WARZYN

Engineers & Scientists
Environmental Services
Waste Management
Water Resources
Site Development
Special Structures
Geotechnical Analysis

December 21, 1989

Ms. Theresa Evanson
Wisconsin Department of Natural Resources
Bureau of Solid and Hazardous Waste Management
101 S. Webster Street, GEF II
Madison, Wisconsin 53707

Re: Copies of Correspondence
Interim Remedial Measures
Refuse Hideaway Landfill
Project No. 13928.41

Dear Ms. Evanson:

Enclosed is one (1) copy of the December 1989 Engineering Design report, entitled "Partial Gas and Leachate Extraction System", Warzyn Project No. 13928.41. It includes the enclosed text and Warzyn Drawings 13928-1 through 13928-7. These documents are being provided to you for distribution to Mr. John DeBeck, per your request. The estimated cost to reproduce the design text and drawings is $28.00.

If you have any questions or comments regarding the above subject matter, please contact us.

Sincerely,

WARZYN ENGINEERING INC.

Joel V. Schittone

Joel V. Schittone, P.E.
Project Manager

BEM/dlk/JVS
[jlv-112-53]

Warzyn Engineering Inc
One Science Court
University Research Park
P.O. Box 5385
Madison, Wisconsin 53705
(608) 273-0440

WARZYN

Engineers & Scientists
Environmental Services
Waste Management
Water Resources
Site Development
Special Structures
Geotechnical Analysis

December 19, 1989

Ms. Theresa A. Evanson
Wisconsin Department of Natural Resources
Bureau of Solid and Hazardous Waste Management
101 S. Webster Street, GEF II Building
Madison, Wisconsin 53707

Re: Engineering Design/Partial Gas and Leachate Extraction System
Interim Remedial Measures
Refuse Hideaway Landfill
Agreement No. 81217.89-2
Project No. 13928.41

Dear Ms. Evanson:

Enclosed are three copies of the Engineering Design for the Partial Gas and Leachate Extraction System for the Refuse Hideaway Landfill project. The design includes the enclosed text and separate drawing set.

Draft design drawings and calculations were submitted to the Wisconsin Department of Natural Resources (WDNR) for review on November 1 and 3, 1989, respectively, and much of the contents of the enclosed text were discussed with the WDNR during several meetings and telephone conversations. Subsequent comments made by the WDNR have been incorporated into this document.

If you have any questions, please contact us.

Sincerely,

WARZYN ENGINEERING INC.

Brian E. McVean
Project Engineer

Joel V. Schittone, P.E.
Project Manager

JVS/kjw/JVS [wpmisc-112-54] 13928.41

Enclosure: Engineering Design-Partial Gas and Leachate Extraction System (3)

cc: Ms. Susan M. Fisher - WDNR
Mr. Mark Giesfeldt - WDNR
Ms. Sally Kefer - WDNR (w/o encl)

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Partial Gas and Leachate Extraction System Interim Remedial Measures Refuse Hideaway Landfill Town of Middleton Dane County, Wisconsin

December 1989

TABLE OF CONTENTS

DRAWINGS

APPENDICES

WARZYN

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
DANE COUNTY, WISCONSIN

INTRODUCTION

General

The Wisconsin Department of Natural Resources (WDNR) has retained Warzyn Engineering Inc. (Warzyn) to provide engineering and construction services in relation to Interim Remedial Measures at the Refuse Hideaway Landfill (Landfill). The Landfill is located in the Town of Middleton, Dane County, Wisconsin and has been identified as a source of groundwater contamination, including the presence of volatile organic compounds (VOCs) at three local residential water supply wells. Additionally, off-site migration of landfill gas, in excess of the lower explosive limit (LEL) of methane has been recorded.

As an interim remedial measure to address these environmental contamination/hazard issues, Warzyn is providing a partial gas and leachate extraction system in a design-build format. This work is being performed under Agreement No. 81217.89-2, and is described in Warzyn's May 1989 Proposal (Proposal No. 81217.89), and October 9 and 19, 1989 documents entitled "Revised Scope of Work" (Project No. 13928.40).

Purpose and Scope

This design document, consisting of Warzyn Drawings 13928-1 through 13928-7 and this text, will provide the WDNR an opportunity to review the proposed partial gas and leachate extraction system design. Draft design drawings and calculations were submitted to the WDNR for review on November 1 and 3, 1989, respectively, and much of the contents of this text were discussed with the WDNR during several meetings and telephone conversations. Subsequent comments made by the WDNR have been incorporated into this document.

The intent of this partial leachate and gas extraction system is to: 1) evaluate leachate drawdown data and the gas well radius of influence and gas flow characteristics, for use in final design of a full gas and leachate extraction system; and 2) to reduce leachate head levels in the landfill and reduce off-site migration of landfill gas. This partial system design includes two gas/leachate extraction wells, three leachate/gas monitoring wells, buried gas header and leachate conveyance piping, blower and flare stations and a leachate holding tank.

As part of the partial system design activities, Warzyn designed a conceptual layout for a full gas and leachate extraction system. To minimize future construction costs and minimize duplication of efforts, Warzyn has designed this partial system to be compatible with the conceptual full system design. It is anticipated that the five wells (two extraction and three monitoring), buried piping, blower station and leachate (and condensate) holding tank will be directly incorporated into the full system when it is installed. The partial system flare station will be available as a back-up flare for the full system. Refer to Drawing 13928-1 for the partial system layout.

DESIGN

General

Design of this partial system includes the installation of two gas/leachate extraction wells (extraction wells) located along the southern perimeters of the site (within the refuse fill limits). The conceptual full system design includes a total of thirteen extraction wells, five of which are to be located along the southern perimeter. Because of the potential for elevated leachate levels along the southern perimeter, Warzyn was directed by the WDNR to size the partial system for a minimum of five extraction wells, assuming that only two were to be installed initially.

Because it is anticipated that a full system will be installed in the near future, as much of the partial system was designed for incorporation into the

conceptual full system as economically feasible. For example, the wells, buried piping, blower station and and the leachate holding tank have been sized for the anticipated full system design capacities.

The full system design referenced is a conceptual plan and is based on Warzyn's past experience in gas and leachate extraction system designs and utilizing minimal site-specific data from this Landfill. A full system will be designed by Warzyn under the current Agreement after pump test data is available from the partial system.

Gas Collection and Conveyance

Basis For Design

The proposed landfill gas (LFG) extraction system is designed to extract methane gas produced by anaerobic decomposition of refuse. Refer to Appendix A for an estimate of gas flow generation and the assumptions made. The gas/leachate extraction wells serve the dual purpose of extracting gas as well as leachate. A vacuum will be created to withdraw gas from the Landfill, which will then be burned in a flare. System performance may depend on the permeability of the fill, and refuse composition, moisture content, placement and compaction techniques.

Gas/Leachate Extraction Wells

Each gas/leachate extraction well will be constructed of a non-perforated section of 6-in. diameter Schedule 80 polyvinyl chloride (PVC) pipe extending into a perforated section of 8-in. diameter Schedule 80 PVC pipe. The well pipes will be placed in 36-in. diameter boreholes, with the annular space around the perforated portion of the pipe consisting of a clear stone pack (refer to Detail 1 of 2 on Drawing 13928-2). The wells will extend to the base of the Landfill. A bentonite seal will be installed at the bottom of the borehole. The partial system has been conservatively sized to draw a suction of 10 in. water column, gauge (WC) at 50 standard cubic feet per minute (SCFM) at each well.

