Addendum C.1

Response Action Plan and Action Leakage Rate for Trenches 31 &34

0041699

START

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

95-SWT-427

JUL 19 1995

Mr. Doug R. Sherwood
Hanford Project Manager
U.S. Environmental Protection Agency
Region 10
712 Swift Boulevard, Suite 5
Richland, Washington 99352

Mr. Michael A. Wilson, Program Manager
Nuclear and Mixed Waste Program
State of Washington
Department of Ecology
Post Office Box 47600
Olympia, Washington 98504-7600

Dear Messrs. Sherwood and Wilson:

REVISION TO THE RESPONSE ACTION PLAN FOR THE LOW-LEVEL BURIAL GROUNDS MIXED WASTE DISPOSAL TRENCHES

Attached for your review in accordance with the requirements of 40 Code of Federal Regulations 265.302, is the "Response Action Plan for the Low-Level Burial Grounds Mixed Waste Disposal Trench 31 and 34 (Project W-025 and Project W-025A)," Revision 2 (WHC-SD-W025-AP-001). This response action plan, has been revised to add Trench 34 and any future trenches that use the same design as Trench 31. No additional trenches are planned at this time. In addition, this response action plan has been revised to reflect the fact that both these landfills have been constructed. The response action plan is a site-specific document that establishes actions to be taken if leakage through the upper (primary) liner exceeds a certain rate, referred to as the action leakage rate.

Trench 31 and 34 are located in the northwestern portion of the 200 West Area in Burial Ground 218-W-5 of the Hanford Site. Trench 31 and 34 are a Resource Conservation and Recovery Act/Washington Administrative Code 173-303 Dangerous Waste Regulations compliant landfills. Trench 31 and 34 are nearly identical in design.

Revision 1 of the Response Action Plan was submitted to the U. S. Environmental Protection Agency and the State of Washington, Department of Ecology, on April 7, 1993, as required by Notice of Deficiency Number 160 for the "Low-Level Burial Grounds Dangerous Waste Permit Application," (DOE/RL-88-20, Revision 0).

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Should you have any questions regarding the revised response action plan, please contact A. K. Crowell, on (509) 372-2346 or Mr. R. D. Pierce of the Westinghouse Hanford Company, on (509) 372-0732.

Sincerely,

Thomas K. Teynor, Director
Waste Programs Division

Attachment

cc: R. Bowman, WHC w/attach
R. Cordts, Ecology w/attach
D. Duncan, EPA w/attach
W. Hamilton, Jr., WHC w/attach
N. Hepner, Ecology w/attach
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Administrative Records, H6-08 w/attach

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RESPONSE ACTION PLAN

FOR THE HANFORD FACILITY

LOW-LEVEL BURIAL GROUNDS,

TRENCHES 31 AND 34 OF THE 218-W-5 BURIAL GROUND

APRIL 1995

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SUMMARY

This response action plan is for Trench 31 and Trench 34 of the 218-W-5 Burial Ground, which are located in the 200 West Area of the Hanford Facility. Trenches 31 and 34 are Resource Conservation and Recovery Act/Washington Administrative Code 173-303 Dangerous Waste Regulations-compliant landfills. Trenches 31 and 34 are nearly identical in design.

A response action plan is required by the U.S. Environmental Protection Agency and, by extension, to the Washington State Department of Ecology for all hazardous/dangerous waste landfills. The response action plan is a site-specific document that establishes actions to be taken if leakage through the upper (primary) liner exceeds a certain rate, referred to as the action leakage rate.

The action leakage rate for Trenches 31 and 34 is 2,150 liters per hectare per day.

Revision 1 of the Response Action Plan was submitted to the U.S. Environmental Protection Agency and the Washington State Department of Ecology on April 7, 1993, as required by Notice of Deficiency Number 160 for the "Low-Level Burial Grounds Dangerous Waste Permit Application" (DOE/RL-88-20, Revision 0).

This revised response action plan, Revision 2, adds Trench 34 and any future trenches that use the same design as Trench 31. In addition, this response action plan has been revised to reflect that both these landfills (Trench 31 and Trench 34) have been constructed. If a new landfill design is used, a new response action plan will be developed to satisfy the requirements of 40 Code of Federal Regulations 264.302.

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METRIC CONVERSION CHART

The following conversion chart is provided to the reader as a tool to aid in conversion.

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0393	inches
inches	2.54	centimeters	centimeters	0.393	inches
feet	0.3048	meters	meters	3.2808	feet
yards	0.914	meters	meters	1.09	yards
miles	1.609	kilometers	kilometers	0.62	miles
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
square miles	259	hectares	hectares	0.00391	square miles
acres	0.404	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.0352	ounces
pounds	0.453	kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
Volume			**Volume**		
fluid ounces	29.57	milliliters	milliliters	0.03	fluid ounces
quarts	0.95	liters	liters	1.057	quarts
gallons	3.79	liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.

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1.0 INTRODUCTION

This response action plan (RAP) has been prepared for the Low-Level Burial Grounds, Trenches 31 and 34 of the 218-W-5 Burial Ground, as well as any future trenches that use the same design. Trenches 31 and 34 are Resource Conservation and Recovery Act (RCRA)/Washington Administrative Code (WAC) 173-303 *Dangerous Waste Regulations* (WAC 173-303)-compliant landfills. The 218-W-5 Burial Ground is in the northwestern portion of the 200 West Area on the Hanford Facility (Figure 1).

Trenches 31 and 34 are rectangular landfills (Figure 2) with approximate base dimensions of 76.2 meters by 30.5 meters, with a surface grade footprint of 1.3 hectares. Trenches 31 and 34 are designed for approximately 21,000 cubic meters of mixed waste. The floor of both trenches slopes slightly, giving a variable depth of 9.1 to 12.2 meters. The floor slope is a minimum of 2 percent, draining to a recessed area at the eastern end that houses the sumps for leachate collection. The sideslope ratio is 3 horizontal:1 vertical. Access to the trench floor is provided by a ramp (8 percent slope).

Trenches 31 and 34 were constructed with a double liner and leachate collection and removal system. The bottom and sides of Trenches 31 and 34 are covered with a 0.9-meter operations layer of soil to protect the liner system during fill operations. Additional layers progressing toward the subgrade for Trenches 31 and 34 floor are as follows:

- A geotextile that acts as a filter between the operations layer and the primary drainage gravel
- A 0.3-meter layer of primary drainage gravel
- A geotextile that acts as a cushion between the drainage gravel and the primary and secondary geomembranes
- A geonet with high transmissivity, which functions as a redundant drainage system in conjunction with the drainage gravel on the floor
- The primary leachate barrier, a 60 mil high-density polyethylene (HDPE) liner
- 0.46-meter of compacted clay/soil admix
- A geotextile cushion
- 0.3-meter of drainage gravel
- A geotextile cushion, geonet, and a secondary 60 mil HDPE liner
- 0.94 meter of admix material (clay/soil) meeting permeability requirements.

