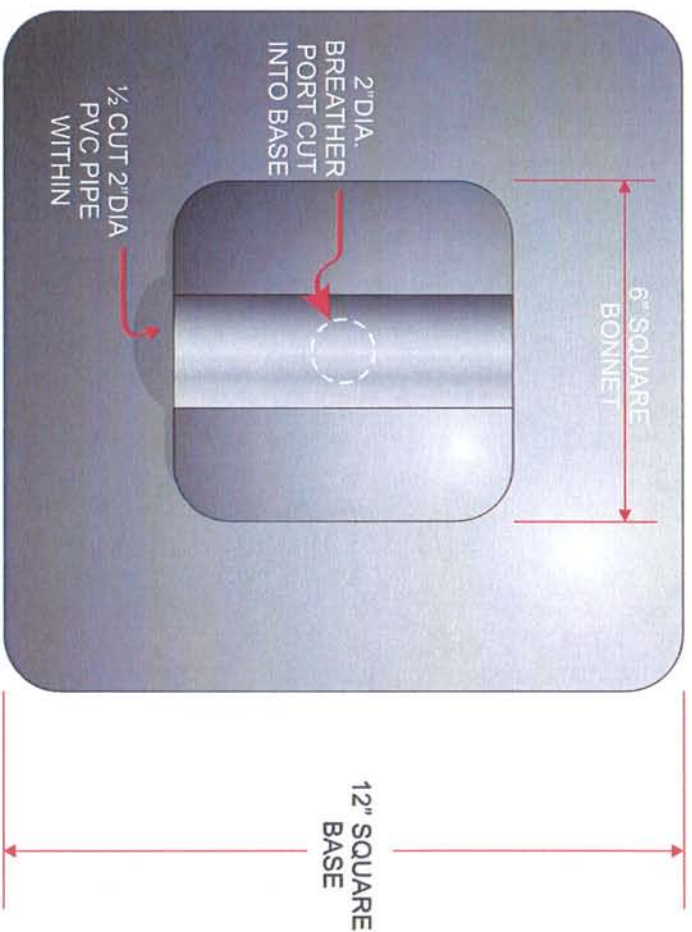


## BERM VENTS FOR REINFORCED MEMBRANE LINER SYSTEMS

BERM VENTS USED WITH A GAS/VAPOR CONDUCTION LAYER (INSTALLED BELOW LINERS) ARE OFTEN SPECIFIED AND EFFECTIVELY USED IN APPLICATIONS WHERE GASES OR WATER VAPOR MAY BE GENERATED UNDER A LINING SYSTEM. EXAMPLES MAY INCLUDE WASTEWATER PONDS, DOUBLE LINED RESERVOIRS AND NEW CONSTRUCTION AT SITES THAT MAY HAVE BIODEGRADABLE MATERIALS IN THE SOILS



## BERM VENT DETAIL FOR REINFORCED MEMBRANE LINER SYSTEMS

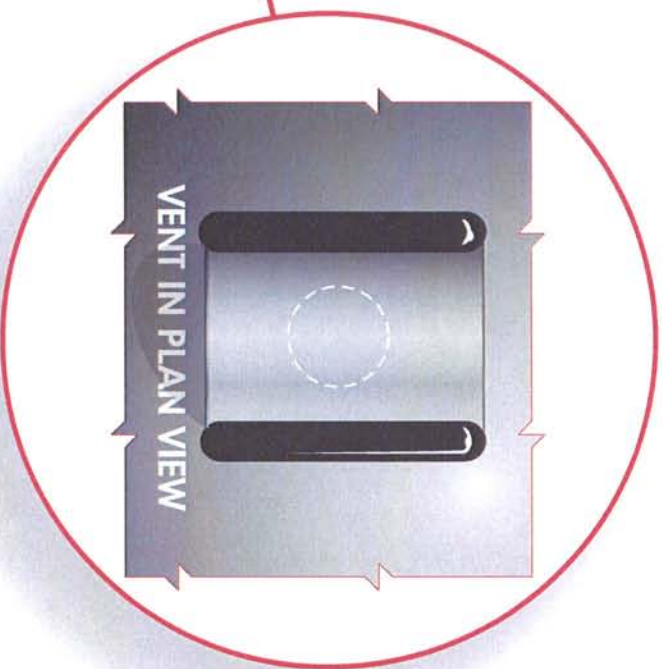
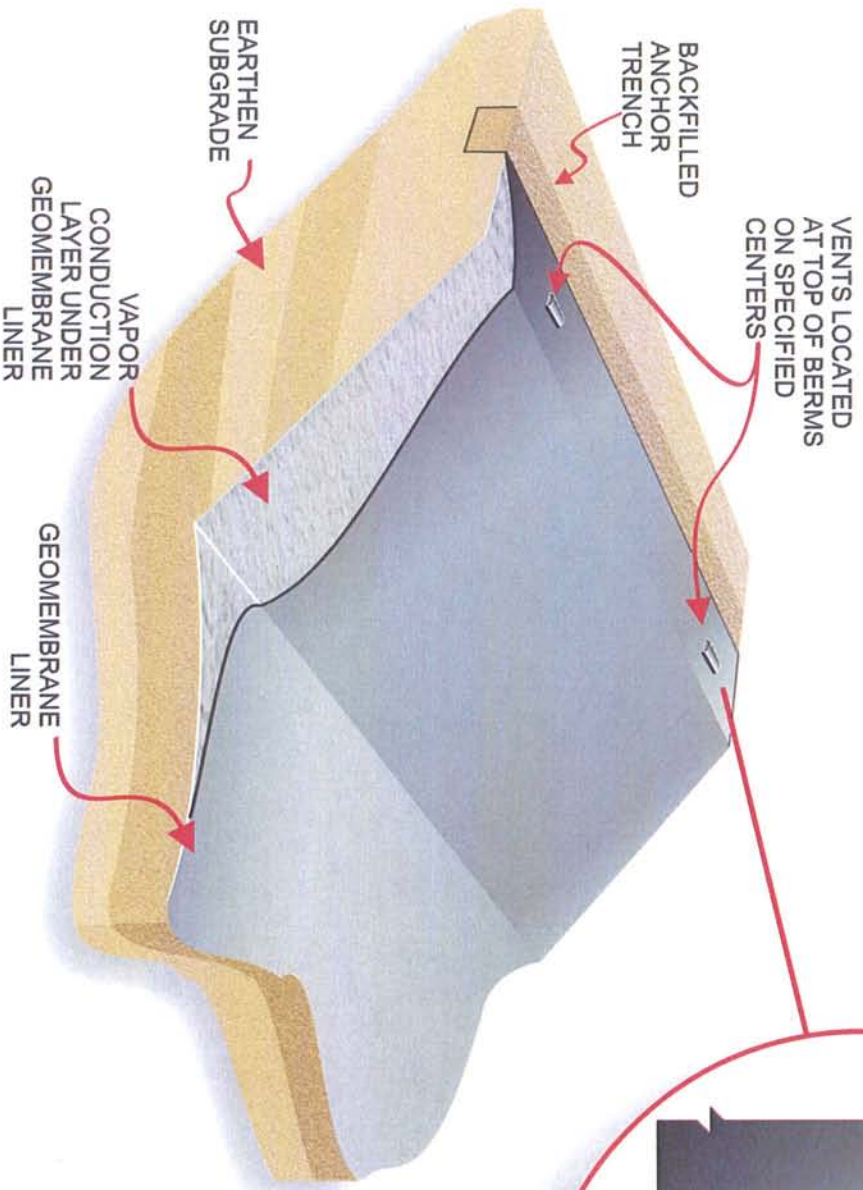