Wells will be constructed with perforated pipe extending from the well bottom to approximately 20 ft below the Landfill surface. A 6-in. x 8-in. PVC

reducing slip coupler will provide a telescoping connection at the location where the 6-in. diameter non-perforated well pipe slides into the 8-in. diameter perforated pipe. This coupling was provided to attempt to compensate for landfill settlement. It is anticipated that wells will range from 49 ft to 52 ft in depth. The radius of influence is estimated to be a minimum of 150 ft, based on field experience at previous sites.

Each well head assembly will include a flexible tubing connection to the gas header pipe to allow for differential settlement. A butterfly valve will be provided at each well for control of gas flow rate. Ports will be provided on each well for gas sampling and flow rate measurement. In addition, two 1-in. diameter PVC pipes will be installed at each well to allow liquid level measurement without dismantling the well head. The well head assemblies will be insulated to minimize the potential for freezing of condensate in the winter. Refer to Detail 1 of 3 on Drawing 13928-3 for a typical well head detail.

Gas Header Piping

The gas header system will transport the landfill gas from the extraction wells to the blower station and will be constructed with provision for extension in the future by providing blind flanges in the gas header system at key locations. The pipe inverts will be installed a minimum of 4 ft below final grade for frost protection and to minimize condensate formation. A continuous warning ribbon and tracing wire will be installed above the pipe to alert excavators of the pipe location and aid in locating the pipe in the future. To allow for potential differential settlement, liquids drainage, and removal of condensate formed in the pipes, a minimum slope of 2.0% will be maintained in the headers. Typical pipe bedding details are shown on Drawing 13928-3.

Trenching/Cover Restoration

The gas header and leachate conveyance pipes within the landfill refuse limits will be placed in the same trench (see Detail 2 of 3 on Drawing 13928-3). The trench will be constructed through the landfill cover and may extend into the uppermost layer of refuse. The landfill cover areas disturbed will be

restored to a condition equal to or exceeding the condition of the existing cover at that location. Clay materials and placement methods will be in conformance with s. NR 504.07(4), Wisconsin Administrative Code.

Blower Station

The LFG blower has been sized to draw gas from the wells and discharge it at a pressure suitable for proper flare operation. Blower sizing calculations are addressed in Appendix B. The New York Blower pressure blower selected is suitable for the full system's flow rate of approximately 650 SCFM and the vacuum/pressure requirements of the two- or five-well partial system. The blower can be upgraded by changing wheel and motor sizes to supply the pressure needed for full system operation, based on available data.

A flame arrestor will be installed at the inlet of the blower to isolate the header system and well field from an explosion or flame initiated at the blower station. A butterfly valve will be installed ahead of the flame arrestor to assist in controlling and balancing the system. Ports will also be provided on the blower inlet piping for monitoring of gas flow rate and for pressure and gas sampling.

Flare Station

LFG extracted from the wells will be combusted on-site by a VAREC 239A Series Waste Gas Burner. The Varec 239A flare is suitable for burning saturated, low BTU waste gas and will have an optional cycling electric pilot ignitor. LFG will be used as the pilot gas. The 6-in. diameter flare has the capacity to handle flows from the two-well extraction system as well as having the added capacity to handle a five-well extraction system. Flare sizing calculations and a detailed description of the Varec 239A Series Waste Gas Burner are included in Appendix C. A flame arrestor will be placed at the inlet of the flare to isolate the system from an explosion or flame initiated at the flare.

A condensate dripleg (DL2) will be placed between the blower and the flare to collect and drain condensate formed in the gas discharge pipe. Condensate will be routed by gravity to the leachate holding tank. Dripleg DL2 is illustrated on Detail 2 of 4 on Drawing 13928-4.

Condensate/Driplegs

Condensate produced by the cooling of the saturated gas mixture in the gas header system will be removed using a dripleg assembly. A dripleg consists of a liquid-filled trap and a connection to the leachate conveyance system, where it will then drain to the leachate holding tank. Dripleg DL1 is located within the refuse limits, on the gas header piping connecting the extraction wells and the blower station. Dripleg DL2 is located between the blower and flare to collect and drain condensate formed in the gas discharge pipe. Refer to Drawing 13928-4 for dripleg details. Condensate flow is estimated to be negligible.

The leachate/condensate conveyance pipes located outside the landfill refuse limits will be encased in 2 ft of compacted clay (see Detail 3 of 3 on Drawing 13928-3). Clay materials and placement methods will be the same as for cover restoration activities performed during trenching activities. In-situ soils excavated will be used to supplement the clay backfill in trenches located outside the landfill refuse limits.

Leachate Collection and Conveyance

Leachate Pump

A Grundfos Model 5S 4-in. diameter stainless steel submersible pump will be installed in each well found to have an elevated leachate level. The pump's flow rate capacity ranges from 2 to 7 gpm, depending on the liquid head. Refer to Appendix D for pump sizing calculations and pump specifications. The submersible leachate extraction pump will discharge through a 1-in. diameter hose which will be piped through stainless steel (SS) fittings mounted in the well head. The well pump will be suspended by a stainless steel cable for ease of removal. After exiting the well head, the leachate discharge pipe will transition from SS to HDPE and extend below grade for connection to the 6-in. SDR 17 HDPE gravity leachate conveyance pipe. This pipe will convey leachate to the leachate holding tank by gravity flow. The leachate discharge piping at the well head will be heat traced and insulated. Refer to Drawings 13928-2 and -3 for applicable details.

The wells are designed so that pumps will be placed as close to the well pipe bottom as possible while minimizing the intake of accumulated sediment. Controls for each pump will be mounted in a control panel and include a manual shut-off switch, elapsed time meter and an automated pump controller. The pump controller includes a timer which activates the pump at pre-set intervals ranging from 15 minutes to 5 hours, and an amperage/flow sensing device which will shut off the pump when the well runs dry. Once the pump is activated by the timer, it will operate until the well runs dry, at which time it will be shut off by the amperage/flow sensing device. The pump will then remain off for the pre-set time interval.

Leachate Conveyance Piping

The leachate conveyance piping will be placed in the same trench with the gas header piping (see Detail 2 of 3 on Drawing 13928-3). The gravity leachate conveyance piping has been sized for compatibility with the full system design assuming open channel flow and discharge from each well to be 2 to 7 gpm (see Appendix D). The flow contribution from condensate is assumed negligible.

Leachate Holding Tank

A double-wall steel STI-P_3 tank will be installed below grade. The 25,000 gal tank was selected based on an estimate of the future steady state leachate production after the standing head has been drawn down (see Appendix D). The double-wall STI-P_3 steel tank was selected because of monitoring capabilities of the interstice, warranty, cost, delivery time and compatibility with leachate. The interstice will be monitored with a conductivity sensor which will shut down the well pumps in the event moisture is detected between the tank walls. Additionally, this alarm will activate an audible alarm and warning light on-site, with capability for future telemetry (through a modem and phone connection).