On the trench sideslopes, the primary and secondary liner systems use geocomposite (two geotextiles thermally bonded to a geonet) drainage layers instead of the drainage gravel and geotextiles used on the floor. The liner system components are illustrated on Figure 3.

The primary leachate collection system is composed of 10.2-centimeter diameter perforated drainage pipes that lie along the centerline of the floor, at the base of the sideslopes, and down the 'upslope' side of the access ramp. The slope of the floor directs leachate to the center of the floor, which also slopes down toward the sump areas located at the east ends of Trenches 31 and 34. The secondary leachate collection system is installed above the secondary liner system. Pumps are provided in both the primary and secondary sump areas. Collected leachate is pumped to RCRA/WAC 173-303-compliant 37,854-liter storage tanks. Trenches 31 and 34 were designed with consideration for the 24-hour peak precipitation event (3.96 centimeters) in a 25-year period.

The planned operational life of Trenches 31 and 34 is 20 years. At the time of closure, a final cover will be constructed to minimize infiltration into these trenches.

The RAP is a site-specific plan that establishes actions to be taken if leakage through the upper (primary) liner of the landfill exceeds a certain rate. The intent of the RAP is to ensure that any leachate that does leak through the primary liner does not migrate out of the landfill into the environment. A key element of the RAP is the action leakage rate (ALR), a threshold value that triggers the responses described (Section 3.0), but below which no special actions are required. Because landfill liner systems have not been perfected, a small amount of leakage through the primary liner generally occurs despite the use of best available materials, construction techniques, and quality assurance procedures. (This leakage is collected by the secondary liner system and removed from the landfill.) Hence, the ALR is set at some level higher than normally expected leakage rates to serve as an indicator that the primary liner is not functioning as expected. Exceeding the ALR might reflect serious failure of the primary liner, and indicates the need for investigation and possibly corrective action while the problem is still manageable.

This RAP has been prepared in accordance with regulatory requirements (40 CFR 264.302) and is part of the supporting material for the *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*, as amended (DOE-RL 1989). The current regulations for determining the ALR and preparing a RAP are contained in 40 CFR 264.302.

2.0 ACTION LEAKAGE RATE

The ALR is defined (40 CFR 264.302) as:

"the maximum design flow rate that the leak detection system can remove without the fluid head on the bottom liner exceeding 1 foot." Also noted in 40 CFR 264.302 are the following.

- This leakage rate must account for an adequate margin of safety for uncertainties in design, construction, and operation of the leak detection system.
- The action leakage rate must not be greater than the flow capacity of the drainage layer.
- The action leakage rate should always be less than or equal to the pumping capacity of the leak detection sump.

Thus, the ALR is based on the flow capacity of the leak detection system rather than on types and sizes of flaws in the primary liner. The EPA provides a formula based on Darcy's Law for calculating this flow capacity, assuming that it originates from a single hole in the primary liner (EPA 1992):

$$Q = k\ h\ \tan(a)\ B \qquad (1)$$

where
- Q = flow rate in leak detection system
- k = hydraulic conductivity of drainage medium in leak detection system
- h = head on secondary liner
- a = slope of leak detection system
- B = width of flow in leak detection system, perpendicular to flow direction

The major uncertainty associated with this formula is determining the value of B, which is a complex function and in part dependent on the other parameters. Additional information and guidance is provided by the EPA (EPA 1992). By assuming that the shape of the wetted area down slope from the hole is parabolic, the EPA rewrites equation (1) to read:

$$Q = k\ D\ (2h - D) \qquad (2)$$

where D = thickness of drainage layer

other parameters are the same as in equation (1)

It can be seen that equation (2) does not depend on the slope of the drainage system. This results in part from simplifying assumptions by the EPA related to the cosine of small angles being nearly equal to 1. As a consequence of this simplification, equation (2) indicates that the flow capacity of the geonet drainage layer on the landfill sideslopes would be

equal to that of the geonet on the landfill floor, all other factors being equal. While intuitively unsatisfying, this approach appears to be conservative. In addition, the added capacity of the gravel drainage layer on the landfill floor can be ignored when finding the lowest flow capacity in the system (i.e., the sideslopes). Again, the EPA approach appears to be conservative.

With respect to selecting appropriate input parameter values for use in solving equation (2), the hydraulic conductivity of the geocomposite drainage layer is based on manufacturer's test results and includes the effects of compression from the load applied by the waste. The thickness of the geocomposite layer is the combined thickness of a geonet plus two layers of geotextile, all of which conform to specifications (WHC 1995). To account for compression, the thickness of the geotextile layers was reduced by 50 percent. The head on the secondary liner system is defined as 1 foot by the regulations.

Using equation (2) and the assumed input parameters, the ALR is 2,150 liters per hectare per day per trench (40 CFR 264.302). This value includes a factor of safety of 2 in accordance with EPA guidelines (EPA 1992). It is also much lower than the pump capacity of (45,000 liters per hectare per day per trench). Thus, this ALR value satisfies all the regulatory requirements noted previously. Details of the calculation (in English units) are presented in Appendix A.

In accordance with 40 CFR 264.302, the flow rate used to determine if the ALR has been exceeded is calculated as the average daily flow rate into the sump, expressed as liters per hectare. This calculation is performed weekly during the active (operational) life of the landfill, and monthly after the landfill has been closed. Postclosure frequency might be reduced if only minimal amounts of leachate accumulate in the leak detection system sump.

3.0 RESPONSE ACTIONS

The following actions are required if the ALR is exceeded (40 CFR 264.304):

- Notify the EPA Regional Administrator and Ecology in writing of the exceedence within 7 days of the determination

- Submit a preliminary written assessment to the EPA Regional Administrator and Ecology within 14 days of the determination, as to the amount of liquids, likely sources of liquids, possible location, size, and cause of any leaks, and short-term actions taken and planned

- Determine to the extent practicable the location, size, and cause of any leak

- Determine whether waste receipt should cease or be curtailed, whether any waste should be removed from the trench for inspection, repairs, or controls, and whether or not the trench should be closed

- Determine any other short-term and long-term actions to be taken to mitigate or stop any leaks

- Within 30 days after the notification that the ALR has been exceeded, submit to the EPA Regional Administrator and Ecology the results of the analyses, the results of actions taken, and actions planned. Monthly thereafter, as long as the flow rate in the leak detection system exceeds the ALR, the owner or operator must submit to the EPA Regional Administrator and Ecology a report summarizing the results of any remedial actions taken and actions planned.

If the ALR is exceeded, the U.S. Department of Energy, Richland Operations, will submit the required notifications to the EPA and Ecology as stated previously.

The leachate will be analyzed for chemical compounds and radionuclides. If the analytical results indicate that regulated constituents are present, and if the constituents can be traced to a particular type of waste placed in a known area of the trench, it might be possible to estimate the location of the leak. However, because the waste meets land disposal restrictions (e.g., stabilized, solidified, neutralized, etc.,) and contains no free liquids, it is possible that the leachate might be clean or the composition too general to indicate a specific source location.