**PLAN VIEW**



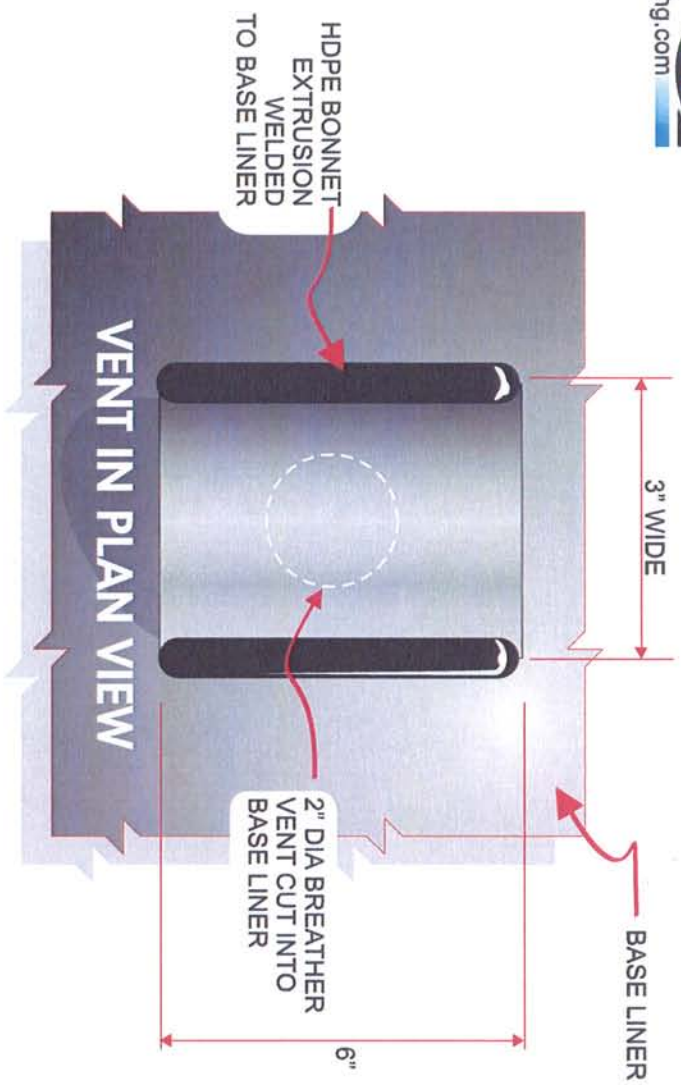
**SECTION VIEW  
(INSTALLED)**

## BERM VENTS FOR POLYETHYLENE MEMBRANE LINER SYSTEMS



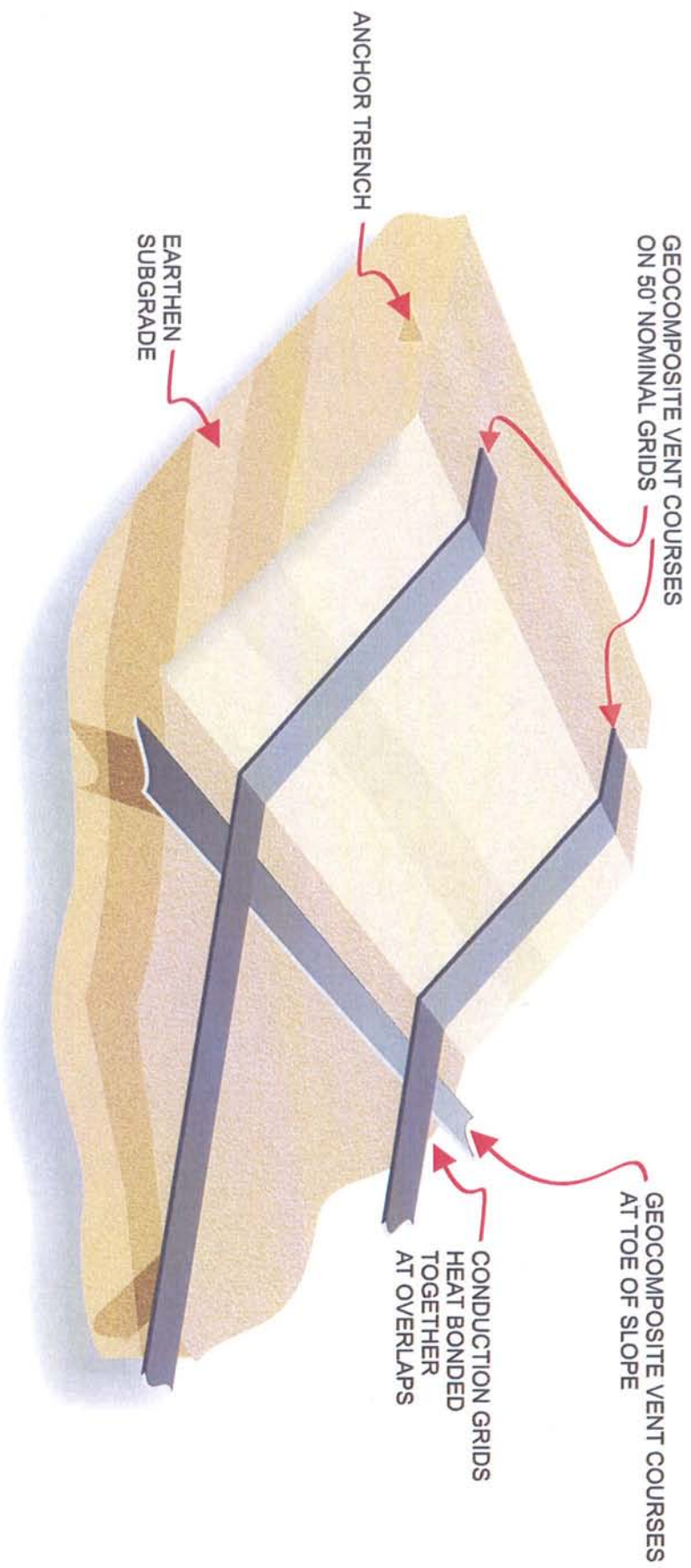


## BERM VENTS FOR POLYETHYLENE MEMBRANE LINER SYSTEMS

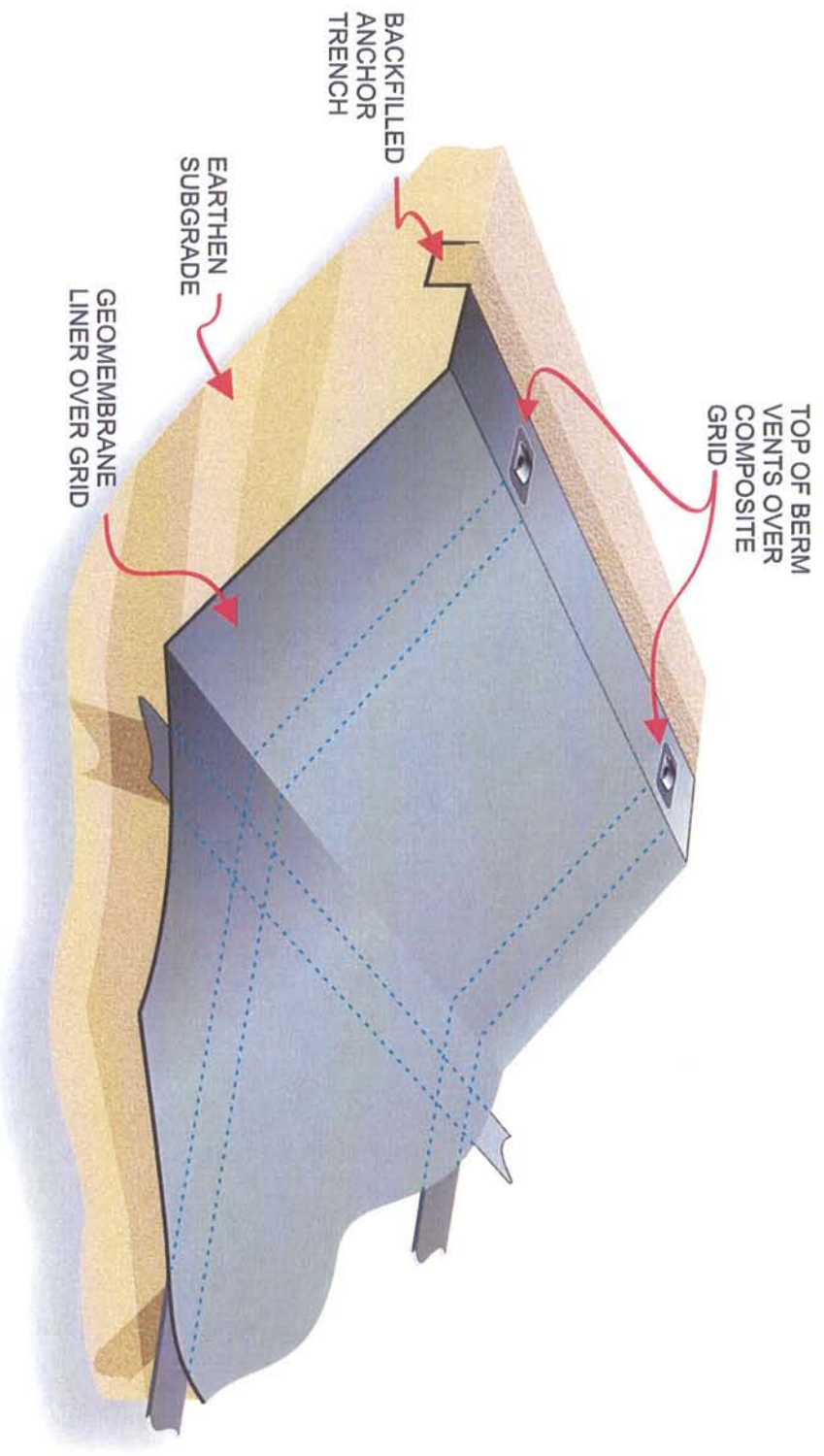


## GEOCOMPOSITE GAS VENTILATION GRID SYSTEM

AS AN ALTERNATIVE TO A COMPLETE GROUND COVER CONDUCTION LAYER SYSTEM, 3' NOMINAL WIDTH GEOCOMPOSITE VENT COURSES ON 50' NOMINAL CENTER GRIDS CAN BE INSTALLED FOR GAS/VAPOR CONDUCTION TO BERM VENTS. TYPICALLY A DOUBLE SIDED GEOCOMPOSITE (GEOTEXTILE LAMINATED ON EITHER SIDE OF A CONDUCTION GRID) IS USED.



## **FINISHED GEOCOMPOSITE GAS VENTILATION GRID SYSTEM WITH GEOMEMBRANE LINER SYSTEM AND BERM VENTS**



Technical Data and Specifications  
for  
**XR<sup>®</sup> Geomembranes**

XR-3<sup>®</sup>  
XR-5<sup>®</sup>  
XR-3<sup>®</sup> PW

**Industrial, Municipal and Potable Water  
Grade Geomembranes**



**Seaman Corporation**

1000 Venture Blvd.  
Wooster, Ohio 44691  
(330) 262-1111  
[www.xr-5.com](http://www.xr-5.com)



**Section 1: Product Overview/Applications**

Product Application Chart

**Section 2: Physical Properties**

Part 1: Material Specifications

8130/8138 XR-5

6730 XR-5

8228 XR-3

8130 XR-3 PW

Part 2: Elongation Properties

8130/8138 XR-5

6730 XR-5

8228 XR-3

**Section 3: Chemical/Environmental Resistance**

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XR-5 Chemical Resistance

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XR-3 Chemical Resistance Statement (Summary)

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XR-5/HDPE Physicals - Comparative Properties

XR-5/Polypropylene Tensile

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Coated Fabric Thermal Stability

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# Seaman Corp. XR Geomembranes

## Section 1 - Product Overview/Applications

- All XR Geomembrane products are classified as an Ethylene Interpolymer Alloy (EIA)
- XR-5 grade is high strength and chemically resistant for maximum resistance to high temperature, and broad chemical resistance, including acids, oils and methane
- XR-3 grade for moderate chemical resistant requirement applications such as stormwater and domestic wastewater
- NSF 61 approved XR-3 PW grade for potable water contact
- Heat weldable-thermal weldable for seams as strong as the membrane. Factory panels over 15,000 square feet (1400 sq meters) for less field seaming
- Stability is excellent, with low thermal expansion-contraction properties
- 30+ year application history

### Product Application Chart

|                                     | XR-5                 |      |      | XR-3 | XR-3 PW |
|-------------------------------------|----------------------|------|------|------|---------|
|                                     | 8130                 | 8138 | 6730 | 8228 | 8130    |
| High Puncture Resistance            | X                    | X    | X    |      | X       |
| UV Resistance                       | X                    | X    | X    | X    | X       |
| High Strength Applications          | X                    | X    | X    |      | X       |
| Floating Covers (Nonpotable)        | X                    | X    | X    | X    |         |
| Diesel/Jet Fuel Containment         | X                    | X    | X    |      |         |
| Industrial Wastewater               | X                    | X    | X    |      |         |
| Stormwater                          | X                    | X    | X    | X    |         |
| Municipal/Domestic Wastewater       | X                    | X    | X    | X    |         |
| Floating Diversion Baffles/Curtains | X                    |      | X    |      | X       |
| Potable Water                       |                      |      |      |      | X       |
| <-65 Deg F Applications             | Contact Seaman Corp. |      |      |      |         |
| Chemically Resistant Applications   | X                    | X    | X    |      |         |

XR-5® is a registered trademark of Seaman Corporation  
 XR-3® is a registered trademark of Seaman Corporation  
 XR® is a registered trademark of Seaman Corporation

## Section 2 - Physical Properties

### Part 1- Material Specifications

| Property                               | Test Method                                 | 8130 XR-5   | 8138 XR-5   | 6730 XR-5   |
|--|---|---|---|---|
| Base Fabric Type                       | ASTM D 751                                  | Polyester   | Polyester   | Polyester   |
| Base Fabric Weight                     |   | 6.5 oz/yd <sup>2</sup> nominal<br>(220 g/m <sup>2</sup> nominal)  | 6.5 oz/yd <sup>2</sup> nominal<br>(220 g/m <sup>2</sup> nominal)  | 7 oz/yd <sup>2</sup> nominal<br>(235 g/m <sup>2</sup> nominal)        |
| Thickness                              | ASTM D 751                                  | 30 mils min.<br>(0.76 mm min.)  | 40 mils nom.<br>(1.0 mm nom.)   | 30 mils min.<br>(0.76 mm min.)  |
| Weight                                 | ASTM D 751                                  | 30.0 ± 2 oz/sq yd<br>(1017 ± 2 g/m <sup>2</sup> )   | 38.0 ± 2 oz/sq yd<br>(1288 ± 70 g/m <sup>2</sup> )  | 30.0 ± 2 oz/sq yd<br>(1017 ± 70 g/m <sup>2</sup> )                    |
| Tear Strength                          | ASTM D 751<br>Trap Tear                     | 40/55 lbs. min.<br>(175/245 N min.)   | 40/55 lbs. min.<br>(175/245 N min.)   |   |
| Breaking Yield Strength                | ASTM D 751<br>Grab Tensile                  | 550/550 lbs. min.<br>(2,447/2,447 N min.)   | 550/550 lbs. min.<br>(2,447/2,447 N min.)   | 600/550 lbs. min.<br>(2,670/2,447 N min.)                             |
| Low Temperature Resistance             | ASTM D 2136<br>4 hrs-1/8" Mandrel           | Pass @ -30° F<br>Pass @ -35° C  | Pass @ -30° F<br>Pass @ -35° C  | Pass @ -30° F<br>Pass @ -35° C  |
| Dimensional Stability                  | ASTM D 1204<br>100° C-1 Hr.                 | 0.5% max.<br>each direction   | 0.5% max.<br>each direction   | 0.5% max.<br>each direction   |
| Hydrostatic Resistance                 | ASTM D 751<br>Procedure A                   | 800 psi min.<br>(5.51 MPa min.)   | 800 psi min.<br>(5.51 MPa min.)   | 800 psi min.<br>(5.51 MPa min.)                                       |
| Blocking Resistance                    | ASTM D 751<br>180° F                        | #2 Rating max.  | #2 Rating max.  | #2 Rating max.  |
| Adhesion-Ply                           | ASTM D 413<br>Type A                        | 15 lbs./in. min. or film<br>tearing bond<br>(13 daN/5 cm min. or FTB)   | 15 lbs./in. min. or film<br>tearing bond<br>(13 daN/5 cm min. or FTB)   | 15 lbs./in. min. or film<br>tearing bond<br>(13 daN/5 cm min. or FTB) |
| Adhesion (minimum)<br>Heat Welded Seam | ASTM D 751<br>Dielectric Weld               | 40 lbs./2in. RF weld min.<br>(17.5 daN/5 cm min.)   | 40 lbs./2in. RF weld min.<br>(17.5 daN/5 cm min.)   | 15 lbs./in. RF weld min.<br>(15 daN/5 cm min.)                        |
| Dead Load Seam Strength                | ASTM D 751, 4-Hour Test                     | Pass 220 lbs/in @ 70° F<br>(Pass 980 N/2.54 cm @ 21° C)<br>Pass 120 lbs/in @ 160° F<br>(Pass 534 N/2.54 cm @ 70° C) | Pass 220 lbs/in @ 70° F<br>(Pass 980 N/2.54 cm @ 21° C)<br>Pass 120 lbs/in @ 160° F<br>(Pass 534 N/2.54 cm @ 70° C) |   |
| Bonded Seam Strength                   | ASTM D 751<br>Procedure A, Grab Test Method | 550 lbs. min.<br>(2,450 N min.)   | 550 lbs. min.<br>(2,450 N min.)   | 550 lbs. min.<br>(2,560 N min.)                                       |

|  |  |  |  |  |
|--|--|--|--|--|
| Abrasion Resistance                              | ASTM D 3389<br>H-18 Wheel<br>1 kg Load | 2,000 cycles min. before fabric exposure, 50 mg/100 cycles max. weight loss              | 2,000 cycles min. before fabric exposure, 50 mg/100 cycles max. weight loss              | 2,000 cycles min. before fabric exposure, 50 mg/100 cycles max. weight loss              |
| Weathering Resistance                            | Carbon-Arc<br>ASTM G 153               | 8,000 hours min. with no appreciable changes or stiffening or cracking of coating        | 8000 hours min. with no appreciable change or stiffening or cracking of coating          | 8000 hours min. with no appreciable change or stiffening or cracking of coating          |
| Water Absorption                                 | ASTM D 471, Section 12<br>7 Days       | 0.025 kg/m <sup>2</sup> max. @70° F/21° C<br>0.14 kg/m <sup>2</sup> max at 212° F/100° C | 0.025 kg/m <sup>2</sup> max. @70° F/21° C<br>0.14 kg/m <sup>2</sup> max at 212° F/100° C | 0.025 kg/m <sup>2</sup> max. @70° F/21° C<br>0.14 kg/m <sup>2</sup> max at 212° F/100° C |
| Wicking  | ASTM D 751                             | 1/8" max<br>(0.3 cm max)   | 1/8" max<br>(0.3 cm max.)  | 1/8" max.<br>(0.3 cm max.)   |
| Bursting Strength                                | ASTM D 751 Ball Tip                    | 750 lbs. min.<br>(3,330 N min.)  | 750 lbs. min.<br>(3,330 N min.)  | 750 lbs. min.<br>(3,330 N min.)  |
| Puncture Resistance                              | ASTM D 4833                            | 275 lbs. min.<br>1,200 N min.  | 275 lbs. min.<br>1,200 N min.  | 275 lbs. min.<br>1,200 N min.  |
| Coefficient of Thermal Expansion/<br>Contraction | ASTM D 696                             | 8 x 10 <sup>-5</sup> in/in/° F max.<br>(1.4 x 10 <sup>-5</sup> cm/cm/° C max.)           | 8 x 10 <sup>-5</sup> in/in/° F max.<br>(1.4 x 10 <sup>-5</sup> cm/cm/° C max.)           | 8 x 10 <sup>-5</sup> in/in/° F max.<br>(1.4 x 10 <sup>-5</sup> cm/cm/° C max.)           |
| Environmental/Chemical Resistant Properties      |  | See Chemical Resistance Table, Page 8  | See Chemical Resistance Table, Page 8  | See Chemical Resistance Table, Page 8  |
| Puncture Resistance                              | FED-STD-101C Method 2031               | 350 lbs. (approx.)   | 350 lbs. (approx.)   |  |
| Cold Crack                                       | ASTM D 2136<br>4 Hrs, 1/8" Mandrel     | Pass at -30° F/-34° C  | Pass @ -30° F/-34° C   | Pass @ -30° F/-34° C   |