The leachate holding tank will have two, high-level float sensors which will sound an alarm when triggered. This alarm will also shut down the well pumps, activate an audible alarm and warning light on-site (different colors for the different alarm conditions), with capability for future telemetry. Two

independent float sensors have been included as a redundant safety precaution to minimize the risk of having leachate overflow from the tank. Leachate and condensate will be pumped from the holding tank on a regular basis.

The leachate holding tank will be ballasted with deadmen to minimize the potential for buoyancy. The Steel Tank Institute (STI) will warranty the tank for 30 years provided the installation is in accordance with their standards. This STI-P_3 system relies heavily on the cathodic protection attached to the tank. To facilitate piping access, a STI-86 containment system has been included which will contain tank piping in a 42-in. diameter manway with a ladder. For details of the leachate holding tank and STI-86 containment system, refer to Drawing 13928-6.

Leachate Removal and Disposal

Leachate will be removed from the holding tank by a suction stand pipe with a quick-connect coupling for tanker truck suction pump adaptability. A leachate loadout facility drain pipe has been included for a future full system loadout apron to convey potential spills back to the tank. The pipe will be temporarily capped during partial system construction. It is anticipated that initially there may be frequent tank truck loading due to the high volume of standing leachate in the landfill. After this standing head has been drawn down, it is estimated that a steady state condition would require a less frequent tank truck load out. We are anticipating that a leachate acceptance agreement will be made between WDNR and Madison Metropolitan Sewage District (MMDS) for ultimate acceptance and treatment of the leachate. Tanker trucks will transport the leachate and condensate mixture to the MMDS Wastewater Treatment Plant after the agreement is made.

Leachate/Gas Monitoring Wells

Basis For Design

Three leachate/gas monitoring wells (LH4, LH5 and LH6) will be installed between the two gas/leachate extraction wells. These monitoring wells will be constructed with multi-depth probes and will be spaced at horizontal intervals of 25, 50, 50, and 90 ft, respectively, between extraction wells GW1 and GW2

(refer to Drawing 13928-1 for leachate/gas monitoring well locations). These monitoring wells have been designed and located to provide the capability to monitor leachate head levels and LFG pressures and quality both before and after partial system operation. This data will be used to evaluate the effectiveness of the partial system and aid in determining the extraction well spacing during full system design activities.

Monitoring Well Design

Each leachate/gas monitoring well will consist of a single 6-in. diameter Schedule 80 PVC leachate head monitoring well and three 1-in. diameter Schedule 80 PVC gas monitoring probes, all placed in a 3-ft diameter borehole (see Detail 2 of 2 on Drawing 13928-2). The leachate head well will extend to approximately 1 ft off the landfill base, with the bottom 10 ft screened (perforated). The three gas monitoring probes will be placed at different elevations within the borehole with each screened interval sealed with bentonite. The three gas monitoring probes will be set at approximately the same elevations relative to each of the leachate/gas monitoring wells, to better evaluate the extraction well performance.

Temporary Storage, Sampling and Characterization of Excavated Waste

Characterization of waste excavated during drilling activities is required before the waste can be permanently disposed. Wastes derived from drilling of the extraction and monitoring wells will serve as "test borings" for collection of samples of the waste excavated during the gas header and leachate conveyance piping installation. These wells will be spaced on the order of 25 to 90 ft on-center and wastes penetrated are anticipated to be representative of the wastes excavated during trenching activities. Waste excavated will be temporarily stored on-site in a manner which allows for accessibility and identification. Completion of characterization testing will indicate if the refuse possess characteristics of a hazardous waste. If the waste is characterized as hazardous, it will be removed and disposed off-site; otherwise it will be permanently disposed on-site.

It is estimated that refuse excavated in the construction of the extraction and monitoring wells will include approximately 100 cu yd of material. This material will be contained on-site, such that it will not be wind blown and exposure to precipitation and surface water run-on will be minimized.

Temporary Storage

The excavated refuse will be temporarily stored in a containment cell constructed as follows:

- Existing cover soils will be removed and salvaged (a minimum of approximately 1 ft of soils will remain above the waste);
- A synthetic membrane (plastic sheeting or tarps) will be placed and covered with approximately 1 ft of cover soils (to form a temporary liner);
- The cell will be graded such that surface water run-on will be diverted around the contaminant cell and water exposed to waste, if any, will be contained;
- Waste materials will be covered with a synthetic membrane to minimize exposure to water.

The containment cell will be constructed along the western perimeter of the site, near the top of the saddle area. See Drawing 13928-1 for approximate location.

As the drilling process or trenching operations proceed, waste representative of each composite sample (i.e., either from above or below the leachate in wells or of visually suspicious waste from trenching) will be segregated in the temporary containment cell. This will be performed so that waste representative of each composite sample can later be identified and separated from other wastes if characterization testing indicates hazardous characteristics.

Sampling Procedure for Excavated Waste

As drilling of wells proceed, two grab samples visually representative of the waste being penetrated will be obtained at 5 ft intervals (maximum). These samples will be placed in 32 oz. glass jars, labeled and temporarily stored

until the well is completed. One of the samples from each 5-ft interval will be identified as "duplicate" and be retained as a record of the material penetrated.

When the well is completed, grab samples will be separated into two groups; those above the leachate level and those below the leachate level. A composite sample from each group will be obtained by emptying the contents of all grab sample jars in the group on a hard, flat HDPE-lined surface, or in the laboratory. The sample will be quartered and split in a manner consistent with ASTM Method C702, Method B, "Standard Practice for Reducing Field Samples of Aggregate to Testing Size". Two composite samples from each group obtained by the above method will be placed in 8 oz. labeled glass jars. One of these composite samples from each group will be identified as "duplicate".

In addition to the composite samples gathered during the drilling operation, samples of visually suspicious waste excavated during trenching activities will be sampled for analysis by EP toxicity testing.

Characterization of Excavated Waste

An EP toxicity test (in accordance with "Test Methods for Evaluating Solid Waste-Physical/Chemical Methods" Method SW1310) will be performed on each composite sample. The waste which the composite sample represents must be disposed of as a hazardous waste if the extract of the sample contains concentrations above the maximum limits listed in 40 CFR 261.31 - 261.33.

Disposal On-Site

Excavated refuse not characterized as hazardous, will remain in the temporary containment cell and be buried. The procedure for burial at the containment cell will include removal of the surface cover membrane and then puncturing the synthetic liner, such that a perched leachate condition will not occur. The refuse containment cell will then be expanded to include the refuse generated by trenching activities, if required. The landfill cover will be restored to a condition equal to or exceeding the condition of the existing cover at that location. Clay materials and placement methods will be the same

as for cover restoration activities performed during trenching activities. Final cover will be graded in a way such that positive drainage and smooth final contours will result.

Disposal Off-Site

In the event excavated refuse is characterized as hazardous, some or all of the refuse will be disposed of off-site as a hazardous waste. This will involve permitting and possibly additional characterization, volume estimation, potentially out-of-state haulage by a licensed hazardous waste hauler and the associated permitting and disposal fees.

CONSTRUCTION OBSERVATION

Construction of the partial system will be documented by video, still photographs, record drawings and field reports. This information will be incorporated into a Construction Observation Report and submitted to the WDNR.