If the source location cannot be identified, large-scale removal of the waste and operations layer to find and repair the leaking area of the liner would be one option for remediation. However, this procedure could risk damage to the liner. In addition, waste would have to be handled, stored, and replaced in the trench. Backfill would need to be removed from the waste to accomplish this. This could cause an increase in risk of accidental exposure to operations personnel or a release to the environment. For these reasons, large-scale removal of waste and liner system materials is not considered a desirable option and will not be implemented except as a last resort.

The preferred options for remediation include covers and changes in trench operating procedures. The preferred alternative depends on factors such as the amount of waste already in the trench, the rate of waste receipt, the chemistry of the leachate (i.e., is it clean?), the availability of other RCRA/WAC 173-303-compliant disposal units, and similar considerations. Hence, at this time no single approach can be selected. If the ALR is exceeded, potential options will be evaluated before selecting a remediation process. If necessary, an interim solution will be implemented while the evaluation and permanent remediation is performed. Examples of potential approaches include the following.

- The surface of the intermediate soil cover over the waste could be graded to direct run-off into a shallow pond. The surface would be covered with a discardable, temporary geomembrane (e.g.,

0.5-millimeter polyvinyl chloride). Precipitation water would be pumped or evaporated from the pond and would not infiltrate the waste already in the trench. Waste packages would be placed only during periods of dry weather, and stored temporarily at other times. This type of approach also would be used, if necessary, to reduce leakage during the time immediately after the ALR was exceeded, while other remediation options are evaluated.

- If the trench is nearly full, partial construction of the final closure cover might be an option. This would reduce infiltration into the trench, and possibly reduce the leakage rate if the cover is constructed over the failed area.

- A layer of low-permeability soil could be placed over the existing waste, perhaps in conjunction with a geomembrane, to create a second 'primary' liner higher in the trench. This new liner would intercept precipitation and allow its removal.

- A rigid-frame or air-supported structure could be constructed over the trench to ensure that no infiltration occurs. Although costly, this approach might be less expensive than constructing a new trench.

In general, the selected remediation efforts will be those that are easiest to implement, with more difficult or expensive options to be applied only if earlier approaches are not satisfactory.

4.0 REFERENCES

DOE-RL, 1989, *Low-Level Burial Grounds Dangerous Waste Permit Application*, DOE/RL-88-20, Rev. 0, plus Supplements 1 and 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1992, *Action Leakage Rates for Leak Detection Systems*, EPA 530-R-92-004, Office of Solid Waste, Washington, D.C., January.

WHC, 1995, *Construction Quality Assurance Report*, WHC-SD-W025-RPT-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

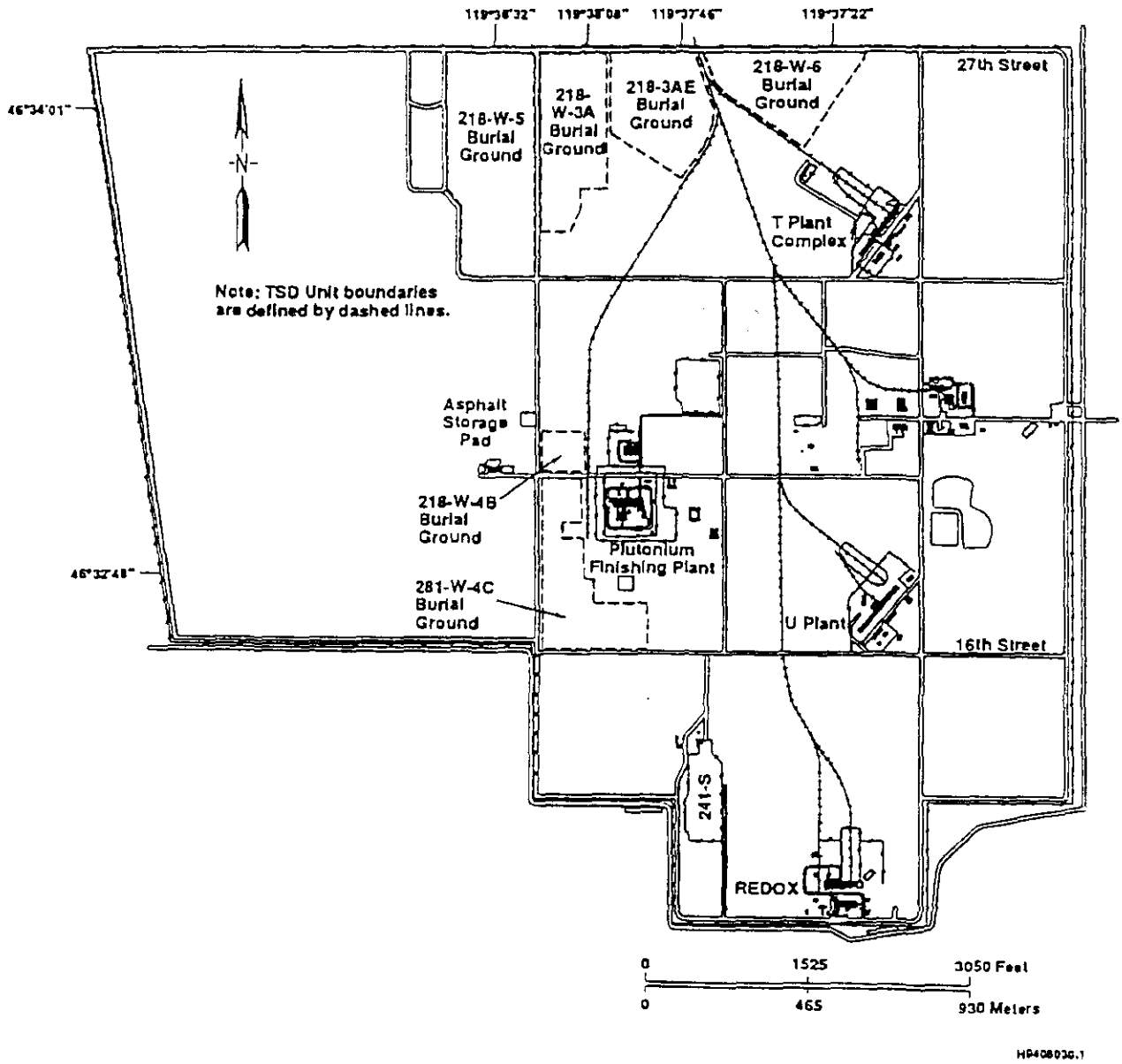

Figure 1. 200 West Area - Low-Level Burial Grounds (Trenches 31 and 34 are located in the 218-W-5 Burial Ground).