## Section 2 - Physical Properties

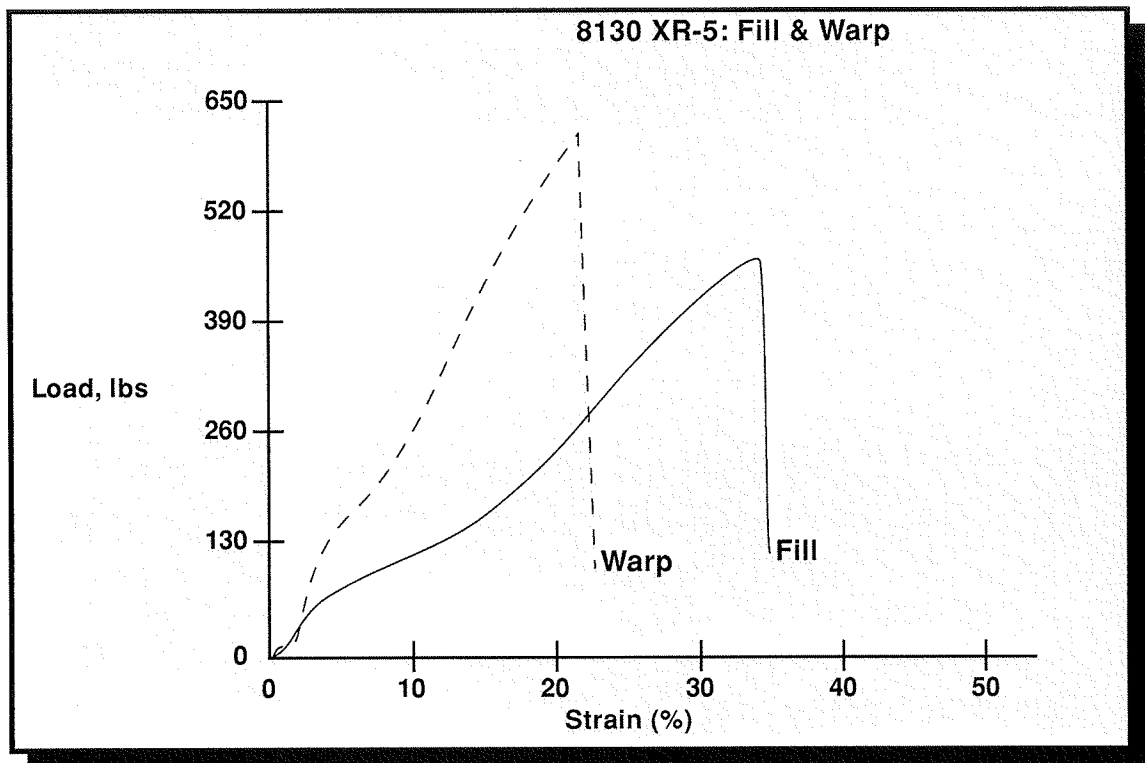
### Part 1- Material Specifications (cont.)

| Property                   | Test Method                                 | 8130 XR-3 PW  | 8228 XR-3  |
|----------------------------|---|---|--|
| Base Fabric Type           | ASTM D 751                                  | Polyester   | Polyester  |
| Base Fabric Weight         |   | 6.5 oz/yd <sup>2</sup> nominal<br>(220 g/m <sup>2</sup> nominal)  | 3.0 oz/yd <sup>2</sup> nominal<br>(100 g/m <sup>2</sup> nominal)                               |
| Thickness                  | ASTM D 751                                  | 30 mils min.<br>(0.76 mm min.)  | 30 mils min.<br>(0.76 mm min.)   |
| Weight                     | ASTM D 751                                  | 30.0 ± 2 oz./sq. yd.<br>(1017 ± 70 g/sq. m)   | 28.0 ± 2 oz./sq. yd.<br>(950 ± 70 g/sq. m)   |
| Tear Strength              | ASTM D 751<br>Trap Tear                     | 40/55 lbs. min.<br>(175/245 N min.)   | 30/30 lbs. nom.<br>(133/133 N nom.)  |
| Breaking Yield Strength    | ASTM D 751<br>Grab Tensile                  | 550/550 lbs. min.<br>(2,447/2447 N min.)  | 250/200 lbs. min.<br>(1,110/890 N min.)  |
| Low Temperature Resistance | ASTM D 2136<br>4hrs-1/8" Mandrel            | Pass @ -30° F<br>(Pass @ -35° C)  | Pass @ -25° F<br>(Pass @ -32° C)   |
| Dimensional Stability      | ASTM D 1204<br>100° C-1 hr.                 | 0.5% max.<br>each direction   | 5% max.<br>each direction  |
| Hydrostatic Resistance     | ASTM D 751<br>Method A                      | 800 psi min.<br>(5.51 MPa min.)   | 300 psi min.<br>(2.07 MPa min.)  |
| Blocking Resistance        | ASTM D 751<br>180° F                        | #2 Rating max.  | #2 Rating max.   |
| Adhesion-Ply               | ASTM D 413<br>Type A                        | 15 lbs./in. min. or film<br>tearing bond<br>(13 daN/5 cm min. or FTB)   | 12 lbs./in. (approx.)<br>(10 daN/5 cm approx.)   |
| Adhesion-Heat Welded Seam  | ASTM D 751<br>Dielectrc Weld                | 40 lbs./2in. min.<br>(17.5 daN/5 cm min.)   | 10 lbs./in min.<br>(9 daN/5 cm min.)   |
| Dead Load Seam Strength    | ASTM D 751, 4-Hour Test                     | Pass 220 lbs/in. @ 70° F<br>(Pass 980 N/2.54 cm @ 21° C)<br>Pass 120 lbs/in. @ 160° F<br>(Pass 534 N/2.54 cm @ 70° C) | Pass 100 lbs/in @ 70° F<br>(Pass 445 N @ 21° C)<br>Pass 50 lb @ 160° F<br>(Pass 220 N @ 70° C) |
| Bonded Seam Strength       | ASTM D 751<br>Procedure A, Grab Test Method | 550 lbs. min.<br>(2,450 N min.)   | 250 lbs. (approx.)<br>(1,112 N min.)   |

|  |  |  |  |
|--|--|--|--|
| Abrasion Resistance                              | ASTM D 3389<br>H-18 Wheel<br>1 kg Load                 | 2000 cycles min. before fabric exposure, 50 mg/100 cycles max. weight loss               | 2000 cycles min.   |
| Weathering Resistance                            | ASTM G 153   | 8000 hours min. with no appreciable change or stiffening or cracking of coating          | 8000 hours min.  |
| Water Absorption                                 | ASTM D 471, Section 12<br>7 Days                       | 0.025 kg/m <sup>2</sup> max. @ 70° F/21° C<br>0.14 kg/m <sup>2</sup> max @ 212° F/100° C | 0.05 kg/m <sup>2</sup> max. @ 70° F/21° C (approx.)<br>0.28 kg/m <sup>2</sup> max. @ 212° F/100° C (approx.) |
| Wicking  | ASTM D 751   | 1/8" max.<br>(0.3 cm max.)   | 1/8" max<br>(0.3 cm max.)  |
| Bursting Strength                                | ASTM D 751 Ball Tip                                    | 750 lbs. min.<br>(3330 N min.)   | 350 lbs. (approx.)<br>(1557 N min.)  |
| Puncture Resistance                              | ASTM D 4833  | 275 lbs. min.<br>1200 N min.   | 50 lb typ.<br>(225 N typ.)   |
| Coefficient of Thermal Expansion/<br>Contraction | ASTM D 696   | 8 x 10 <sup>-5</sup> in/in/° F max.<br>(1.4 x 10 <sup>-5</sup> cm/cm/° C max.)           | 8 x 10 <sup>-5</sup> in/in/° F max. (approx.)<br>(1.4 x 10 <sup>-5</sup> cm/cm/° C max. approx.)             |
| Environmental/Chemical Resistant Properties      | ASTM D 741 7-Day Total<br>Immersion With Exposed Edges | NSF 61 approved for potable water  | Crude oil 5% max. weight gain<br>Diesel fuel 5% max. weight gain   |
| Puncture Resistance                              | FTMS 101C Method 2031                                  | 350 lbs. (approx.)   | 205 lbs. (approx.)   |
| Tongue Tear                                      | ASTM D 751   |  | 50 lbs. (approx.)  |

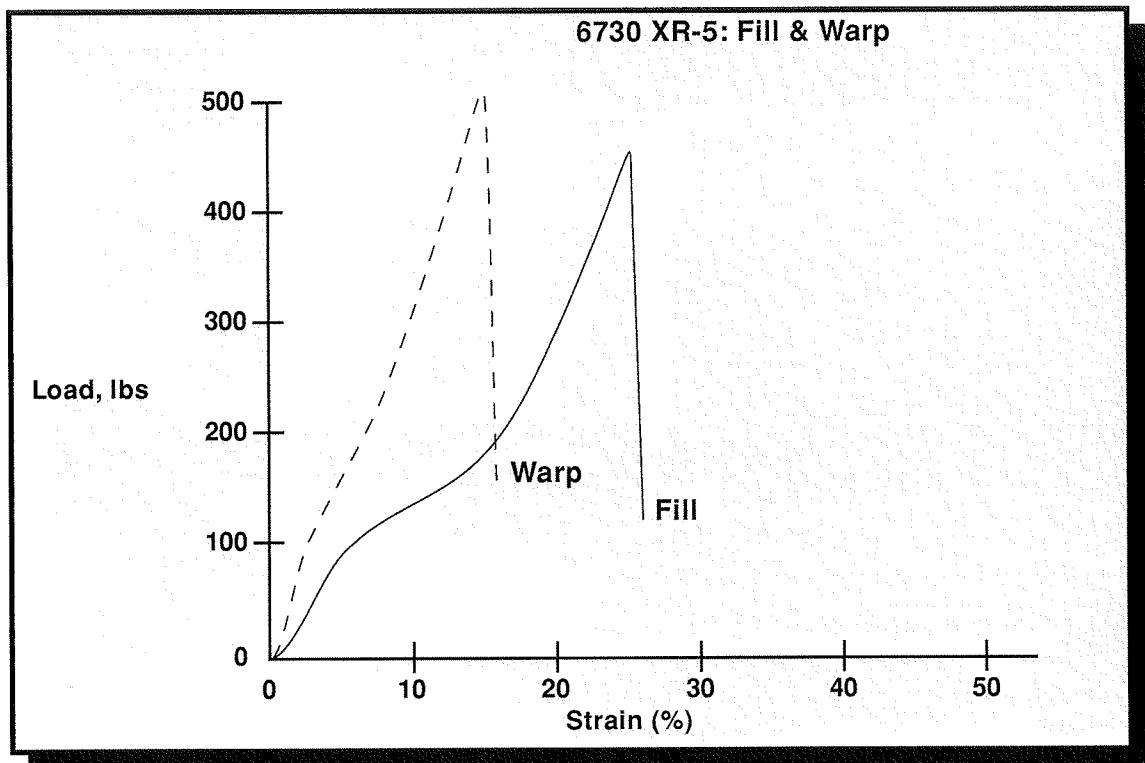
## Part 2 - Elongation Properties Test

### 8130 XR-5



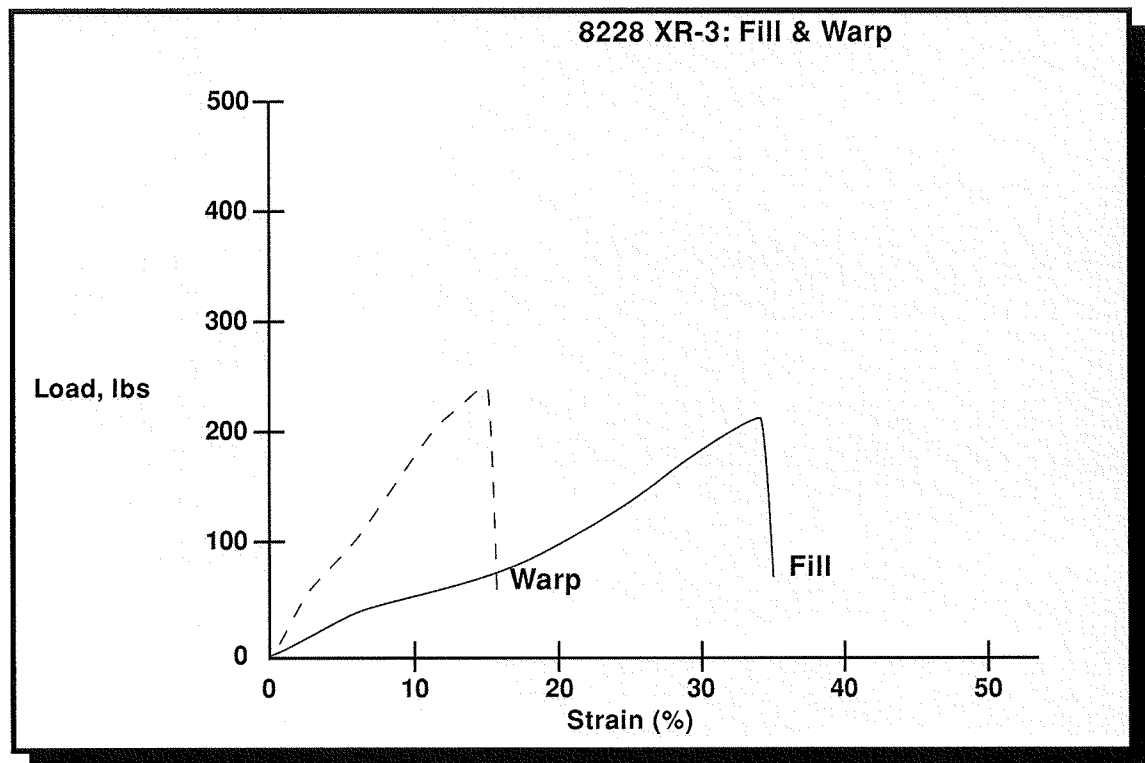
## Part 2 - Elongation Properties Test

### 6730 XR-5



## Part 2 - Elongation Properties Test

### 8228 XR-3





## Section 3 - Chemical/Environmental Resistance

### Part 1 - XR-5® Fluid Resistance Guidelines

The data below is the result of laboratory tests and is intended to serve only as a guide. No performance warranty is intended or implied. The degree of chemical attack on any material is governed by the conditions under which it is exposed. Exposure time, temperature, and size of the area of exposure usually varies considerably in application, therefore, this table is given and accepted at the user's risk. Confirmation of the validity and suitability in specific cases should be obtained. Contact a Seaman Corporation Representative for recommendation on specific applications.