In addition, soil testing of the clay bedding and cover soils will be performed during construction. Field density tests will be performed at approximately 100 lin. ft intervals, per lift, along the trenches. A Troxler Model 3411-B nuclear density/moisture meter will be used to perform the density tests. Modified Proctor curves will be developed for each 2500 cu yd of clay placed. Grain size and Atterberg limits of the clay will also be determined. Laboratory hydraulic conductivity tests of undisturbed Shelby tube samples will be conducted for each 5000 cu yd of clay placed. The results of the aforementioned field tests will also be presented in the Construction Observation Report.

SYSTEM PERFORMANCE STANDARDS

Purpose

The following performance standards have been developed to demonstrate in the field that the piping, blower, flare, submersible pumps and leachate holding tank can meet or exceed the specifications presented in this document. It may not be possible to duplicate the performance standards specified by the

equipment manufacturer's specifications if the necessary quantity or quality of LFG or leachate is not available from the Landfill, or if other environmental conditions are not adequate (e.g., temperature, pressure, etc.). However, documentation of the performance standards can be adequately demonstrated to satisfy the intent of the specifications.

Piping

Gas header and leachate conveyance piping will be pressure tested. The pipes will be air pressurized to 3.5 psi (gauge pressure) prior to closing the valve on the pressurizing unit. The valve will then be closed and the pressure monitored. A pressure of 3.0 psi or greater maintained for thirty minutes after the valve closing will be considered acceptable.

Blower

The blower performance will be verified by measuring air flow through the blower and suction and positive pressures developed at the blower. The blower will be rated for 650 SCFM at 40 in. Static Pressure, 3321 RPM, 8.5 BHP at 0.0676 lb/cu ft air.

Flare

The flare performance will be checked in accordance with the manufacture's recommendations. The burning capacity of the flare is rated at 20,100 cubic feet per hour (CFH) in air at 60°F and 14.7 PSIA at 1/2 in WC pressure drop, at sea level.

Submersible Pumps

The performance of the submersible leachate extraction pumps to be installed in the extraction wells will be demonstrated before being installed in the wells. The pumps will be placed in a 55 gal drum of clean water at approximately 20°C and then run through a temporary piping setup consisting of a pressure gage and ball valve. The pressure gage will be installed as close as possible to the pump discharge and will be used to determine the head on the pump. The ball valve will be used to control the discharge flow. The pumps will be turned on and will discharge into a container with a known volume. The time it takes the pump to fill the container will also be

recorded. The flow rate can be determined by applying the time it takes to fill the container to the volume of the container. Also, the head on the pump will be determined by converting the pressure read from the pressure gage into feet of head.

The determined flow rate and head will be used in conjunction with the manufacturer's performance curves to verify pump performance. Additionally, after system startup the pump run time will be compared with volume in the leachate holding tank (as a rough check).

Leachate Holding Tank

During the tank installation, continuity testing will be performed to demonstrate that the tank is electrically isolated from ground throughout to maintain the cathodic protection and warranty. The cathodic protection test post at the control panel will be an ongoing check on the cathodic protection. The float switches and interstitial monitoring equipment will be tested in accordance with the manufacturer's recommendations.

Additionally, the tank manufacturer will pressure test the tank and interstice both at the factory and on-site. These tests will be performed in accordance with the Petroleum Equipment Institute Recommended Practices (PEI/RP100).

JCK/kjw/JVS/SGW
[wpmisc-600-54]
13928.41

APPENDIX A

GAS FLOW ESTIMATE

WARZYN

A. Objective – Determine gas flow generated by refuse decomposition within the Refuse Hideaway Landfill.

B. Assumptions –

Refuse accepted, Nov. 1974 – May 1988 (say 14 years)

Refuse received, majority was commercial & residential (Characteristics as described on pg 2 of 4)

Refuse density, assuming light compaction – 1000 lbs/cy

Refuse Volume, estimated at 1,500,000 cy (Volume estimated by Warzyn Oct. 31, 1989 using Base grade information from RMT, Inc. In-field Conditions Report Jan. 1988 and Existing Final Grade information from Warzyn Drawing 13928-1 Nov. 1989)

C. Calculations –

Refuse placed per year; (assumed average)

$1{,}500{,}000 \text{ cy} \times 1000 \text{ lb/cy} \times 1 \text{ ton}/2000 \text{ lb} = 750{,}000 \text{ tons}$

$750{,}000 \text{ tons} / 14 \text{ yr} = 53{,}570 \text{ tons/yr}$

Using the methane generation calculation described on page 2 and 53,570 tons/yr average refuse placed, the Gas Generation Curve on page 3 was generated.

Refuse Characterization (2)

Waste Type (%)

Component	Composite			t@	t#
Food Waste	9.0	0	0	1.5	3.5
Garden Waste	10.0	0	0	7	30
Paper Products	42.0	0	0	10	30
Plastic/Rubber	12.0	0	0	20	60
Textiles	2.0	0	0	7	20
Wood	6.0	0	0	15	50
Rubble/Inerts	19.0	0	0	0	0
Moisture Content	30%	0%	0%		
Dry Solids	70%	0%	0%		
Volatile Solids	56%	0%	0%		
Volatile Solids (Dry Wt. Basis)	47%	0%	0%		
Maximum Methane Production (3) (cu.ft./lbm)	1.54	0.00	0.00	Total Methane Production 1.54	(cu.ft./lbm)

(2) Refuse characterization based on "Methane Generation and Recovery From Landfills", EMCON Associates, previous feasibility reports and Warzyn Engineering Inc.

(3) Maximum methane production based on the biodegradability of volatile solids present in the refuse as described in "Methane Generation and Recovery From Landfills", EMCON Associates.

Methane Generation Calculation (4)

First Stage Equation:

$$G = (L/2)e^{-k1(t@ - t)}$$

Second Stage Equation:

$$G = L[1 - .5e^{-k2(t - t@)}]$$

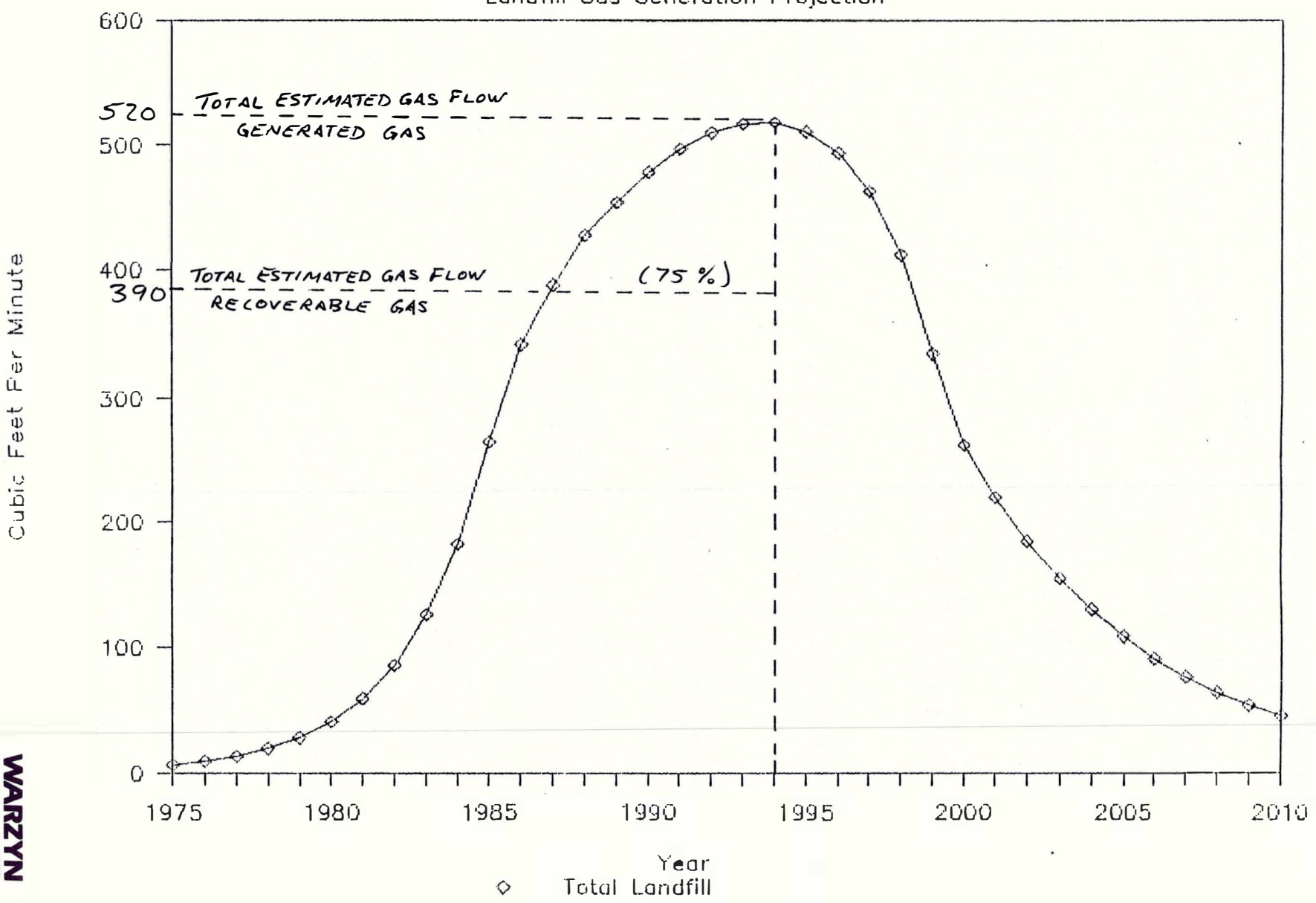
Where:

G = Volume of gas produced prior to time t
L = Maximum methane production
k1 = ln(50/t@)
k2 = ln(50)/(t# - t@)
t@ = time when 50% of methane has been produced in years
t# = time when 99% of methane has been produced in years

(4) Based on the Palos Verdes Kinetic Model where the first stage methane production rate is proportional to the volume of methane already produced until half of the potential methane has been gene[illegible]. The second stage methane production rate is proportional to the volume of methane remaining to be produced.

WARZYN

Refuse Hideaway Landfill, Middleton WI



WARZYN

The curve shown on page 3 represents the Total Estimated Gas Flow for the landfill. However, the amount of landfill gas that can be recovered is estimated to be only 75% of the Total Estimated Gas Flow.

From curve page 3;

Maximum Total Estimated Gas Flow in CFM (1994);
= 520 CFM

Total Estimated Recoverable Gas Flow in CFM (1994) 75%;

⇒ 520 CFM X .75 = 390 CFM

As a second method to estimate the maximum gas flow expected in the system, an assumption of 50 CFM per well was used. This is based on Warzyn's experience with similar landfills, the estimated depth of the wells (> 50 ft.) and the composition of the refuse.

Maximum Total Estimated Recoverable Gas Flow;
(Assuming 13 wells in final system design)

13 wells X 50 CFM/well = 650 CFM

Therefore,

Maximum Total Estimated Recoverable Gas Flow ⇒

Gas Flow Range = 390 – 650 CFM

APPENDIX B

BLOWER SIZING CALCULATIONS

WARZYN

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY BEM DATE 2-17-89 SUBJECT REFUSE HIDEAWAY SHEET NO. ____ OF ____
CHKD. BY JCK DATE 10-24-89 BLOWER SIZING CALCULATIONS JOB NO. 13928.41
SUMMARY

FLOW

System	How Derived	FLOW (CFM)
2 Well	50 CFM/well *	100 CFM
5 Well	50 CFM/well *	250 CFM
13 Well (FINAL)	50 CFM/well *	650 CFM
Total (FINAL)	Gas Generation Curve **	390 CFM

* Based on past experience at similar landfills (See Gas Flow Estimate calculations).

** Based on theoretical gas generation model (See Gas Flow Estimate calculations).

PRESSURE

System	FLOW (CFM)	SUCTION (in. WC)	PRESSURE (in. WC)	TOTAL
2 Well	100	12.7	Non Controlling	Non Controlling
→ 5 Well	250	26.7	10.3	37.0
Flare Capacity	335	NOT APPLICABLE AT THIS TIME	11.6	

Blower Selection

Based on the information above, a 10 HP New York Blower was selected. The blower has the following rating:

650 CFM @ 40 in SP, 3321 RPM, 8.5 BHP @ .0616 lb/cu ft.

WARZYN

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY BEM DATE 10-17-89 SUBJECT REFUSE HIDEAWAY SHEET NO. 1 OF 18
CHKD. BY JCK DATE 10-24-89 BLOWER SIZING CALCULATIONS JOB NO. 13528.41
SUCTION PRESSURES

A. Objective - Determine the total head (suction + pressure) required to select a blower for the five (5) well system - conservative design, and then select a blower.

B. Assumptions -

- Use flow criteria of 50 CFM/well since it is the most conservative.
- Head loss due to HDPE pipe fusion (joints) negligible.
- Vacuum set at 10 in. WC at furthest point/well on system. This is also a conservative design.
- 6 in. WC needed at the top of pilot on VAREC flare.
- 3 in. WC needed at the top of burner on VAREC flare.
- Proposed design is for a 2-well system. However, if excess leachate levels are encountered, up to 3 additional wells may be installed. Therefore, size blower for a 5-well system as directed by WDNR. Size blower for 5-well system pressures and full system flows.

C. Calculations - Suction Pressure

Determine equivalent lengths of fittings and pipe lengths for H_L calculations, and estimate the suction pressures.

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BY SEM DATE 10-17-89 SUBJECT REFUSE + DENWAT SHEET NO. 2 OF 18
CHKD. BY VK DATE 10-24-89 BLOWER SIZING CALCULATIONS JOB NO. 3928.41
SUCTION PRESSURES

Two-Well Design

Description	Length or Equivalent Length (L-)	Reference
4" x 3" Reducer	5.0'	Pg 14 of 18
3" ø Pipe	4.0'	
3" 90° ELL	5.7'	Pg 12 of 18
3" Butterfly Valve (FULLY OPEN)	(40)(3/12) = 10'	Pg 13 of 18
3" ø Pipe	8.0'	
6"x6"x3" Tee (Branch)	(60)(3/12) = 15'	Pg 13 of 18
6" ø Pipe	215'	
6"x6"x3" Tee (Run)	(20)(6/12) = 10'	Pg 13 of 18
6" 45° ELL	6.4'	Pg 12 of 18
6" ø Pipe	110'	
6" 90° ELL	12.9'	Pg 12 of 18
6" ø Pipe	320'	
6" x 6" CROSS (DRIPLEG)	(20)(6/12) = 10'	Pg 13 of 18
6" ø Pipe	40'	
6" 45° ELL	6.4'	Pg 12 of 18
6" 90° ELL	12.9'	Pg 12 of 18
6" ø Pipe	10'	
6" 45° ELL	6.4'	Pg 12 of 18
6" ø PIPE	2'	
6" x 3" REDUCER	7'	Pg 14 of 18
3" ø PIPE	6'	
3" 90° ELL	5.7'	Pg 12 of 18
3" ø PIPE	3'	
3" BUTTERFLY VALVE (FULLY OPEN)	(40)(3/12) = 10'	Pg 13 of 18
3" FLAME ARRESTER	.8 in WC	SEE Pg 15 of 18
3" x 6" INCREASER	6'	Pg 14 of 18