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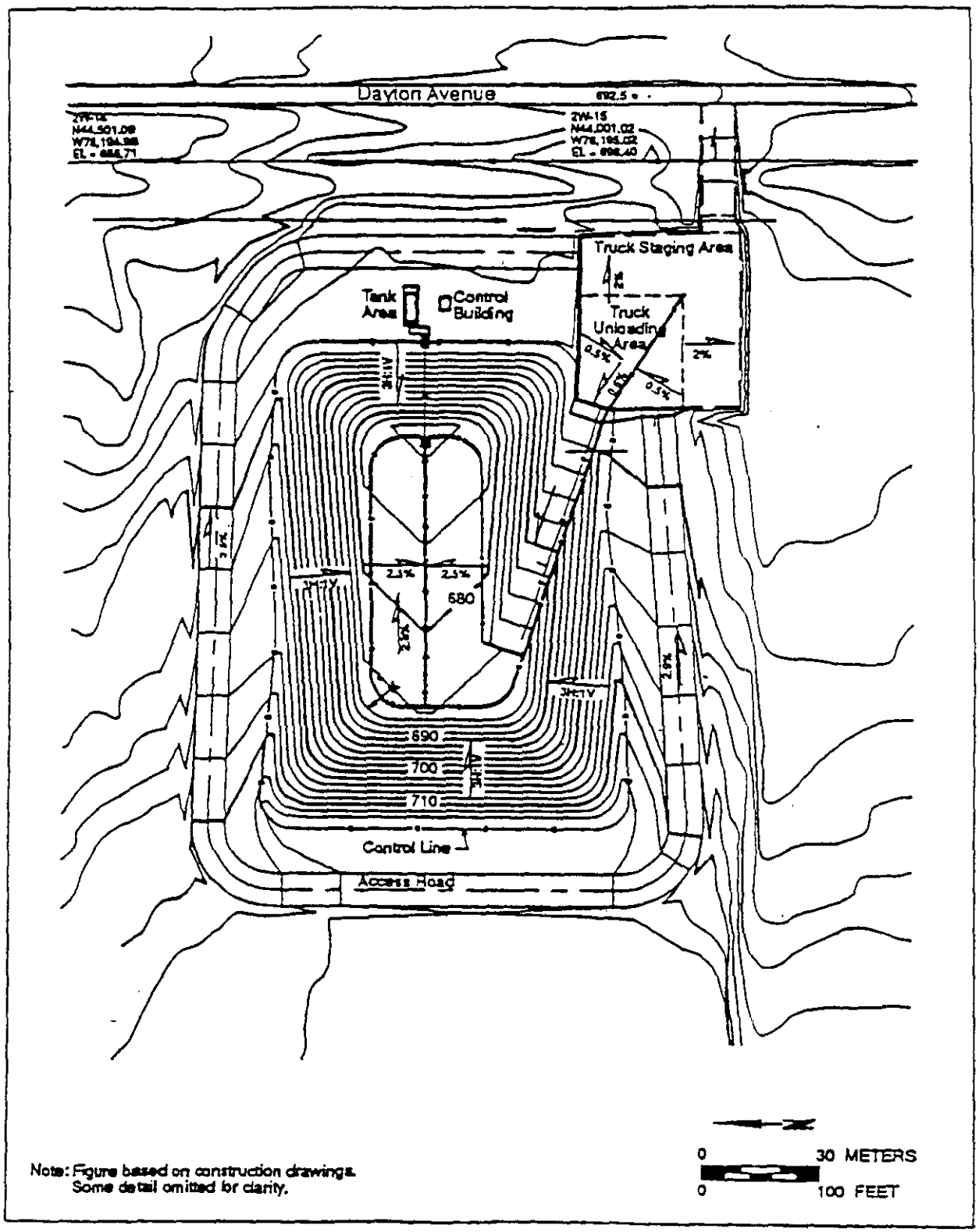

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Figure 2. Typical Trench Floor Plan.

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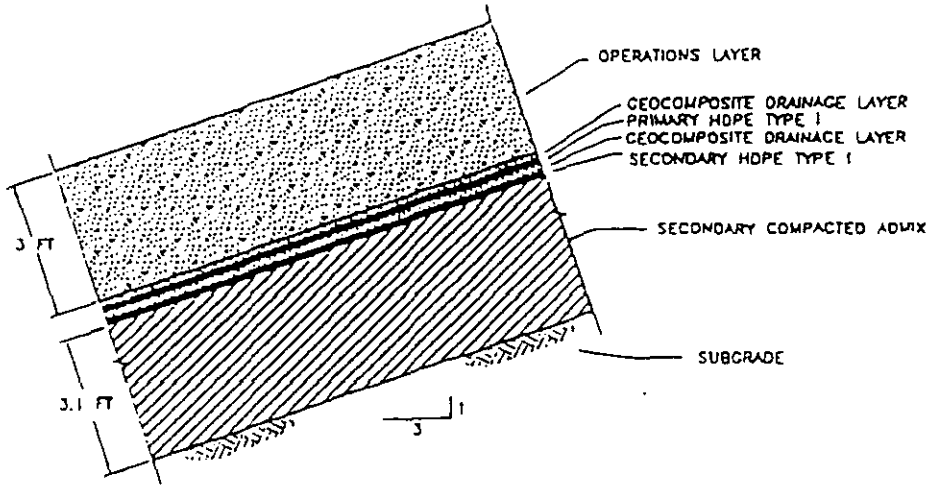
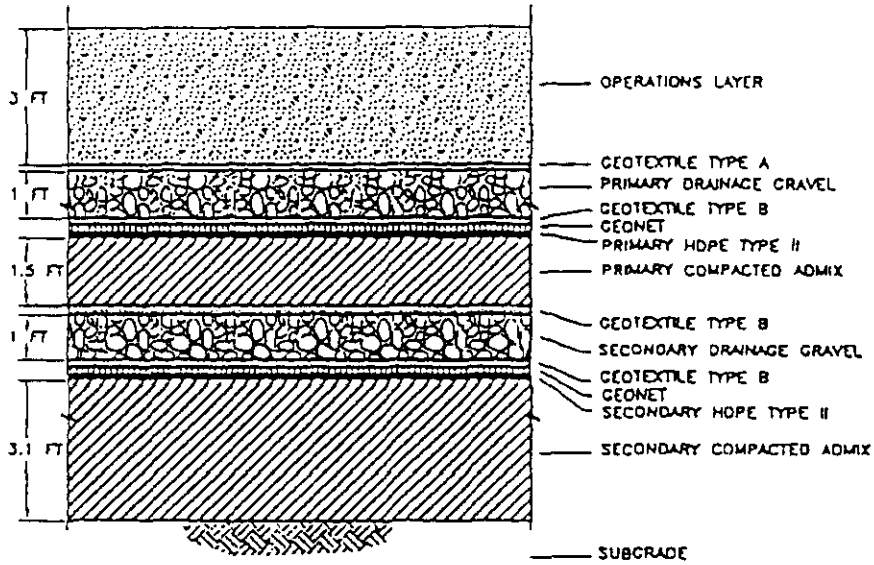


SIDESLOPE LINER DETAIL



BASE LINER DETAIL

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Figure 3. Sideslope Liner Detail and Base Liner Detail.

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APPENDIX A

ACTION LEAKAGE RATE CALCULATIONS

TRADEMARKS

TEX-NET is a registered trademark of Fluid Systems, Inc.

POLY-NET is a registered trademark of Fluid Systems, Inc.