When considering XR-5 for specific applications, it is suggested that a sample be tested in actual service before specification. Where impractical, tests should be devised which simulate actual service conditions as closely as possible.

| EXPOSURE                           | RATING | EXPOSURE                  | RATING |
|------------------------------------|--------|---------------------------|--------|
| AFFF                               | A      | JP-4 Jet Fuel             | A      |
| Acetic Acid (5%)                   | B      | JP-5 Jet Fuel             | A      |
| Acetic Acid (50%)                  | C      | JP-8 Jet Fuel             | A      |
| Ammonium Phosphate                 | T      | Kerosene                  | A      |
| Ammonium Sulfate                   | T      | Magnesium Chloride        | T      |
| Antifreeze (Ethylene Glycol)       | A      | Magnesium Hydroxide       | T      |
| Animal Oil                         | A      | Methanol                  | A      |
| Aqua Regia                         | X      | Methyl Alcohol            | A      |
| ASTM Fuel A (100% Iso-Octane)      | A      | Methyl Ethyl Ketone       | X      |
| ASTM Oil #2 (Flash Pt. 240° C)     | A      | Mineral Spirits           | A      |
| ASTM Oil #3                        | A      | Naphtha                   | A      |
| Benzene                            | X      | Nitric Acid (5%)          | B      |
| Calcium Chloride Solutions         | T      | Nitric Acid (50%)         | C      |
| Calcium Hydroxide                  | T      | Perchloroethylene         | C      |
| 20% Chlorine Solution              | A      | Phenol                    | X      |
| Clorox                             | A      | Phenol Formaldehyde       | B      |
| Conc. Ammonium Hydroxide           | A      | Phosphoric Acid (50%)     | A      |
| Corn Oil                           | A      | Phosphoric Acid (100%)    | C      |
| Crude Oil                          | A      | Phthalate Plasticizer     | C      |
| Diesel Fuel                        | A      | Potassium Chloride        | T      |
| Ethanol                            | A      | Potassium Sulphate        | T      |
| Ethyl Acetate                      | C      | Raw Linseed Oil           | A      |
| Ethyl Alcohol                      | A      | SAE-30 Oil                | A      |
| Fertilizer Solution                | A      | Salt Water (25%)          | B      |
| #2 Fuel Oil                        | A      | Sea Water                 | A      |
| #6 Fuel Oil                        | A      | Sodium Acetate Solution   | T      |
| Furfural                           | X      | Sodium Bisulfite Solution | T      |
| Gasoline                           | B      | Sodium Hydroxide (60%)    | A      |
| Glycerin                           | A      | Sodium Phosphate          | T      |
| Hydraulic Fluid- Petroleum Based   | A      | Sulphuric Acid (50%)      | A      |
| Hydraulic Fluid- Phosphate         |        | Tanic Acid (50%)          | A      |
| Ester Based                        | C      | Toluene                   | C      |
| Hydrocarbon Type II (40% Aromatic) | C      | Transformer Oil           | A      |
| Hydrochloric Acid (50%)            | A      | Turpentine                | A      |
| Hydrofluoric Acid (5%)             | A      | Urea Formaldehyde         | A      |
| Hydrofluoric Acid (50%)            | A      | UAN                       | A      |
| Hydrofluosilicic Acid (30%)        | A      | Vegetable Oil             | A      |
| Isopropyl Alcohol                  | T      | Water (200°F)             | A      |
| Ivory Soap                         | A      | Xylene                    | X      |
| Jet A                              | A      | Zinc Chloride             | T      |

Ratings are based on visual and physical examination of samples after removal from the test chemical after the samples of Black XR-5 were immersed for 28 days at room temperature. Results represent ability of material to retain its performance properties when in contact with the indicated chemical.

#### Rating Key:

- A – Fluid has little or no effect
- B – Fluid has minor to moderate effect
- C – Fluid has severe effect
- T – No data - likely to be acceptable
- X – No data - not likely to be acceptable

## Vapor Transmission Data

### Tested according to ASTM D814-55 Inverted Cup Method

Perhaps a more meaningful test is determination of the diffusion rate of the liquid through the membrane. The vapor transmission rate of Style 8130 XR-5® to various chemicals was determined by the ASTM D814-55 inverted cup method. All tests were run at room temperature and results are shown in the table.

| Chemical             | 8130 XR-5 Black<br>g/hr/m2 |
|----------------------|----------------------------|
| Water                | 0.11                       |
| #2 Diesel Fuel       | 0.03                       |
| Jet A                | 0.11                       |
| Kerosene             | 0.15                       |
| Hi-Test Gas          | 1.78                       |
| Ohio Crude Oil       | 0.03                       |
| Low-Test Gas         | 5.25                       |
| Raw Linseed Oil      | 0.01                       |
| Ethyl Alcohol        | 0.23                       |
| Naphtha              | 0.33                       |
| Perchloroethylene    | 38.58                      |
| Hydraulic Fluid      | 0.006                      |
| 100% Phosphoric Acid | 7.78                       |
| 50% Phosphoric Acid  | 0.43                       |
| Ethanol (E-96)       | 0.65                       |
| Transformer Oil      | 0.005                      |
| Isopropyl Alcohol    | 0.44                       |
| JP4 (E-96)           | 0.81                       |
| JP8 (E-96)           | 0.42                       |
| Fuel B (E-96)        | 6.28                       |
| Fuel C (E-96)        | 7.87                       |

Note: The tabulated values are measured Vapor Transmission Rates (VTR). Normal soil testing methods to determine permeability are impractical for synthetic membranes. An "equivalent hydraulic" permeability coefficient can be calculated but is not a direct units conversion. Contact Seaman Corporation for additional technical information.

## Seam Strength

### Style 8130 XR-5 Black Seam Strength After Immersion

Two pieces of Style 8130 were heat sealed together (seam width 1 inch overlap) and formed into a bag. Various oils and chemicals were placed in the bags so that the seam area was entirely covered. After 28 days at room temperature, the chemicals were removed and one inch strips were cut across the seam and the breaking strength immediately determined. Results are listed below.

| Chemical                         | Seam Strength                          |
|----------------------------------|--|
| None                             | 340 Lbs. Fabric Break- No Seam Failure |
| Kerosene                         | 355 Lbs. Fabric Break- No Seam Failure |
| Ohio Crude Oil                   | 320 Lbs. Fabric Break- No Seam Failure |
| Hydraulic Fluid- Petroleum Based | 385 Lbs. Fabric Break- No Seam Failure |
| Toluene                          | 0 Lbs. Adhesion Failure                |
| Naphtha                          | 380 Lbs. Fabric Break- No Seam Failure |
| Perchloroethylene                | 390 Lbs. Fabric Break- No Seam Failure |

Even though 1-inch overlap seams are used in the tests to study the accelerated effects, it is recommended that XR-5 be used with a 2-inch nominal overlap seam in actual application. In some cases where temperatures exceed 160°F and the application demands extremely high seam load, it may be necessary to use a wider width seam.

## Long Term Seam Adhesion

### 11 Years Immersion

#### ASTM D 751

##### Lbs./In.

Seam samples of 8130 XR-5® were dielectrically welded together and totally immersed in the liquids for 11 years. The samples were taken out, dried for 24 hours and visually observed for any signs of swelling, cracking, stiffening or degradation of the coating. The coating showed no appreciable degradation and no stiffening, swelling, cracking or peeling.

The adhesion, or resistance to separation of the coating from the base cloth, was then measured by ASTM D 751. Results show 8130 XR-5 maintains seam strength over this long period (11 years).

|           | <b>Control</b> | <b>Crude Oil</b> | <b>JP-4 Jet Fuel</b> | <b>Diesel Fuel</b> | <b>Kerosene</b> | <b>Naphtha</b> |
|-----------|----------------|------------------|----------------------|--------------------|-----------------|----------------|
| 8130 XR-5 | 20+            | 18               | 33                   | 25                 | 40              | 33*            |

Values in lbs./in.

\*The naphtha sample was sticky.

We believe this information is the best currently available on the subject. We offer it as a suggestion in any appropriate experimentation you may care to undertake. It is subject to revision as additional knowledge and experience are gained. We make no guarantee of results and assume no obligation or liability whatsoever in connection with this information.

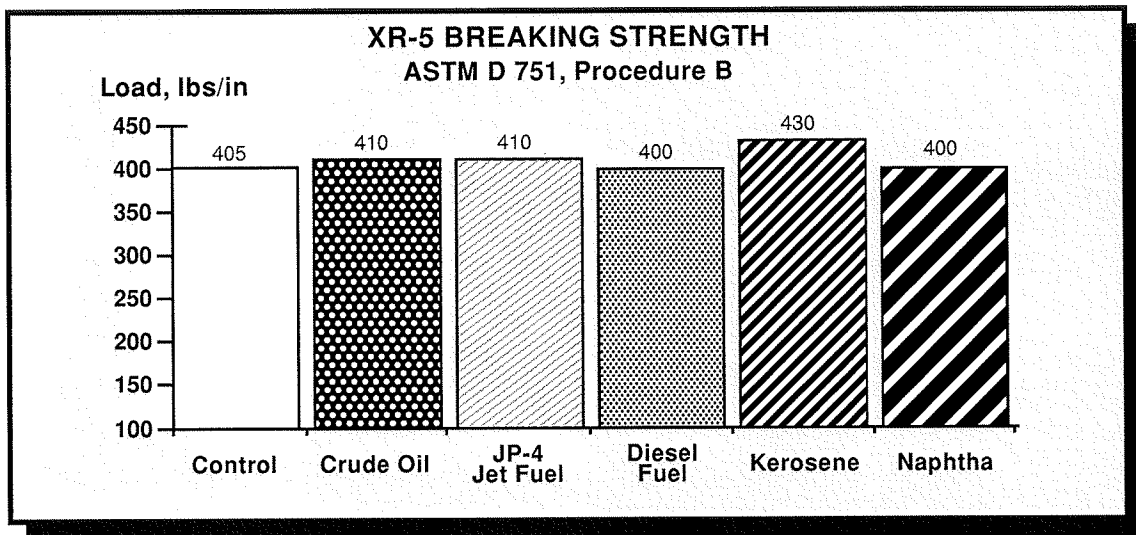
## Fuel Compatibility - Long Term Immersion

**Test:** Samples of 8130 XR-5® Black were immersed in Diesel Fuel, JP-4 Jet Fuel, Crude Oil, Kerosene, and Naphtha for 6 1/2 years.

The samples were then taken out of the test chemicals, blotted and dried for 24 hours. The samples were observed for blistering, swelling, stiffening, cracking or delamination of the coating from the fiber.

**Results:** It was found in all cases that the 8130 XR-5, after immersion for six years, maintained its strength and there was no evidence of blistering, swelling, stiffening, cracking or delamination.

The strip tensile strength, or breaking strength, of the samples was measured after six years of immersion and the following are the results.



## XR-3 Chemical Resistance Statement (Summary)

XR-3® is recommended for moderate chemical resistant applications such as stormwater and municipal wastewater and is not recommended for prolonged contact with pure solutions. XR-3 PW® membranes are recommended only for contact with drinking water and are resistant to low levels of chlorine found in drinking water. XR-5 has a broad range of chemical resistance which is detailed in this section.

## Part 2: XR-5® Comparative Chemical Resistance

### Chemical Resistance Chart Comparative Chemical Resistance

|                   | <u>XR-5</u> | <u>HDPE</u> | <u>PVC</u> | <u>Hypalon</u> | <u>Polypropylene</u> |
|-------------------|-------------|-------------|------------|----------------|----------------------|
| Kerosene          | A           | B           | C          | C              | C                    |
| Diesel Fuel       | A           | A           | C          | C              | C                    |
| Acids (General)   | A           | A           | A          | B              | A                    |
| Naphtha           | A           | A           | C          | B              | C                    |
| Jet Fuels         | A           | A           | C          | B              | C                    |
| Saltwater, 160° F | A           | A           | C          | B              | A                    |
| Crude Oil         | A           | B           | C          | B              | C                    |
| Gasoline          | B           | B           | C          | C              | C                    |

**A= Excellent    B= Moderate    C= Poor**

Source: Manufacturer's Literature

XR-5 data based on conditions detailed in Section 3, Part 1.

## Part 3: Weathering Resistance

### Accelerated Weathering Test

XR-5 has been tested in the carbon arc weatherometer for over 10,000 hours of exposure and in the Xenon weatherometer for over 12,000 hours of exposure. The sample showed no loss in flexibility and no significant color change. Based on field experience of Seaman Corporation products and similar weatherometer exposure tests, XR-5 should have an outdoor weathering life significantly longer than competitive geomembranes, particularly in tropical or subtropical applications.

EMMAQUA Testing: ASTM E-838-81 was performed on a modified form of XR-5, FiberTite, used in the single-ply roofing industry. After 3 million Langley's in Arizona, no signs of degradation were noted with no evidence of cracking, blistering, swelling or adhesion delamination failure of the coating.

### Natural Exposure

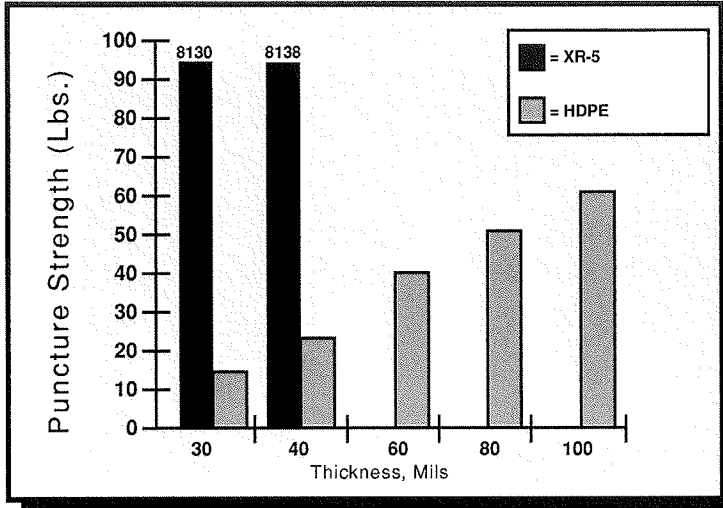
After over 17 years as a holding basin at a large oil company in the Texas desert, XR-5 showed no signs of environmental stress cracking, thermal expansion/contraction, or low yield strength problems. Temperature ranges from near zero to over 100° F.

In service approximately 17 years in a solar pond application at a research facility in Ohio, UV exposed samples, as well as immersed samples, retained over 90% of the tensile strength. Examination of the material determined there was little effect on the coating compound. The solar pond was exposed to temperatures from below zero to over 100° F.

XR5 was exposed for 12½ years in Sarasota, Florida, on a weathering rack, facing the southern direction at 45°. No significant color loss, cracking, crazing, blistering, or adhesion delamination failure of the coating was noted.