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MADISON, WISCONSIN

BY BEM DATE 6-17-89 SUBJECT REFUSE + DEPANNY SHEET NO. 3 OF 18
CHKD. BY JCK DATE 10.24.89 BLOWER SIZING CALCULATIONS JOB NO. 13928.41
SUCTION PRESSURES

Five-Well Design

Description	Length or Equivalent Length (Ft)	Reference
4"x3" Reducer	5'	Pg 14 of 18
3" ø Pipe	4.0	
3" 90° ELL	5.7'	Pg 12 of 18
3" Butterfly Valve (fully Open)	(40)(3/12) = 10.0	Pg 13 of 18
3" ø Pipe	8.0	
6"x6"x3" Tee (Branch)	(60)(3/12) = 15.0	Pg 13 of 18
6" ø Pipe	250.0	
6"x6"x3" Tee (Run)	(20)(6/12) = 10.0	Pg 13 of 18
6" ø Pipe	215.0	
6"x6"x3" Tee (Run)	10.0	Pg 13 of 18
6" ø Pipe	210.0	
6"x6"x3" Tee (Run)	10.0	Pg 13 of 18
6" ø Pipe	215.0	
6"x6"x3" Tee (Run)	10.0	Pg 13 of 18
6" ø Pipe	110.0	
6" 90° ELL	12.9'	Pg 12 of 18
6" ø Pipe	320'	
6"x6" Cross	(20)(6/12) = 10'	Pg 13 of 18
6" ø Pipe	30'	
6" 45° ELL	6.4'	Pg 12 of 18
6" ø Pipe	10.0	
6" 90° ELL	12.9'	Pg 12 of 18
6" ø PIPE	10.0	
6" 45° ELL	6.4'	Pg 12 of 18
6" ø PIPE	2'	
6" X3" REDUCER	7'	Pg 14 of 18
3" ø PIPE	6'	
3" 90° ELL	5.7'	Pg 12 of 18
3" ø PIPE	3'	
3" BUTTERFLY VALVE (FULLY OPEN)	(40)(3/12) = 10'	Pg 13 of 18
3" ø PIPE	2'	
3" FLAME ARRESTER	4.5 in WC	Pg 15 of 15
3"x6" INCREASER	6'	Pg 14 of 18

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TWO - WELL VACUUM (FLOW = 50 CFM/WELL)

REFUSE HIDEAWAY
13928.41

PIPE HEAD LOSS CALCULATION

BEM 10-17-89.

WELL	PIPE SIZE (inches)	PIPE LENGTH (feet)	FLOW REQUIRED (cfm)	HEAD LOSS PER 100' (inches W.C.)	HEAD LOSS BTWN. WELLS (inches W.C.)	SUCTION PRESSURE REQ'D. (inches W.C.)	COMMENTS
GW2						10.0	START W/ 10 in WC @ WELL FOR CONSERVATIVE APPROACH
	3	48	50	.75	.36		
6" HEADER						10.36	
	6	215	50	.025	.05		
GW1						10.41	
	6	547	100	.09	.5		
3" PIPE						10.91	
	3	32	100	2.7	.86		
FLAME ARR						11.77	
	—	—	—	—	.8		H_L THRU FLAME ARR SEE PG 15 OF 18
3" PIPE						12.57	
	3	6'	100	2.7	.16		
BLOWER						12.73	

WARZYN

REFUSE HIDEAWAY
13928.41

PIPE HEAD LOSS CALCULATION

BEM 10-17-89

WELL	PIPE SIZE (inches)	PIPE LENGTH (feet)	FLOW REQUIRED (cfm)	HEAD LOSS PER 100' (inches W.C.)	HEAD LOSS BTWN. WELLS (inches W.C.)	SUCTION PRESSURE REQD. (inches W.C.)	COMMENTS
GW5						10.0	START W/ 10 IN WC @ WELL FOR CONSERVATIVE APPROACH
	3	48	50	.75	.36		
6" HEADER						10.36	
	6	250	50	.025	.06		
GW4						10.42	
	6	225	100	.09	.2		
GW3						10.62	
	6	220	150	.2	.44		
GW2						11.06	
	6	225	200	.3	.68		
GW1						11.74	
	6	541	250	.45	2.43		
3" PIPE						14.17	
	3	34	250	20	6.8		
FLAME ARR.						20.97	
	—	—	—	—	4.5		HE THRU FLAME ARR SEE PG 15 OF 18
3" PIPE						25.47	
	3	6	250	20	1.2		
BLOWER						26.67	

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BY BEM DATE 10-17-89 SUBJECT REFUSE HIDEAWAY SHEET NO. 6 OF 18
CHKD. BY JJK DATE 10.26.89 BLOWER SIZING CALCULATIONS JOB NO. 13928.41
SUCTION PRESSURES

Assuming controlling Suction Pressure is based on 5-well system design;

Total Suction Pressure estimated is = 26.7 in. WC

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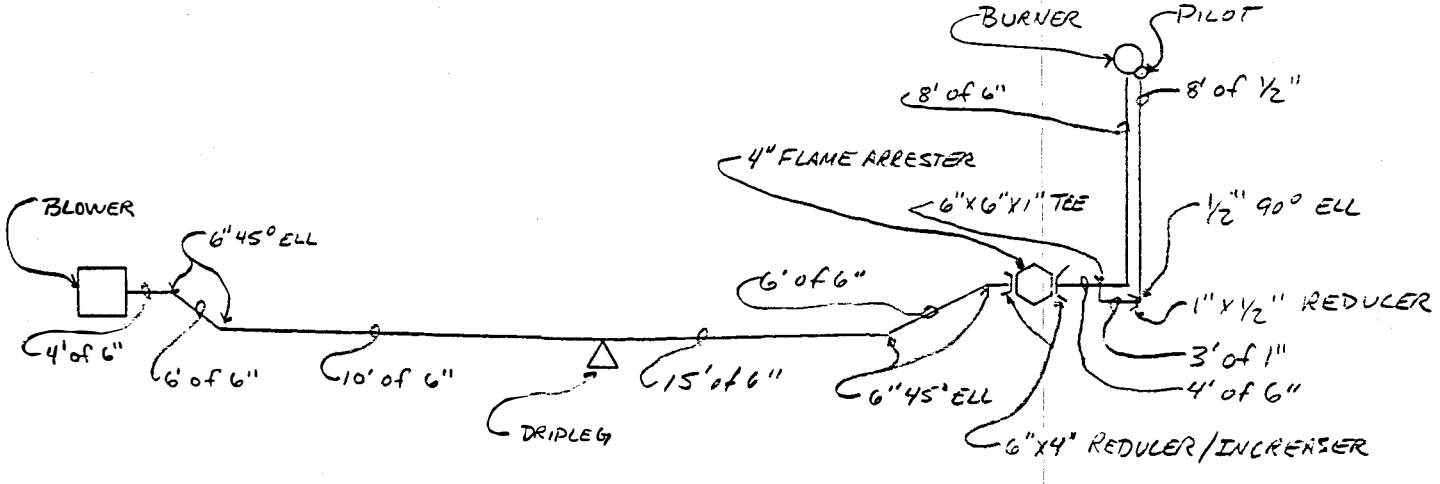
C2. Calculations - Positive Pressure.