Trevira is a registered trademark of Hochst Aktiengesellschaft

Golder Associates

SUBJECT Action Leakage Rate - W025 Landfill		
Job No. 913-1756	Made by FSS	Date 8-13-92
Ref.	Checked JPP	Sheet 1 of 10
	Reviewed	

Reference: EPA, Action Leakage Rates for Leak Detection Systems, EPA 530-R-92-004, Office of Solid Waste, Washington, D.C., January 1992.

From EPA, page 12, flow capacity of drainage layers where $h \geq D$ is:

$$Q = kD(2h - D)$$

where Q = flow
k = permeability of drainage layer
D = thickness of drainage layer
h = head in drainage layer

note that $kD = T$, the transmissivity of the drainage layer

For W-025 landfill, assume that geocomposite is Tex-Net 3002 (this material was originally specified)

Also assume that the maximum normal load results from 40 feet of waste @ 100 lbs/ft³

= 4000 psf

From transmissivity chart, Transmissivity of Tex-Net 1002 under 4000 psf load ≈ 2×10^{-4} m²/sec

From Polynet transmissivity chart, transmissivity of PN-3000 (used in Tex-Net 3002) is slightly less than that of PN-1000 (used in Tex-Net 1002).

∴ Assume transmissivity of Tex-Net 3002 = 1×10^{-4} m²/sec
= 10.76×10^{-4} ft²/sec

Thickness of geocomposite = 1 layer PN-3000 geonet + 2 layers Trevira 1125

From manufacturers' spec sheets
$D = 0.22 + 2 \times 0.095$ inches $/ 2$
$= 0.32$ inches $= 0.027$ ft

Golder Associates

SUBJECT Action Leakage Rate — W025 Landfill		
Job No. 913-1756 Ref.	Made by FSS Checked JFP Reviewed	Date 8-13-92 Sheet 2 of 10

By regulation, $h \sim 1$ ft

$\therefore Q = 10.76 \times 10^{-4}\ ft^2/sec\ (2 \times 1\ ft - 0.027\ ft)$

$= 21.73 \times 10^{-4}\ ft^3/sec$

$= 1376$ gal/day

Apply Factor of Safety = 2, per regulations

$Q = \frac{1376}{2} = 688$ gal/day

Area of W-025 = 3.0 acres (see attached sheet)

$\therefore Q = \frac{688}{3} = 229$ say $\boxed{230 \text{ gal/acre/day}}$

minimum technical requirements and other design assumptions to maximize potential head on the bottom liner, and uses a safety factor, EPA believes that the units meeting the minimum technical requirements would not require action leakage rates below 100 gpad for landfills and waste piles and 1,000 gpad for surface impoundments.

Assuming the wetted area in the drainage layer beneath a small hole leak has approximately the shape of a cone from side view and a parabola from top view, the width of the parabola (B) is:

$$B = \frac{2\sqrt{Q/k}}{\sin\alpha}\sqrt{1+\frac{2x\sin\alpha}{\sqrt{Q/k}}}$$

where x = plan distance downslope from hole (i.e., B is a function of the distance x from the hole; most of B is at the hole with only slight increases downslope).

Assuming x = 0 (i.e., looking at B under the hole, $B = \frac{2\sqrt{Q/k}}{\sin\alpha}$) and substituting this value for B into Equation 1 modified for a triangular cross-section of flow (i.e., $Q = 1/2\ k \cdot h \cdot \tan\alpha \cdot B$) and solving for Q yields:

$$Q = k \cdot h^2 \qquad \text{[Equation 2]}$$

where h = head on the bottom liner and h < thickness of drainage layer.

This equation becomes the following if the condition is changed from "h < thickness of the drainage layer (D)" to "h ≥ D" (which is important for geonet calculations):

$$Q = k \cdot D\ (2h - D) \qquad \text{[Equation 3].}$$

Solving Equation 3 using the minimum design specifications in the final rule, Q =

for .1 cm/sec: 2100 gpad
.01 cm/sec: 210 gpad
geonet: 6800 gpad.

These numbers are the same as the results given above for Equation 1.

Results Using a 3-D Model

Tables 1-4 and Figures 1-10 in Appendix B were developed from a 3-D model to show the relative effects of various design parameters and assumptions on flow capacity, and to show the shapes of the flow in the drainage layer for various designs and assumptions, including hole size and head. Appendix C gives background information on the 3-D model. The tables show that slope, length of run, and hole size have some effect on flow rate (e.g., 4% increase in flow rate when slope is increased from 1% to 2% [Tables 1, 3-5]; 1% increase in flow rate at 1% slope when

TEX-NET

Installation

No underground drainage system is easier to install than TEX-NET composite. It is a simple one-step operation. Because it is lightweight, flexible and strong, it can be rolled out in place on flat or steep slopes, around building foundations or along footings. The composite is supplied with a geotextile overlap of 2" on both edges or 5" on one edge so that continuity of drainage action can be assured from one strip of the composite to the next. TEX-NET sheets can be cut to size in the field to fit nearly any required area. It is also easily hung vertically on basement or retaining walls prior to backfilling.

By specifying TEX-NET on your next drainage project you will save considerable time and labor costs. And when compared to a sand and gravel system, extra savings can be expected through lower transportation and installation costs.

Hydraulic Properties

Transmissivity/flow charts for TEX-NET are available on supplemental data sheets. They are prepared for use by design engineers to help determine TEX-NET performance under varying conditions of pressure, hydraulic gradient and field profile. All transmissivity tests were performed in accordance with ASTM D4716 where a drainage layer is characterized by its transmissivity or $\Theta = (Q/B)/i$

TEX-NET can also be specified with non-woven polypropelene fabrics and woven monofilaments heat laminated to any style of POLY-NET. Call FSI for further details.

To determine Q (flow per unit width of TEX-NET) in actual conditions, simply multiply Θ (transmissivity m^2/sec) by i (hydraulic gradient).

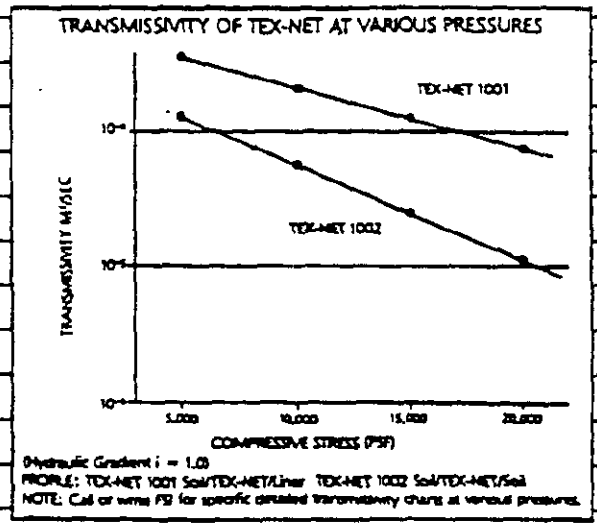
Example: TEX-NET 1001 under 4000 p.s.f. and gradient of 0.75 has a transmissivity of $1.0 \times 10^{-3} m^2/sec$.

$$Q = 1.0 \times 10^{-3} m^2/sec\ (0.75)$$
$$= 7.5 \times 10^{-4} m^2/sec$$
$$= 3.6 \text{ GPM/FT of WIDTH}$$

The information contained herein is, to the best of our knowledge, true and accurate; however, all recommendations or suggestions are made without guarantee, since the conditions of use are beyond our control. There is no expressed warranty and no implied warranty of fitness for purpose of the product or products described herein. In submitting this information, no liability is assumed or license or other rights implied or given with respect to any existing or pending patent, patent applications or trademarks. The observance of all legal regulations and patents is the responsibility of the user.