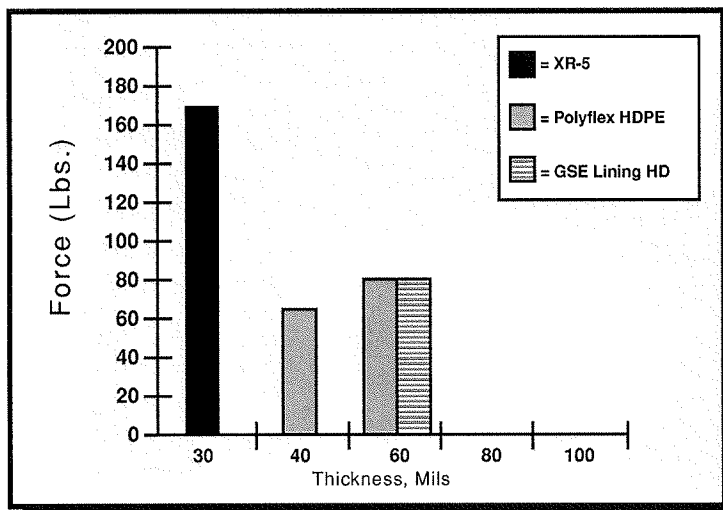
## Section 4 - Comparative Physical Properties

### XR-5/HDPE Comparative Properties

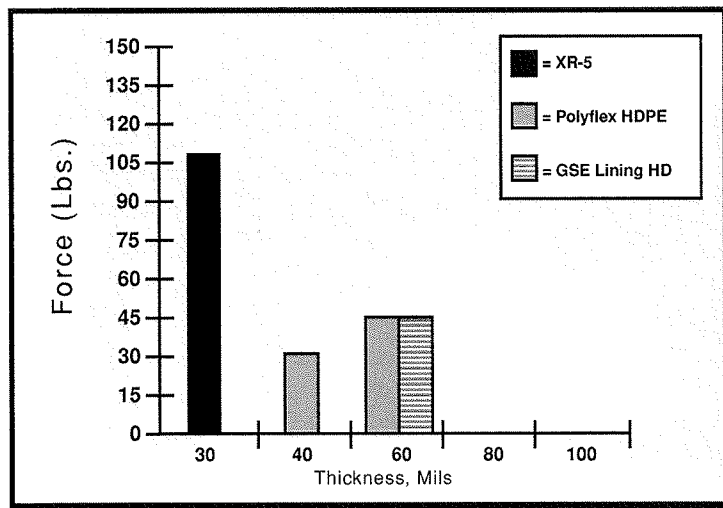


#### Puncture Resistance

1. ASTM D 751, Screwdriver Tip, 45° Angle (Room Temperature) Puncture Resistance, XR5 vs. HDPE



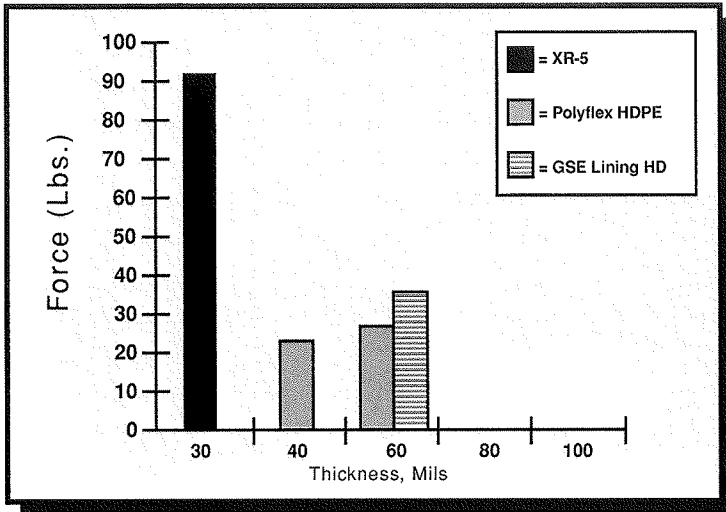
2. FED-STD-101C Method 2065 (Room Temperature)\*



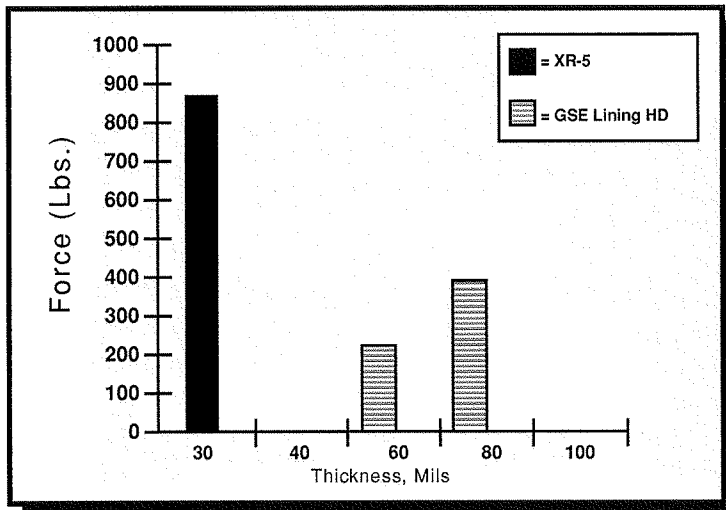
3. FED-STD-101C Method 2065 (70°C)\*

\* Data provided by E.I. DuPont de Nemours & Co. Wilmington, Delaware

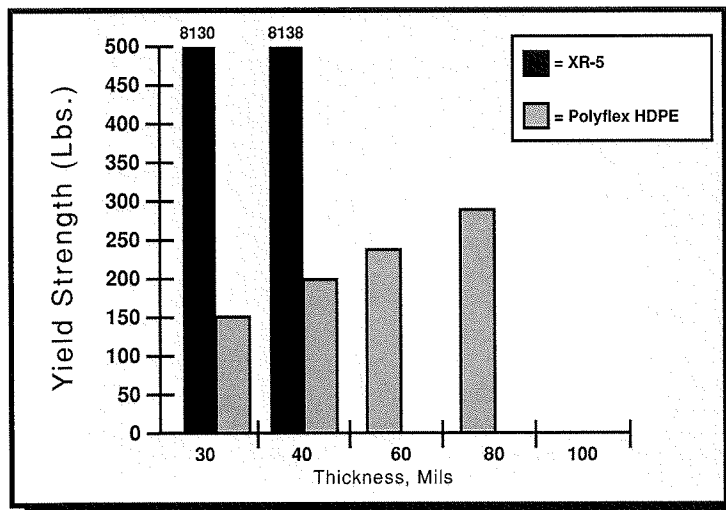
GSE is a registered trademark of GSE Lining Technology, Inc.



4. FED-STD-101C Method 2065 (100°C)\*



5. ASTM D 751 Ball Burst Puncture



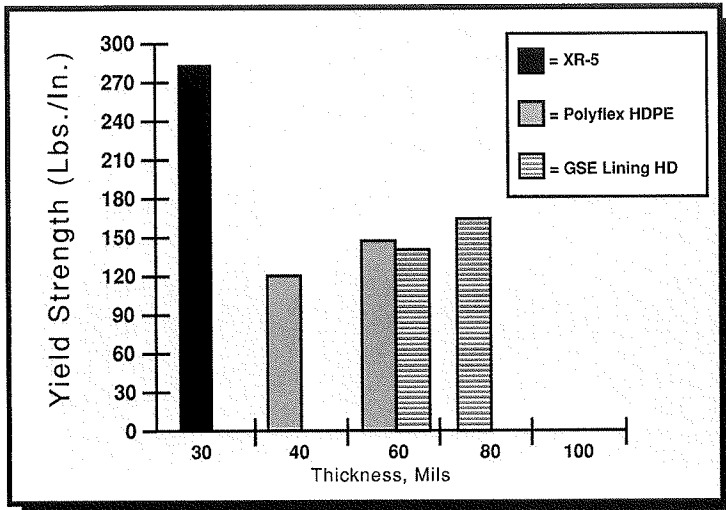
## Yield Strength

1. Yield Strength, XR-5 vs. HDPE

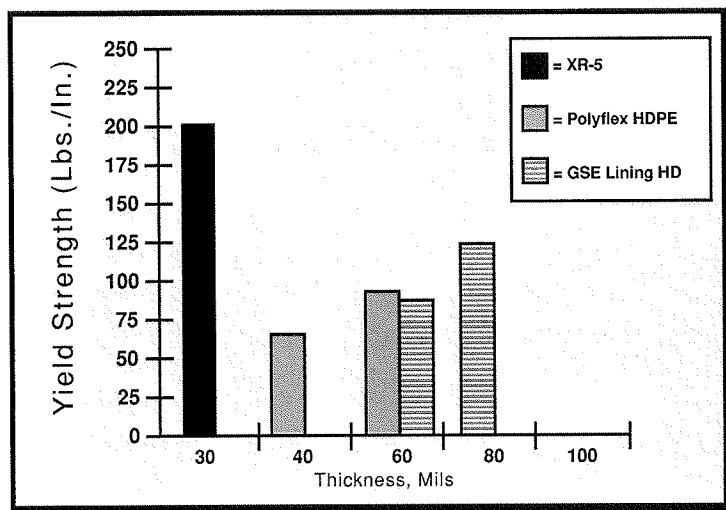
Test Method: Grab Tensile, ASTM D 751, 70° C

\* Data provided by E.I. DuPont de Nemours & Co. Wilmington, Delaware

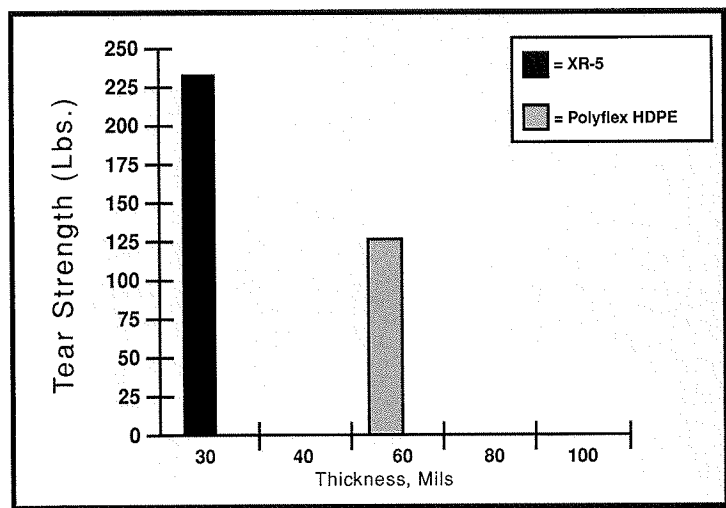
GSE is a registered trademark of GSE Lining Technology, Inc.



2. Strip Tensile, ASTM D 751, Room Temperature\*



3. Strip tensile, ASTM D 751, 70°C\*



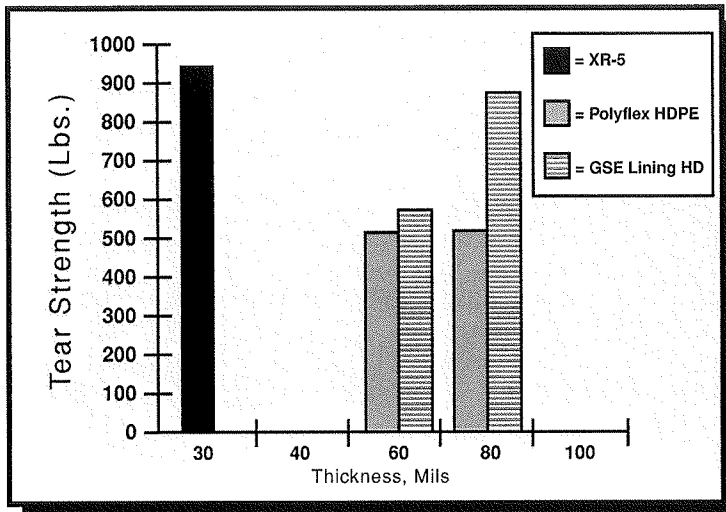
## Tear Strength

1. Tongue Tear (8" x 10" Specimens), ASTM D 751, Room Temperature\*

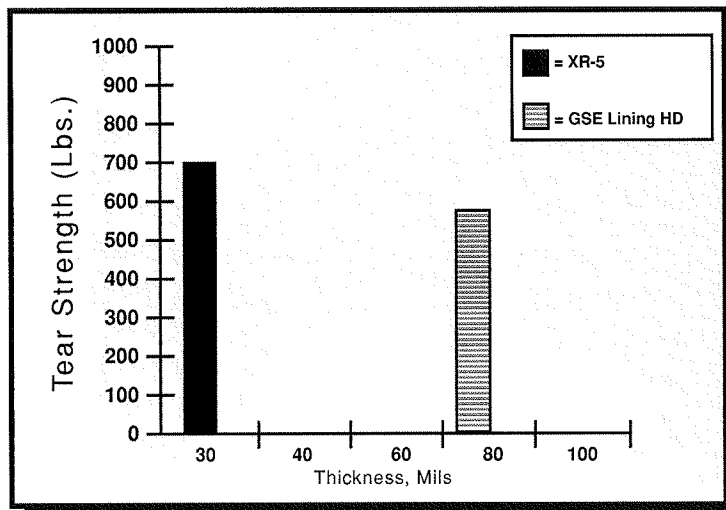
\* Data provided by E.I. DuPont de Nemours & Co. Wilmington, Delaware

GSE is a registered trademark of GSE Lining Technology, Inc.





1. Graves Tear, ASTM D 624, Die C, Room Temperature\*

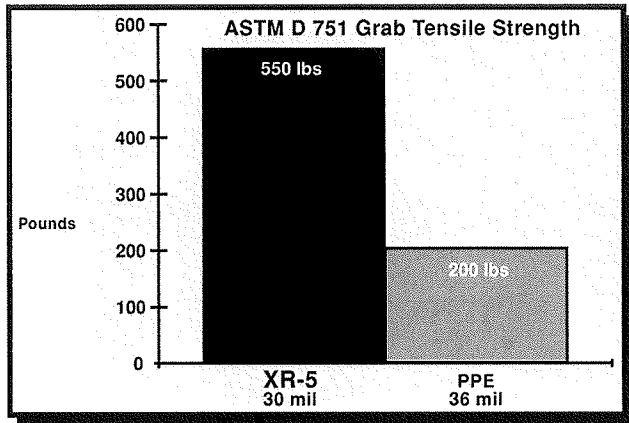


2. Graves Tear, ASTM D 624, Die C, 70°C\*

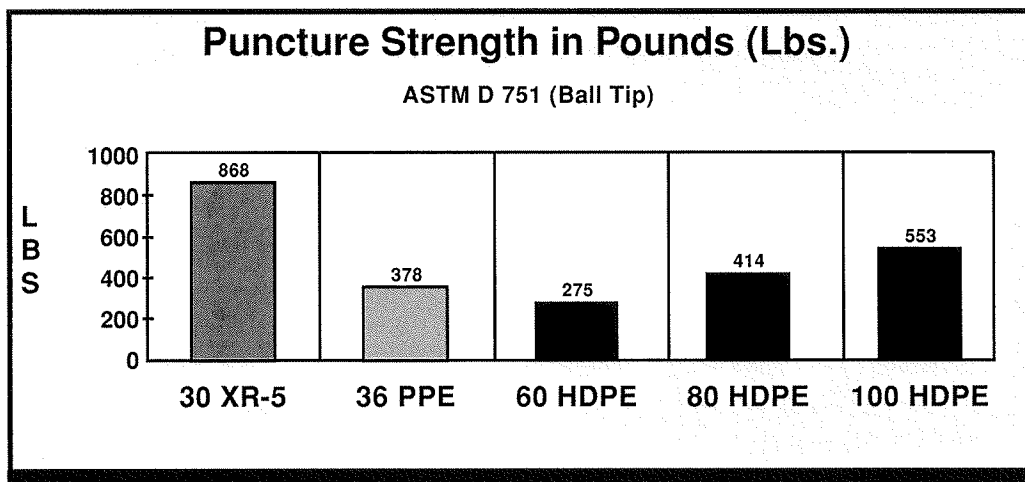
\* Data provided by E.I. DuPont de Nemours & Co. Wilmington, Delaware

GSE is a registered trademark of GSE Lining Technology, Inc.