Objective - Determine blower pressure (in. WC) necessary to operate 6" VAREC Series 239A Waste Gas Burner at maximum design and flare capacity flows.

Assumptions -

- Max. design flow = 250 CFM (5 wells @ 50 CFM/well)
- Flare Capacity flow = 335 CFM (6" VAREC 239A)
- 6 in. WC @ 1.2 CFM required at top of pilot
- 3 in. WC required at top of burner

Schematic



Calculations

Determine equivalent lengths of fittings and pipe lengths for H_L calculations, and estimate the positive pressures.

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From blower to Pilot:

	Description	Length or Equivalent Length	Reference
BLOWER			
	6" Ø PIPE	4'	
	6" 45° ELL	6.4'	Pg 12 of 18
	6" Ø PIPE	6'	
	6" 45° ELL	6.4'	Pg 12 of 18
	6" Ø PIPE	10'	
	DRIPLEG (6"X6"X6" TEE - RUN)	(20)(6/12) = 10'	Pg 13 of 18
	6" Ø PIPE	15'	
	6" 45° ELL	6.4	Pg 12 of 18
	6" Ø PIPE	6'	
	6" 45° ELL	6.4'	Pg 12 of 18
	6"X4" REDUCER	7'	Pg 14 of 18
	4" FLAME ARRESTER	2.5 in. WC @ 335 CFM 1.5 in. WC @ 250 CFM	Pg 15 of 18
	4"X6" INCREASER	12'	Pg 14 of 18
(A)	6" Ø PIPE	2'	
	6"X6"X1" TEE (BRANCH)	(60)(1/12) = 5'	Pg 13 of 18
	1" 90° ELL	2' assumed	
	1" Ø PIPE	3'	
	1"X½" REDUCER	2' assumed	
	½" 90° ELL	1' assumed	
PILOT	½" Ø PIPE	8'	

From blower to Burner:

	Description	Length or Equivalent Length	Reference
BLOWER			
	SAME AS ABOVE TO POINT (A)	SEE ABOVE	SEE ABOVE
	6" Ø PIPE	4'	
	6" 90° ELL	12.9	Pg 12 of 18
	6" Ø PIPE	8'	

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HL FROM BLOWER TO PILOT

REFUSE HIDEAWAY
13928.41

PIPE HEAD LOSS CALCULATION

BEM 10-25-89

WELL	PIPE SIZE (inches)	PIPE LENGTH (feet)	FLOW REQUIRED (cfm)	HEAD LOSS PER 100' (inches W.C.)	HEAD LOSS BTWN. WELLS (inches W.C.)	~~SUCTION~~ PRESSURE REQ'D. (inches W.C.)	COMMENTS
BLOWER	FLOW = 335 CFM					6.0	START W/ 6.0 IN WC NEEDED @ PILOT
	6"	84	335	0.8	0.7		
FLAME ARRESTER						6.7	
	—	—	—	—	2.5		HL THRU 4" FLAME ARRESTER - SEE PG 15 OF 18
6" PIPE						9.2	
	6"	14	335	0.8	.1		
TEE 6X6X1						9.3	
	1"	10	2	10 assumed	1.0		1.2 CFM REQUIRED FOR PILOT PER MANUFACT.
1/2"						10.3	
	1/2"	11	2	12 assumed	1.3		
PILOT						11.6	
BLOWER	FLOW = 250 CFM					6.0	START W/ 6 in WC. FOR PILOT
	6"	84	250	.45	.4		
FLAME ARRESTER						6.4	
	—	—	—	—	1.5		HL THRU FLAME ARRESTER SEE Pg 15 of 18
6" PIPE						7.9	
	6"	14	250	.45	.06		
TEE 6X6X1						7.96	
	1"	10	2	10 assumed	1.0		
1/2"						8.96	
	1/2"	11	2	12 assumed	1.3		
PILOT						10.3	

WARZYN

REFUSE HIDEAWAY
13928.41

PIPE HEAD LOSS CALCULATION

BEM 10-25-89

WELL	PIPE SIZE (inches)	PIPE LENGTH (feet)	FLOW REQUIRED (cfm)	HEAD LOSS PER 100' (inches W.C.)	HEAD LOSS BTWN. WELLS (inches W.C.)	~~SUCTION~~ PRESSURE REQ'D. (inches W.C.)	COMMENTS
BLOWER	FLOW = 335 CFM					3.0	START W/ 3 in WC Needed @ BURNER
	6"	84	335	.8	.7		
FLAME ARR.						3.7	
	—	—	—	—	2.5		HL THRU FLAME ARR. SEE Pg 15 of 18
6" PIPE						6.2	
	6"	36	335	.8	.3		
BURNER						6.5	
BLOWER	FLOW = 250 CFM					3.0	START W/ 3 in WC @ BURNER
	6"	84	250	.45	.4		
FLAME ARR						3.4	
	—	—	—	—	1.0		HL THRU FLAME ARR. SEE P 15 of 18
6" PIPE						4.4	
	6"	36	250	.45	.2		
BURNER						4.6	

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MADISON, WISCONSIN

BY BEM DATE 10-17-89 SUBJECT REFUSE HIDEAWAY SHEET NO. 11 OF 18
CHKD. BY JCK DATE 10-25-89 BLOWER SIZING CALCULATIONS JOB NO. 13928.41
POSITIVE PRESSURES

Assuming controlling positive pressure is based on 5-well system design; (Blower to Pilot)

Total Positive Pressure estimated is = 10.3 in. WC

Select Blower

Pressure:

Suction Press.	26.7
Positive Press.	10.3
Total	37.0 in. WC

Flow:
(full system) Flow Range = 390 - 650 CFM

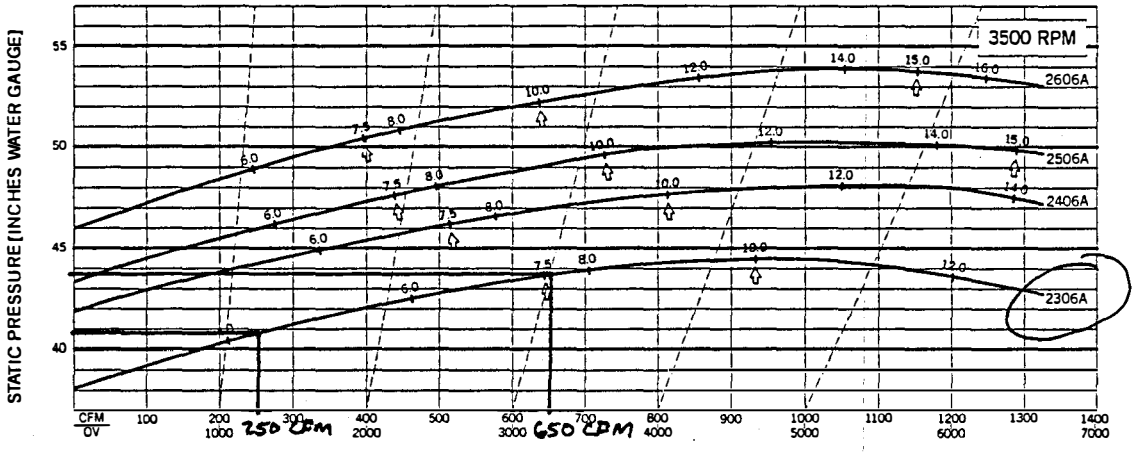
- Select blower which has capacity for full system flow, but pressure capacity for 5-well system. Select blower that may be upgraded in motor and wheel size for full system pressure capacity.*,

*Based on limited assumptions at this time.