Specifications

Refer to supplemental data sheets and performance curves.



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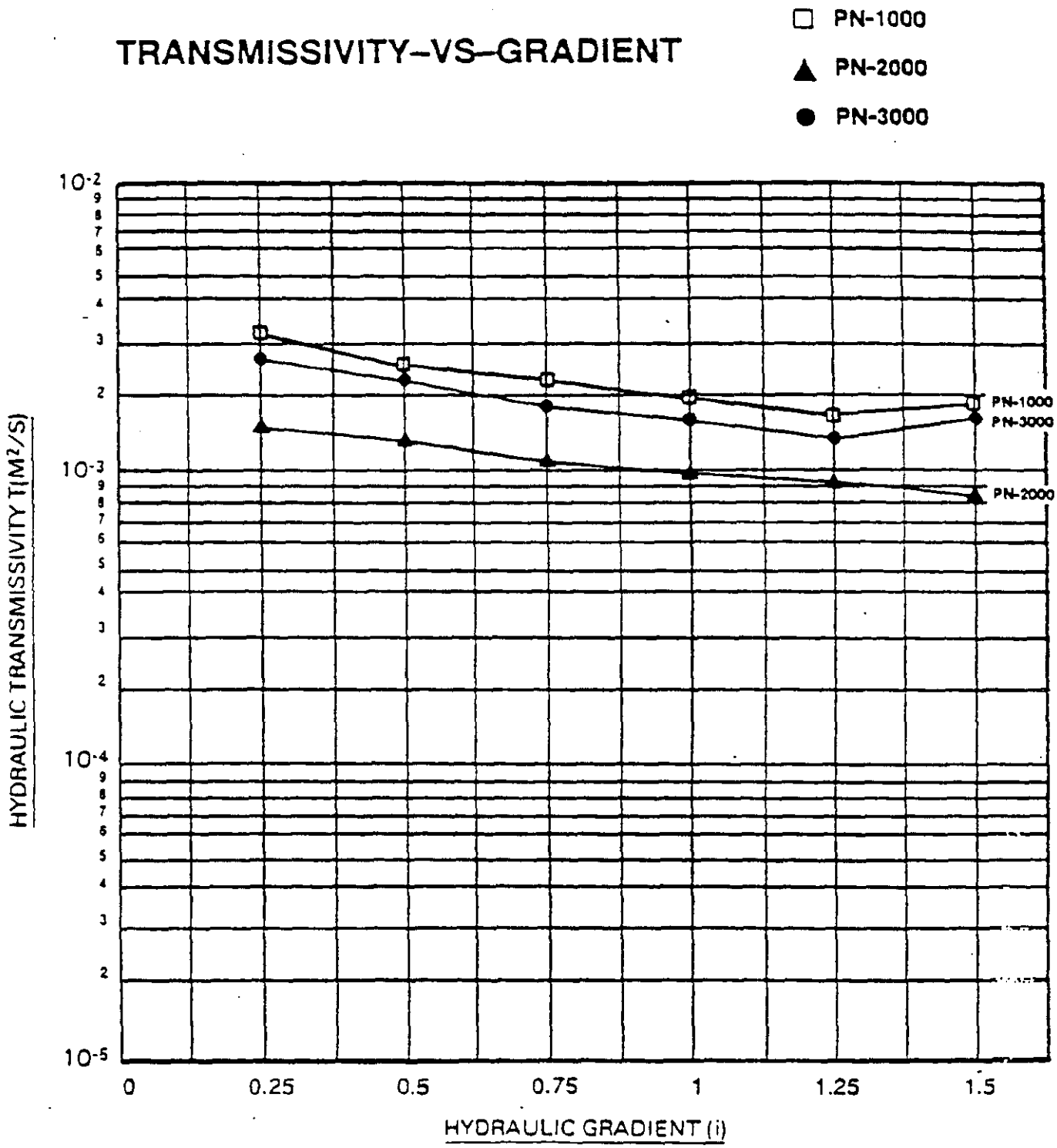
Offices in Denver and Atlanta

POLY-NET® TRANSMISSIVITY	INSTALLATION METHOD LEAK DETECTION HDPE LINER/POLY-NET/HDPE LINER	HYDRAULIC PRESSURE 4000 P.S.F.

TRANSMISSIVITY–VS–GRADIENT



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SUITE 3201
CINCINNATI, OH 45246
513/771-5656
800/346-9107
FAX - 513/771-4844

Installation

Poly-Net is easily installed by hand. On steep slopes, nets should be anchored at the top, then unrolled. On vertical walls, anchoring the net with masonry nails may be necessary.

Adjacent rolls can be easily joined by plastic ties supplied with the Poly-Net. When joining adjacent rolls in the direction of the flow, butt the rolls together, or overlap 2-4". When joints are not in the direction of flow, overlap adjacent rolls in shingle fashion. On the bottom of landfills or ponds, a 2-4" overlap is recommended to maintain flow.

Geotextiles should always be used to prevent migration of soil particles into the net, except when Poly-Net is between two geomembranes, in which case a geotextile is not necessary. Poly-Net is U.V. stabilized and can be stored outside for short periods, but care should be taken to keep them clean of mud and debris. If Poly-Net becomes dirty, simply wash out debris with a high pressure hose.

FSI
FLUID SYSTEMS, INC.
32 Triangle Park Drive • Suite 3201
Cincinnati, Ohio 45246 • FAX: 513/771-4844
513/771-5656 • 800/346-9107
Offices in Denver and Atlanta

Hydraulic Properties

Transmissivity charts for Poly-Net under various profiles, gradients, and pressures are available in the FSI transmissivity brochure.

Specifications

Refer to specifications below and FSI "suggested specification guide" brochure.

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SPECIFICATION

Details

	PN-1000*	PN-2000	PN-3000	PN-3000-CN*	PN-4000*
Raw material	polyethylene	polyethylene	polyethylene	polyethylene	polyethylene
Weight (lbs/ft²) D-3776	.165 ± 0.016	.130 ± 0.013	.180 ± 0.018	.115 ± 0.011	.245 ± 0.024
Thickness (inches) D-1777	.250 ± 0.025	.160 ± 0.016	.220 ± 0.022	.220 ± 0.022	.300 ± 0.030
Density of polymer (g/cm³) D-1505	.937 ± 0.002	.937 ± 0.002	.937 ± 0.002	.937 ± 0.002	.937 ± 0.002
Tensile strength (lb/in) D-1682	40 ± 10	38 ± 10	50 ± 10	28 ± 10	54 ± 10
Porosity	.81-.84	.81-.84	.81-.84	.81-.84	.81-.84
Roll width (feet)	7.54	7.54	7.54	7.54	7.00
Standard roll length (feet)	250	300	300	300	220
Square feet per roll	1885	2262	2262	2262	1540
Carbon black ASTM D-1603	2-3%	2-3%	2-3%	2-3%	2-3%
Nominal Transmissivity (m²/s) D-4716	See Transmissivity Charts				

*Foamed.