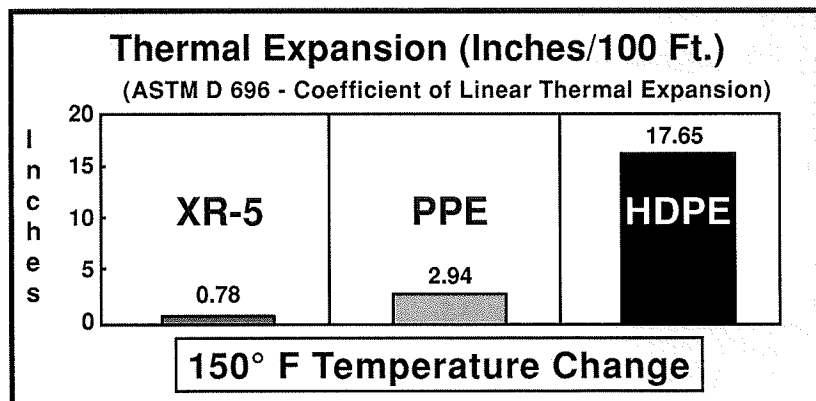
## Grab Strength – XR-5® vs. Polypropylene Tensile



## Puncture Strength Comparison



## Coated Fabric Thermal Stability



# Specification For Geomembrane Liner

(Sample specification: 8130 XR-5°. For other product specifications, go to [www.xr-5.com](http://www.xr-5.com))

## General

### 1.01 Scope Of Work

Furnish and install flexible membrane lining in the areas shown on the drawings. All work shall be done in strict accordance with the project drawings, these specifications and membrane lining fabricator's approved shop drawings.

Geomembrane panels will be supplied sufficient to cover all areas, including appurtenances, as required in the project, and shown on the drawings. The fabricator/installer of the liner shall allow for shrinkage and wrinkling of the field panels.

### 1.02 Products

The lining material shall be 8130 XR-5 as manufactured by Seaman Corporation (1000 Venture Boulevard, Wooster, OH 44691; 330-262-1111), with the following physical specifications:

|   |  |
|---|--|
| Base- (Type) .....  | Polyester  |
| Fabric Weight (ASTM D 751) .....  | .6.5 oz./sq. yd.   |
| Finished Coated Weight (ASTM D 751) .....                               | .30 ± 2 oz./sq. yd.  |
| Trapezoid Tear (ASTM D 751) .....                                       | .40/55 lbs. min.   |
| Grab Yield Tensile (ASTM D 751, Grab Method Procedure A) .....          | .550/550 lbs. min.   |
| Elongation @ Yield (%) .....  | .20% min.  |
| Adhesion- Heat Seam (ASTM D 751, Dielectric Weld) .....                 | .40 lbs./2in. weld min.  |
| Adhesion- Ply (ASTM D 413, Type A) .....                                | .15 lbs./in. or film tearing bond                                |
| Hydrostatic Resistance (ASTM D 751, Method A) .....                     | .800 psi min.  |
| Puncture Resistance (ASTM D 4833) .....                                 | .275 lbs. min.   |
| Bursting Strength (ASTM D 751 Ball Tip) .....                           | .750 lbs. min.   |
| Dead Load (ASTM D 751) Room Temperature .....                           | .220 lbs. min.   |
| (2" overlap seam, 4 hours) 160°F .....                                  | .120 lbs. min.   |
| Bonded Seam Strength .....  | .575 lbs. min.   |
| (ASTM D 751 Grab Test Method, Procedure A)                              |  |
| Low Temperature (ASTM D 2136, 4 hours- 1/8" Mandrel) .....              | .Pass @ -30°F  |
| Weathering Resistance ASTM G 153 Carbon Arc .....                       | .8,000 hours min.  |
|   | With no appreciable changes or stiffening or cracking of coating |
| Dimensional Stability (ASTM D 1204, 212°F 1 Hour, Each Direction) ..... | .0.5% max.   |
| Water Absorption (ASTM D 471, 7 Days) .....                             | .0.025 kg/m <sup>2</sup> max. @ 70°F                             |
|   | .0.14 kg/m <sup>2</sup> max. @ 212°F                             |
| Abrasion Resistance ASTM D 3389, .....                                  | .2000 cycles before fabric exposure;                             |
| H-18 Wheel, 1000 g load .....   | .50 mg/100 cycles max. wgt. Loss                                 |
| Coefficient of Thermal Expansion/Contraction (ASTM D 696) .....         | .8 x 10 <sup>-6</sup> in/in/° F max.                             |

### 1.03 Submittals

The fabricator of panels used in this work shall prepare shop drawings with a proposed panel layout to cover the liner area shown in the project plans. Shop drawings shall indicate the direction of factory seams and shall show panel sizes consistent with the material quantity requirements of 1.01.

Details shall be included to show the termination of the panels at the perimeter of lined areas, the methods of sealing around penetrations, and methods of anchoring.

Placement of the lining shall not commence until the shop drawings and details have been approved by the owner, or his representative.

#### **1.04 Factory Fabrication**

The individual XR-5® liner widths shall be factory fabricated into large sheets custom designed for this project so as to minimize field seaming. The number of factory seams must exceed the number of field seams by a factor of at least 10.

A two-inch overlap seam done by heat or RF welding is recommended. The surface of the welded areas must be dry and clean. Pressure must be applied to the full width of the seam on the top and bottom surface while the welded area is still in a melt-type condition. The bottom welding surface must be flat to insure that the entire seam is welded properly. Enough heat shall be applied in the welding process that a visible bead is extruded from both edges being welded. The bead insures that the material is in a melt condition and a successful chemical bond between the two surfaces is accomplished.

Two-inch overlapped seams must withstand a minimum of 240 pounds per inch width dead load at 70° F. and 120 pounds per inch width at 160° F. as outlined in ASTM D 751. All seams must exceed 550 lbs. bonded seam strength per ASTM D 751 Bonded Seam Strength Grab Test Method, Procedure A.

#### **1.05 Inspection And Testing Of Factory Seams**

The fabricator shall monitor each linear foot of seam as it is produced. Upon discovery of any defective seam, the fabricator shall stop production of panels used in this work and shall repair the seam, and determine and rectify the cause of the defect prior to continuation of the seaming process.

The fabricator must provide a Quality Control procedure to the owner or his representative which details his method of visual inspection and periodic system checks to ensure leak-proof factory fabrication.

#### **1.06 Certification and Test Reports**

Prior to installation of the panels, the fabricator shall provide the owner, or his representative, with written certification that the factory seams were inspected in accordance with Section 1.05.

#### **1.07 Panel Packaging and Storage**

Factory fabricated panels shall be accorian-folded, or rolled, onto a sturdy wooden pallet designed to be moved by a forklift or similar equipment. Each factory fabricated panel shall be prominently and indelibly marked with the panel size. Panels shall be protected as necessary to prevent damage to the panel during shipment.

Panels which have been delivered to the project site shall be stored in a dry area.

#### **1.08 Qualifications of Suppliers**

The fabricator of the lining shall be experienced in the installation of flexible membrane lining, and shall provide the owner or his representative with a list of not less than five (5) projects and not less than 500,000 square feet of successfully installed XR-5 synthetic lining. The project list shall show the name, address, and telephone number of an appropriate party to contact in each case. The manufacturer of the sheet goods shall provide similar documentation with a 10 million square foot minimum, with at least 5 projects demonstrating 10+ years service life.

The installer shall provide similar documentation to that required by the fabricator.

#### **1.09 Subgrade Preparation By Others**

Lining installation shall not begin until a proper base has been prepared to accept the membrane lining. Base material shall be free from angular rocks, roots, grass and vegetation. Foreign materials and protrusions shall be removed, and all cracks and voids shall be filled and the surface made level, or uniformly sloping as indicated

on the drawings. The prepared surface shall be free from loose earth, rocks, rubble and other foreign matter. Generally, no rock or other object larger than USCS sand (SP) should remain on the subgrade in order to provide an adequate safety factor against puncture. Geotextiles may be used to compensate for irregular subgrades. The subgrade shall be uniformly compacted to ensure against settlement. The surface on which the lining is to be placed shall be maintained in a firm, clean, dry and smooth condition during lining installation.

#### **1.10 Lining Installation**

Prior to placement of the liner, the installer will indicate in writing to the owner or his representative that he believes the subgrade to be adequately prepared for the liner placement.

The lining shall be placed over the prepared surface in such a manner as to assure minimum handling. The sheets shall be of such lengths and widths and shall be placed in such a manner as to minimize field seaming.

In areas where wind is prevalent, lining installation should be started at the upwind side of the project and proceed downwind. The leading edge of the liner shall be secured at all times with sandbags or other means sufficient to hold it down during high winds.

Sandbags or rubber tires may be used as required to hold down the lining in position during installation. Materials, equipment or other items shall not be dragged across the surface of the liner, or be allowed to slide down slopes on the lining. All parties walking or working upon the lining material shall wear soft-sole shoes.

Lining sheets shall be closely fit and sealed around inlets, outlets and other projections through the lining. Lining to concrete seals shall be made with a mechanical anchor, or as shown on the drawings. All piping, structures and other projections through the lining shall be sealed with approved sealing methods.

#### **1.11 XR-5 Field Seaming**

All requirements of Section 1.04 and 1.05 apply. A visible bead should be extruded from the hot air welding process.

Field fabrication of lining material will not be allowed.

#### **1.12 Inspection**

All field seams will be tested using the Air Lance Method. A compressed air source will deliver 55 psi minimum to a 3/16 inch nozzle. The nozzle will be directed to the lip of the field seam in a near perpendicular direction to the length of the field seam. The nozzle will be held 4 inches maximum from the seam and travel at a rate not to exceed 40 feet per minute. Any loose flaps of 1/8" or greater will require a repair.

Alternatively all field seams should also be inspected utilizing the Vacuum Box Technique as described in Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber (ASTM D 5641-94 (2006)), using a 3 to 5 psi vacuum pressure. All leaks shall be repaired and tested.

All joints, on completion of work, shall be tightly bonded. Any lining surface showing injury due to scuffing, penetration by foreign objects, or distress from rough subgrade, shall as directed by the owner or his representative be replaced or covered, and sealed with an additional layer of lining of the proper size, in accordance with the patching procedure.

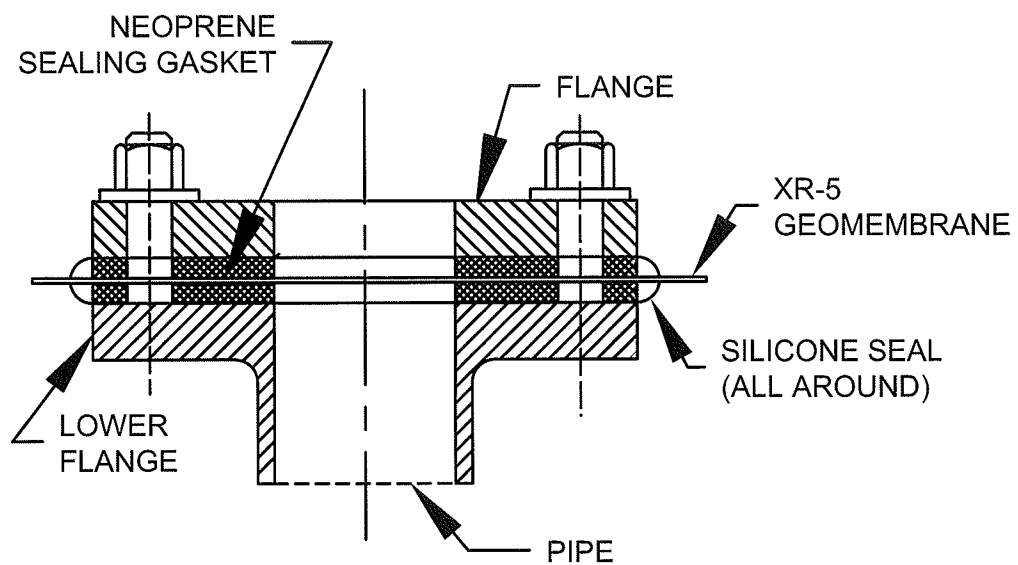
#### **1.13 Patching**

Any repairs to the lining shall be patched with the lining material. The patch material shall have rounded corners and shall extend a minimum of four inches (4") in each direction from the damaged area.

Seam repairs or seams which are questionable should be cap stripped with a 1" wide (min.) strip of the liner material. The requirements of Section 1.11 apply to this cap stripping.

#### **1.14 Warranty**

The lining material shall be warranted on a pro-rated basis for 10 years against both weathering and chemical compatibility in accordance with Seaman Corporation warranty for XR-5® Style 8130. A test immersion will be performed by the owner and the samples evaluated by the manufacturer. Workmanship of installation shall be warranted for one year on a 100% basis.