FSI-PN89 7.5M

Trevira® Spunbond nonwoven engineering products are highly needled fabrics with excellent tensile properties, high filtration potential and outstanding permeability.

Trevira® Spunbond Type 11 products are 100% continuous filament polyester nonwoven needlepunched engineering fabrics. They deliver a combination of advantages unmatched by any other spunbonded geotextiles. They're resistant to freeze-thaw, soil chemicals and ultraviolet light exposure.

Trevira® Spunbond nonwoven engineering fabrics offer excellent performance where the requirement is tensile reinforcement, planar flow, filtration, or separation. They are ideal for roadways, railbeds, drainage systems, pondliners, retaining walls. And much more.

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TYPICAL PHYSICAL PROPERTIES OF TREVIRA® TYPE 11 PRODUCTS

Fabric Property	Unit	Test Method	1112	1114	1120	1125	1136	1146	1166
Fabric Weight	oz/yd²	ASTM D-3776	3.5	4.2	6.0	7.5	10.5	13.5	16.5
Thickness, t	mils	ASTM D-1777	60	70	90	110	140	170	210
Grab Strength (MD/CD)[1]	lbs	ASTM D-4632	120/95	150/115	230/180	300/235	420/350	540/450	850/570
Grab Elongation (MD/CD)[1]	%	ASTM D-4632	65/75	75/85	75/85	75/85	75/80	80/80	85/85
Trapezoid Tear Strength (MD/CD)[1]	lbs	ASTM D-4533	50/40	55/50	80/75	105/95	140/125	180/165	225/200
Puncture Resistance	lbs	ASTM D-4833	55	65	95	115	155	185	225
Mullen Burst Strength	psi	ASTM D-3786	195	225	320	400	560	700	855
Water Flow Rate	gpm/ft²	ASTM D-4491	195	190	170	150	120	100	80
Permittivity, Ψ	sec⁻¹	ASTM D-4491	2.61	2.54	2.27	2.01	1.60	1.34	1.07
Permeability, k = Ψt	cm/sec	ASTM D-4491	.40	.45	.52	.58	.57	.58	.67
AOS	Sieve Size mm	ASTM D-4751	70-100 .210-.149	70-100 .210-.149	70-100 .210-.149	70-100 .210-.149	100-120 .149-.125	120-140 .125-.106	140-170 .106-.088
Standard Roll Widths[2]	ft		12.5 and 15.0						
Standard Roll Length[2]	ft		400	400	300	300	300	300	300

[1]MD = Machine Direction, CD = Cross Machine Direction. [2]Other width and length rolls are available upon request.

MINIMUM[1] PHYSICAL PROPERTIES OF TREVIRA® TYPE 11 PRODUCTS

Fabric Property	Unit	Test Method	1112	1114	1120	1125	1136	1146	1166
Fabric Weight	oz/yd²	ASTM D-3776	3.3	4.0	5.7	7.1	10.0	13.0	16.0
Thickness, t	mils	ASTM D-1777	50	55	75	95	125	150	185
Grab Strength	lbs	ASTM D-4632	80	100	160	210	305	390	500
Grab Elongation	%	ASTM D-4632	60	60	60	60	60	65	70
Trapezoid Tear Strength	lbs	ASTM D-4533	30	40	60	75	100	130	150
Puncture Resistance	lbs	ASTM D-4833	40	50	80	95	130	155	195
Mullen Burst Strength	psi	ASTM D-3786	170	190	275	360	510	640	760
Water Flow Rate	gpm/ft²	ASTM D-4491	155	150	130	110	80	60	40
Permittivity, Ψ	sec⁻¹	ASTM D-4491	2.07	2.01	1.74	1.47	1.07	0.80	0.53
Permeability, k = Ψt	cm/sec	ASTM D-4491	.26	.28	.33	.35	.34	.31	.25
AOS	Sieve Size mm	ASTM D-4751	50 .300	50 .300	70 .210	70 .210	70 .210	100 .149	100 .149

[1]These minimum values represent minimum test values determined from Q.C. testing on all lots produced in 1989. Certified "Minimum Average Roll Values" representing the industry standard of a 95 percent confidence level (i.e. mean less two standard deviations) may be higher than these values and are determined for each production lot. Please contact your Trevira® Distributor or Hoechst Celanese Corporation for additional information.

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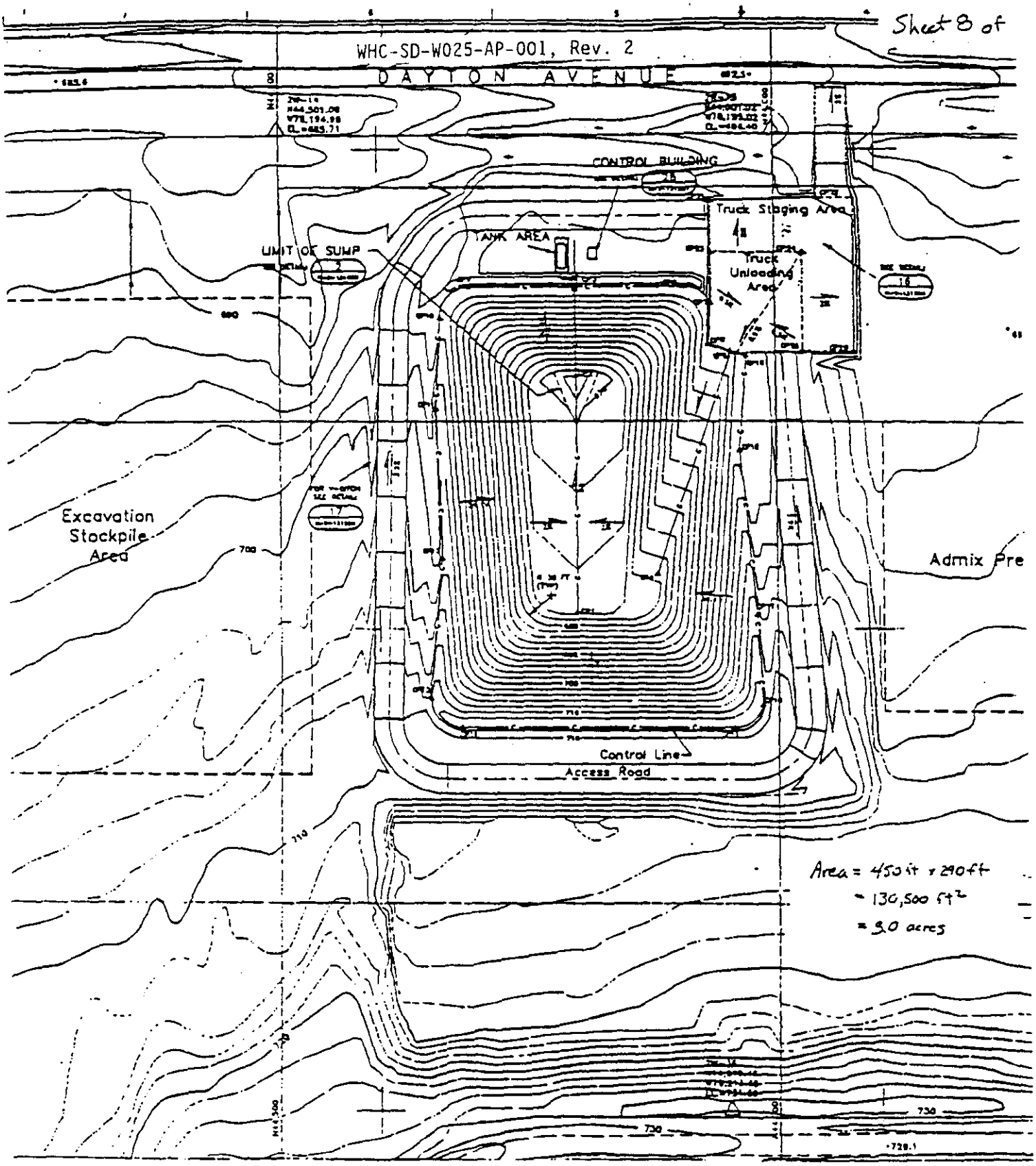

DAYTON AVENUE
CONTROL BUILDING
Truck Staging Area
TANK AREA
LIMIT OF SUMP
Truck Unloading Area
Excavation Stockpile Area
Admix Pre
Control Line
Access Road
Area = 450 ft x 290 ft
= 130,500 ft²
= 3.0 acres
N

Golder Associates

SUBJECT Action Leakage Rate - W025 Landfill

Job No. 913-1756	Made by FGS	Date 8-13-92
Ref.	Checked JPP	Sheet 9 of 10
	Reviewed	

Pump Capacity: from Specifications, pump is Gandfos 7503-B

from attached curve, capacity is at least 10 gpm (head ≈ 40 ft)

10 gal/min × 60 min/hr × 24 hr/day = 14,400 gal/day

required: ALR = 230 gal/acre-day × 3.0 acres = 690 gal/day

∴ Pump has more than enough capacity to remove ALR volume.

MODEL 7S

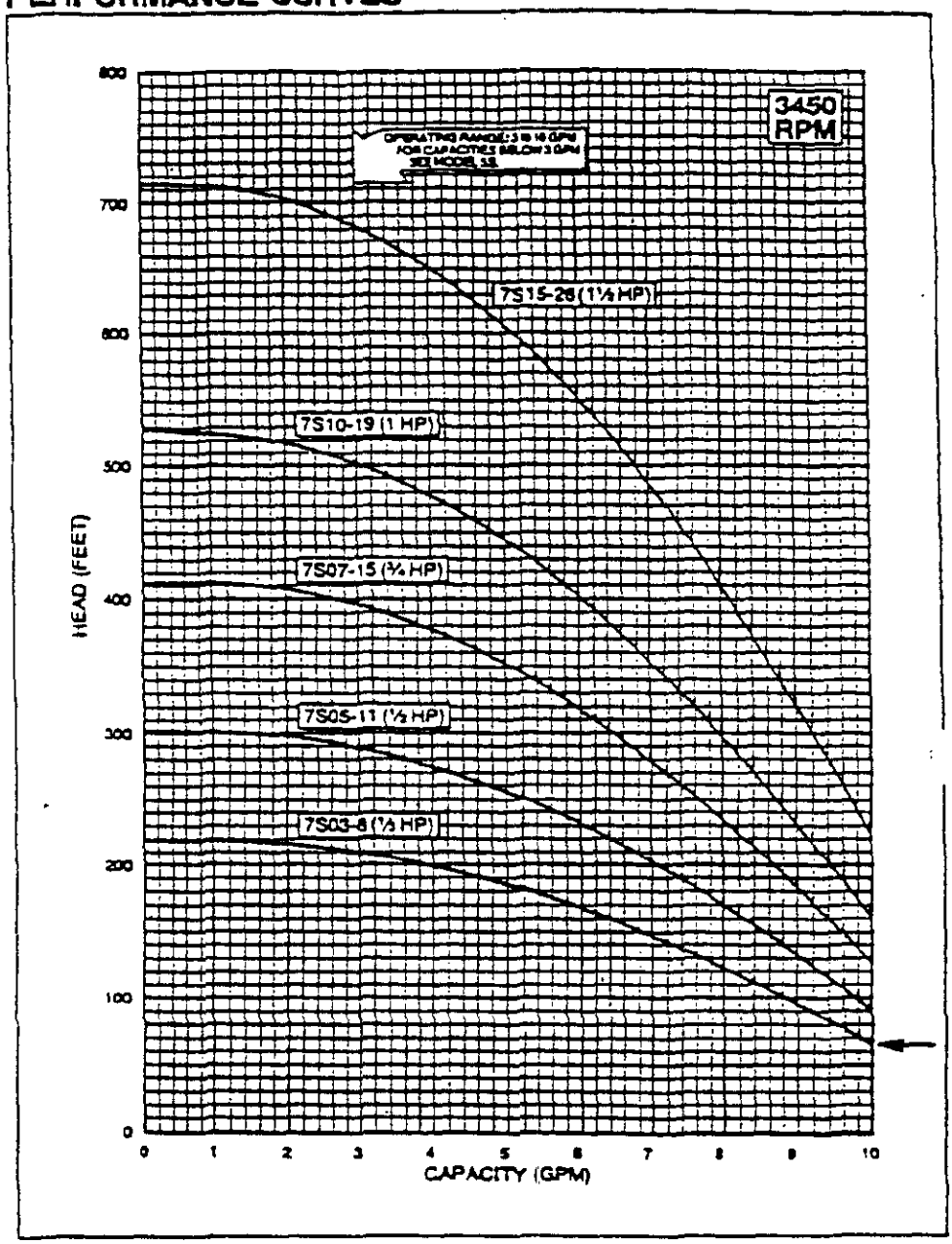
7 GPM

GRUNDFOS

FLOW RANGE
3 to 10 GPM

PUMP OUTLET
1" NPT

PERFORMANCE CURVES



DIMENSIONS AND WEIGHTS

MODEL NO.	HP	LENGTH (INCHES)	WIDTH (INCHES)	APPROX. UNIT SHIPPING WT. (LBS.)
7S03-8	⅓	23½	3 15/16	27
7S05-11	½	26⅞	3 15/16	30
7S07-15	¾	30¾	3 15/16	33
7S10-19	1	34⅝	3 15/16	36
7S15-26	1½	42	3 15/16	46

Specifications are subject to change without notice.