**Seaman Corporation**

ENGINEERED PRODUCTS GROUP

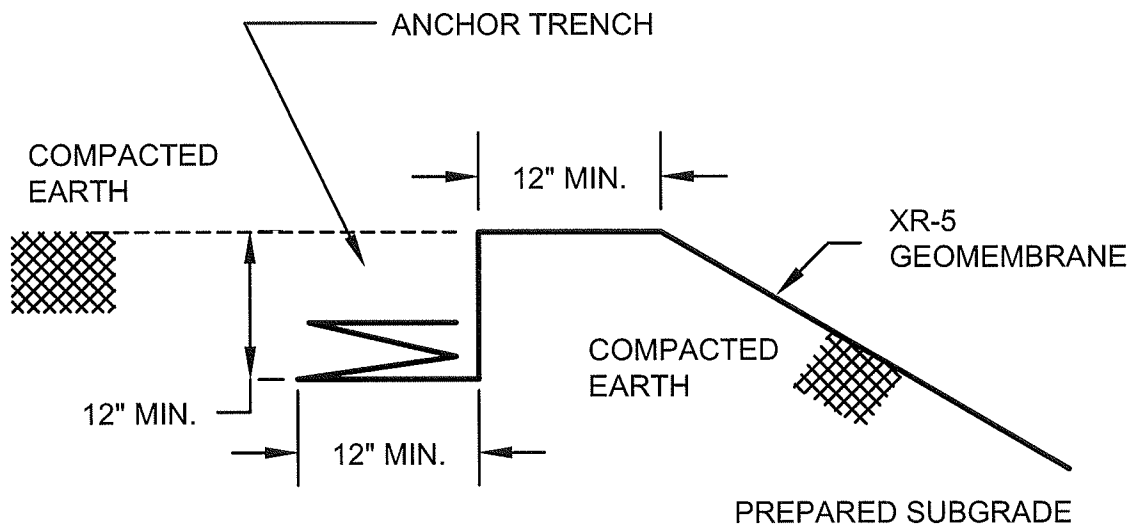
1000 Venture Blvd., Wooster, Ohio 44691

*FLANGE CONNECTION  
TO  
PIPE SECTION*

SCALE: NONE

SHEET 1 of 1

DRAW NO. XRD-019



**Seaman Corporation**

ENGINEERED PRODUCTS GROUP

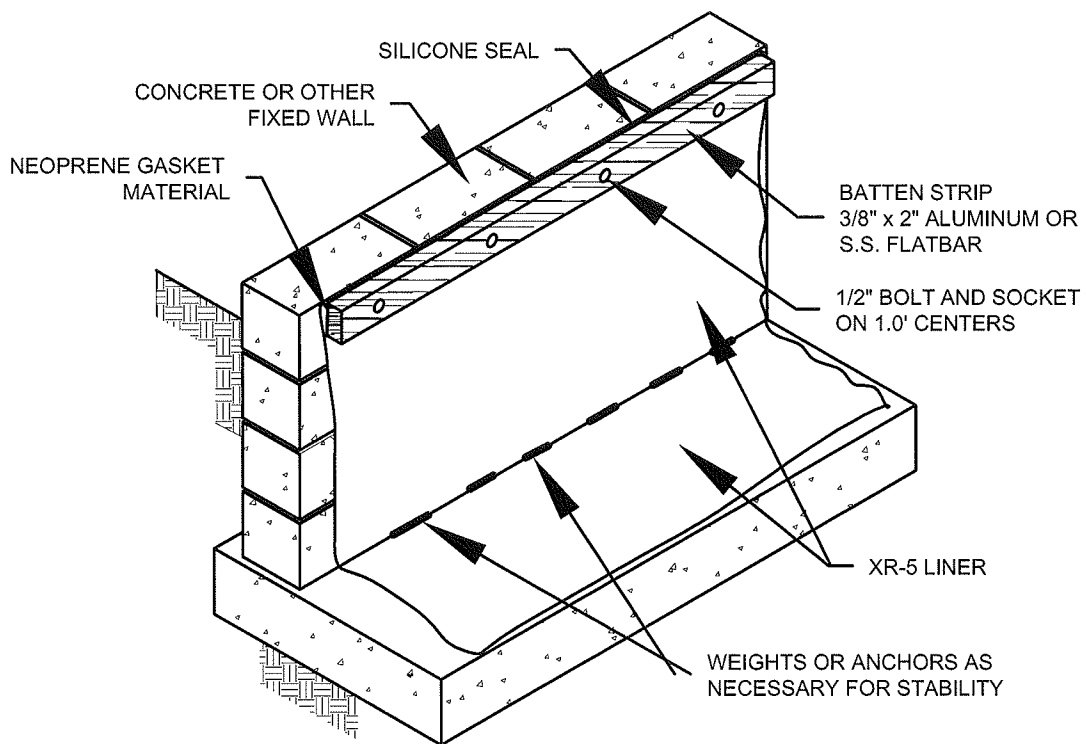
1000 Venture Blvd., Wooster, Ohio 44691

*ELEVATION VIEW  
TYPICAL ANCHOR DETAILS  
XR-5 LINER*

SCALE: NONE

SHEET 1 of 1

DRAW NO. XRD-001



## Seaman Corporation

ENGINEERED PRODUCTS GROUP

1000 Venture Blvd., Wooster, Ohio 44691

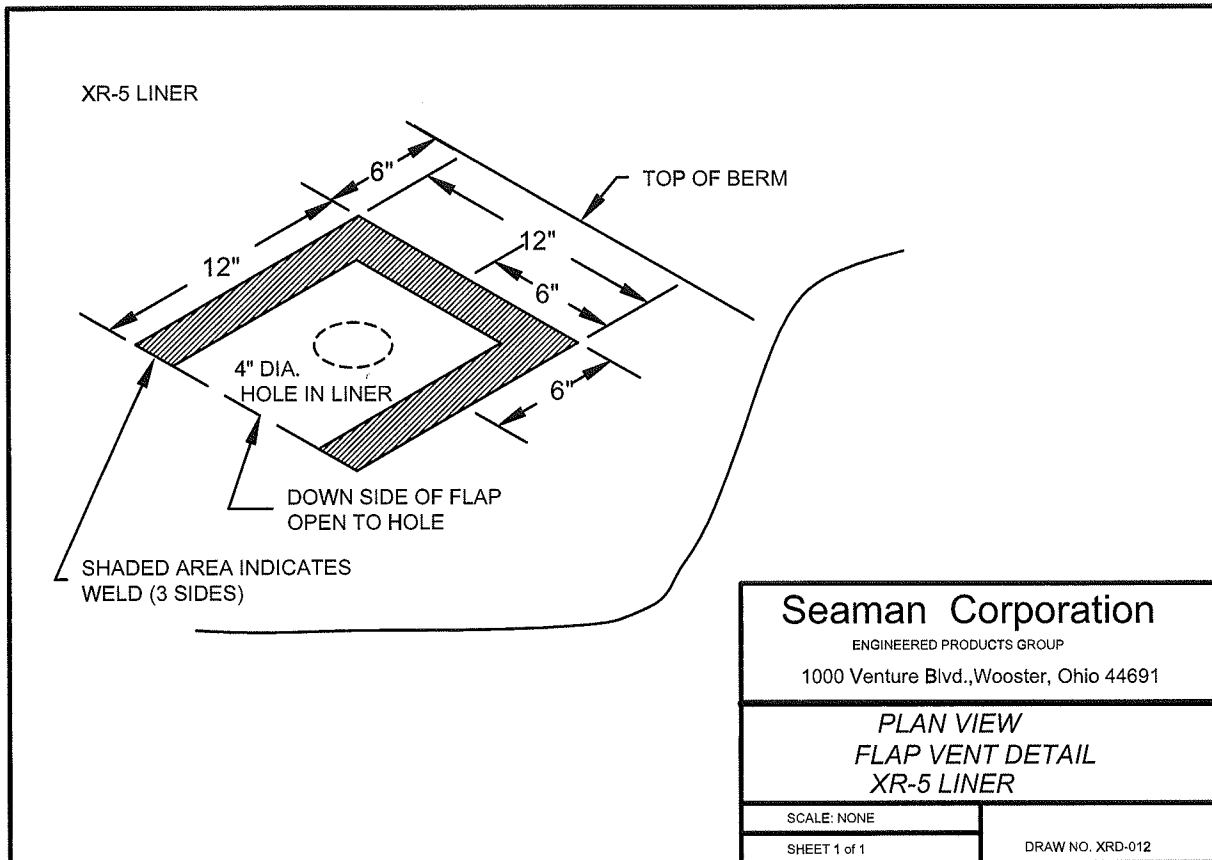
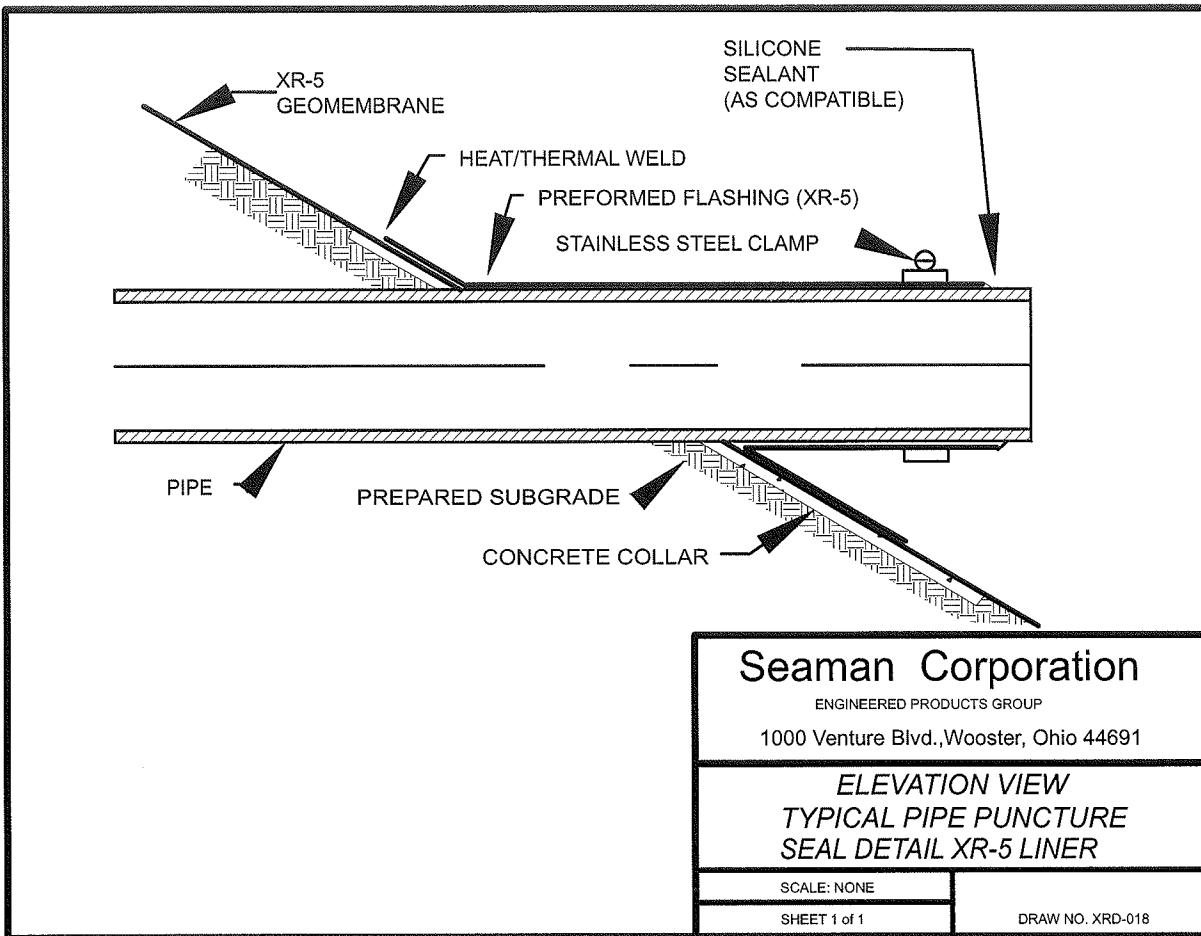
### ANCHORING DETAIL XR-5 LINER TO FIXED WALL

SCALE: NONE

SHEET 1 of 1

DRAW NO. XRD-023





## Section 6 - Warranty Information

### Warranty

XR-5® is offered with Seaman Corporation standard warranty which addresses weathering and chemical compatibility for a 10-year period. A test immersion is required with subsequent testing and approval by Seaman Corporation.

#### Instructions for XR-5 Test Immersions and Warranty Requests

1. Completely immerse six Style 8130 XR-5 samples (8-1/2" x 11" size) in the liquid to be contained.
2. At the end of approximately thirty days, retrieve three of the samples. The samples should be rinsed with fresh water and dried.
3. Send the three samples to:  
Attn: Geomembrane Department  
Seaman Corporation  
1000 Venture Blvd.  
Wooster, OH 44691
4. Keep the other three samples immersed until further notice in case longer immersion data is required.
5. Complete and return the information form on the liner application.

8228 XR-3® and all PW Geomembranes are offered with a standard 10-year warranty for weathering. The attached information form should be completed.

# XR® Membrane Application and Utilization Form

**Installation Owner and Address:**

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**Physical Location of Installation:**

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**Expected Date of Installation:** \_\_\_\_\_

**Expected Beginning Date of Service:** \_\_\_\_\_

**Description of Application:**

(Example: impoundment used to contain brine on an emergency basis.)

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**Physical Features of Application:**

(Example: 1.3 million gallon earthen impoundment with overall top dimensions of 160' x 160' with 3:1 slopes and 10' deep.)

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**Description of Liquid:**

(Describe content of liquid including pollutants and expected temperature extremes in basin and at application point.  
Attach analysis of liquid chemistry, composition taken on a representative basis.)

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**Operational Characteristics:**

(Describe the operation of the facility such as filling schedules, fluctuating liquid levels, operating temperatures, etc.)

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**Performance Requirements, Etc:**

(State any other requirements, such as rate of permeability required.)

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Owner represents the information herein is complete and accurate,  
and understands and agrees that issuance of Seaman Corporation Warranty  
for XR products are conditioned upon such completeness and accuracy.

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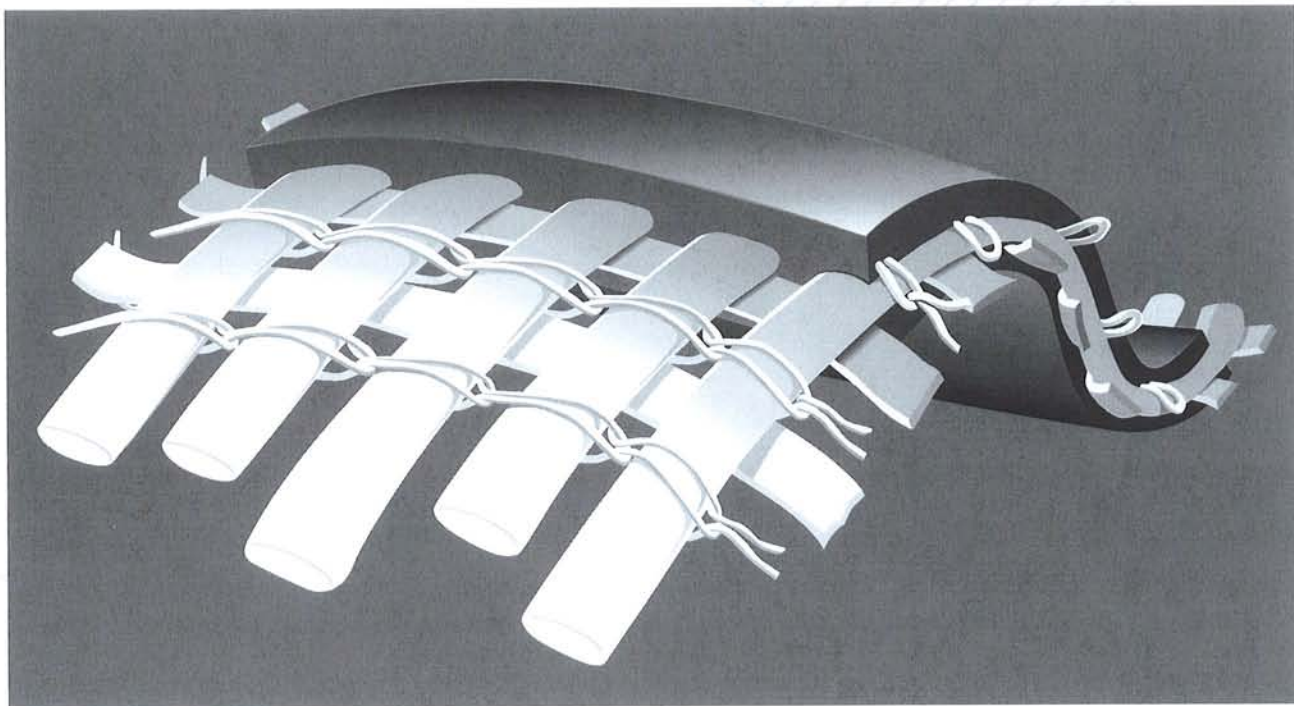
OWNER'S SIGNATURE

**Reference Materials:**

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**XR-5®: High Performance Composite Geomembrane**



**Seaman Corporation**

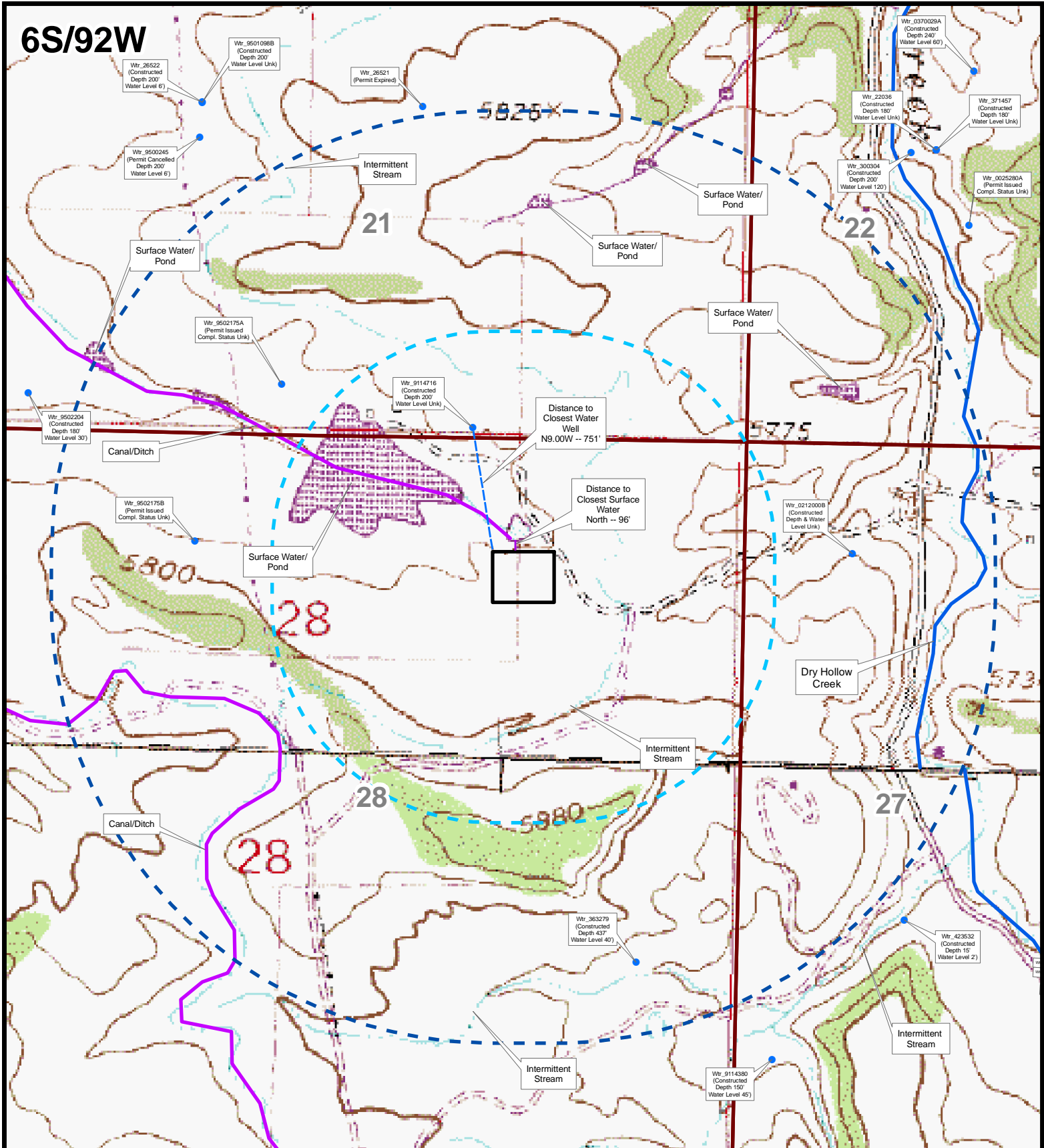
1000 Venture Blvd.  
Wooster, Ohio 44691  
(330) 262-1111  
[www.xr-5.com](http://www.xr-5.com)

Seaman Corporation

# Attachment D

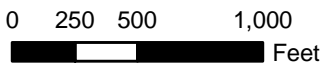
Information Utilized for Sensitive Area Determination

6S/92W



# State Hydrology Map

Old Specialty 2 Pad  
NENE, Section 28, T6S R92W  
Garfield County, Colorado



## Wells

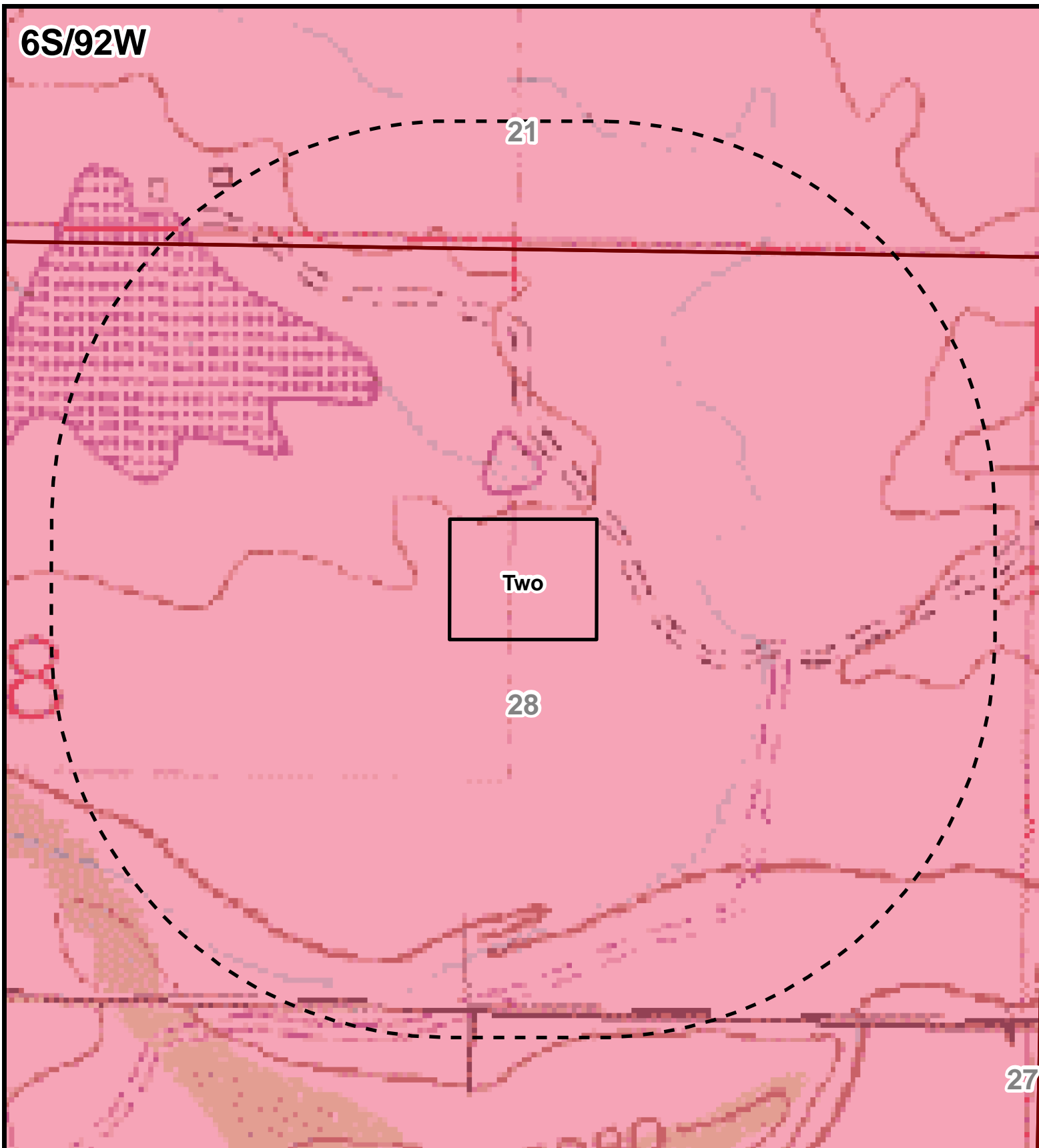
Water Wells

Pad/Pit Location



- 1/2 Mile Buffer
- 1/4 Mile Buffer
- Stream / River
- Canal / Ditch

6S/92W





## State Surface Geology Map

Old Specialty 2 Pad  
NENE, Section 28, T6S R92W  
Garfield County, Colorado


0 125 250 500  
Feet



 Pad/Pit Location  
 1000' Buffer



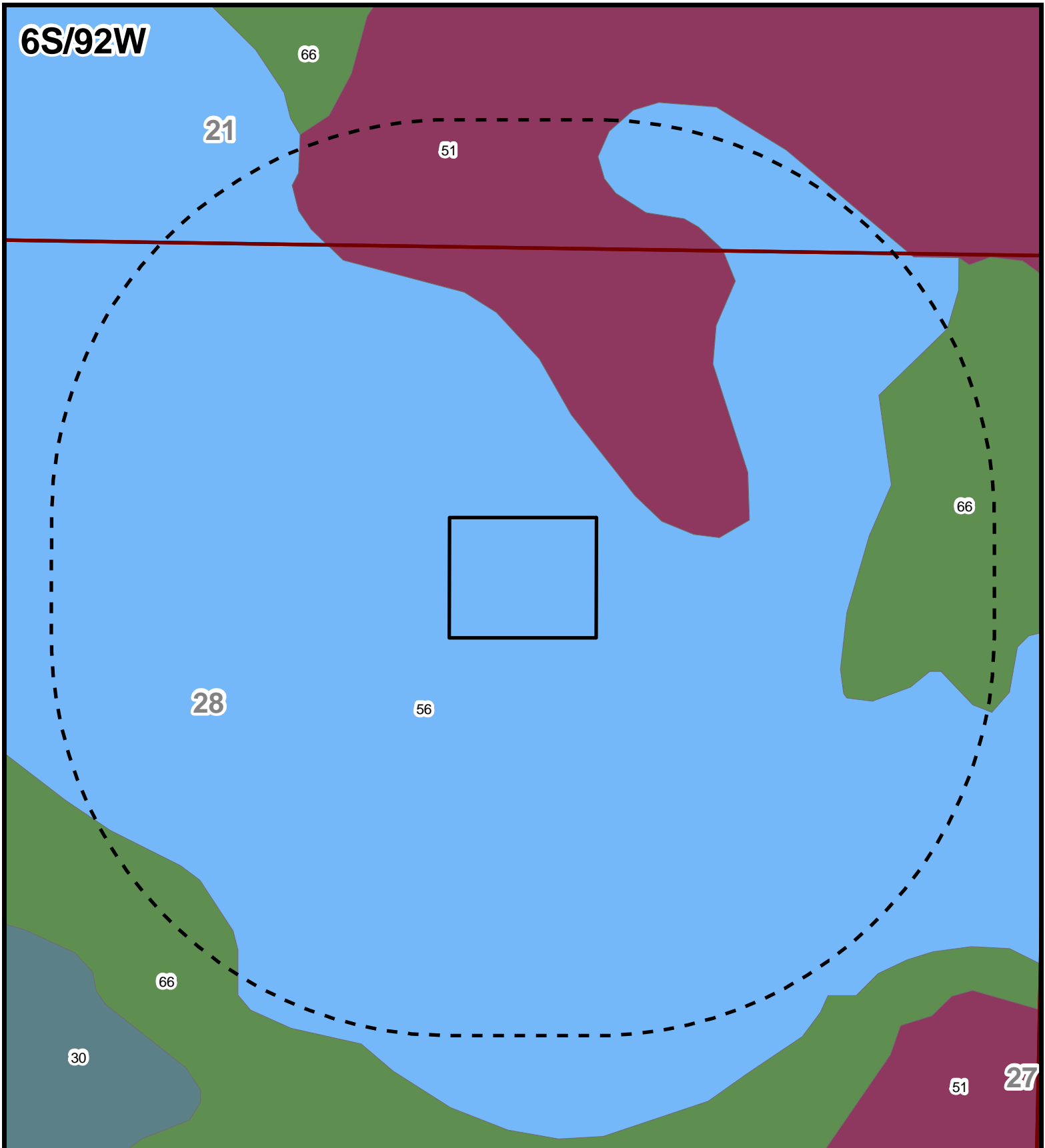
### Surface Geology

 Two - Wasatch Formation  
(incl. Fort Union equivalent at base)  
and Ohio Creek Formation

5/5/2010



6S/92W



# State Soils Map


Old Specialty 2 Pad  
NENE, Section 28, T6S R92W  
Garfield County, Colorado



0 125 250 500  
Feet

 Pad/Pit Location



 1000' Buffer

# Map Unit Description

Rifle Area, Colorado, Parts of Garfield and Mesa Counties

56 Potts loam, 6 to 12 percent slopes

## Setting

Elevation: 5000 to 7000 feet

## Composition

Potts and similar soils: 85 percent

## Description of Potts

### Setting

Landform: Valley sides, benches, mesas

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Parent material: Alluvium derived from basalt and/or alluvium derived from sandstone and shale

### Properties and Qualities

Slope: 6 to 12 percent

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate maximum: 15 percent

Gypsum maximum: 0 percent

Available water capacity: High (about 10.3 inches)

### Interpretive Groups

Land capability classification (irrigated): 4e

Land capability (non irrigated): 4e

Ecological site: Rolling Loam (R048AY298CO)

### Typical Profile

0 to 4 inches: loam

4 to 28 inches: clay loam

28 to 60 inches: loam