06 OUTLET SIZE

Performance shown is for Pressure Blowers with outlet duct and with or without inlet duct.

Outlet area: .20 sq. ft.



Select New York Blower # 2306A10, 10HP

FLOW OF AIR IN PIPES

$$P = \frac{1.268\, t\, Q^{1.852}}{1{,}000{,}000\, p\, d^{4.973}}$$ FRITZSCHE FORMULA.

P = drop in pressure in pounds per square inch per foot of pipe.
t = absolute temperature in degrees Fahrenheit = recorded temp. in degrees F + 459.6.
Q = cubic feet of free air per minute at 60 degrees Fahrenheit.
p = absolute pressure in pounds per square inch = gage pressure + 14.7.
d = diameter of the pipe in inches.

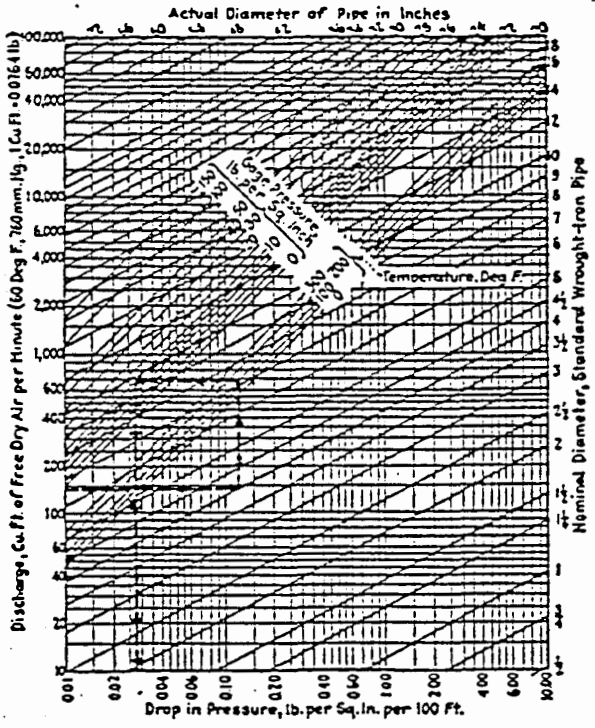


FIG. A - FLOW OF AIR IN CIRCULAR PIPES. MORRILL'S CHART. BASED ON FRITZSCHE FORMULA.*

TABLE B - ECONOMICAL MAXIMUM VELOCITIES OF AIR FLOW IN PIPES.

SIZE OF PIPE INCHES	MAXIMUM VELOCITY FEET PER SEC	SIZE OF PIPE INCHES	MAXIMUM VELOCITY FEET PER SEC.
6	20	16	50
8	28	20	54
10	35	24	57
12	41	30	60
14	46	36	62

TABLE C - POWER REQUIRED FOR COMPRESSING AIR.*

FINAL PRESSURE OF AIR LB. PER SQ. INCH	THEORETICAL WORK TO COMPRESS 1 MIL. CU. FT. OF FREE AIR HP - HR.	FINAL PRESSURE OF AIR LB. PER SQ. INCH	THEORETICAL WORK TO COMPRESS 1 MIL. CU. FT. OF FREE AIR HP - HR.
1	72.3	8	490.2
2	144.0	10	596.5
3	200.8	12	697.1
4	265.2	14	785.4
6	384.7	16	875.9

TABLE D - RESISTANCE TO FLOW OF AIR THROUGH FITTINGS.

DIAMETER OF PIPE IN INCHES	EQUIVALENT LENGTH OF STRAIGHT PIPE IN FEET				
	GATE VALVE	ANGLE VALVE	LONG RADIUS ELBOW 45°	STANDARD ELBOW 90°	SIDE OUTLET TEE
2	1.3	4.8	1.7	3.6	7.1
3	2.1	7.7	2.8	5.7	11.4
4	3.0	10.7	3.9	7.9	15.8
6	4.8	17.4	6.4	12.9	25.6
8	6.7	24.1	8.9	17.9	35.6
10	8.8	31.5	11.5	23.4	46.6
12	10.9	39.3	14.4	29.3	58.6
16	15.4	55.4	20.3	41.3	82.6
20	20.2	72.7	26.6	54.1	108.2
24	25.1	90.4	33.1	67.3	134.6
30	32.8	118.1	43.3	87.9	175.8
36	40.9	147.2	54.0	109.6	219.2
42	49.2	177.1	64.9	131.9	263.8
48	57.7	207.7	76.2	154.8	309.2

*Data from Metcalf & Eddy, American Sewerage Practice, Mc Graw-Hill

PAGE 13 OF 18

Schedule (Thickness) of Steel Pipe Used in Obtaining Resistance Of Valves and Fittings of Various Pressure Classes by Test*

Valve or Fitting ANSI Pressure Classification			Schedule No. of Pipe Thickness
Steam Rating		Cold Rating	
250-Pound and Lower		500 psig	Schedule 40
300-Pound to 600-Pound		1440 psig	Schedule 80
900-Pound		2160 psig	Schedule 120
1500-Pound		3600 psig	Schedule 160
2500-Pound	½ to 6"	6000 psig	xx (Double Extra Strong)
	8" and larger	3600 psig	Schedule 160

*These schedule numbers have been arbitrarily selected only for the purpose of identifying the various pressure classes of valves and fittings with specific pipe dimensions for the interpretation of flow test data; they should not be construed as a recommendation for installation purposes.

Representative Equivalent Length‡ in Pipe Diameters (L/D) Of Various Valves and Fittings

Description of Product				Equivalent Length In Pipe Diameters (L/D)
Globe Valves	Stem Perpendicular to Run	With no obstruction in flat, bevel, or plug type seat	Fully open	340
		With wing or pin guided disc	Fully open	450
	Y-Pattern	(No obstruction in flat, bevel, or plug type seat)		
		– With stem 60 degrees from run of pipe line	Fully open	175
		– With stem 45 degrees from run of pipe line	Fully open	145
Angle Valves		With no obstruction in flat, bevel, or plug type seat	Fully open	145
		With wing or pin guided disc	Fully open	200
Gate Valves	Wedge, Disc, Double Disc, or Plug Disc		Fully open	13
			Three-quarters open	35
			One-half open	160
			One-quarter open	900
	Pulp Stock		Fully open	17
			Three-quarters open	50
			One-half open	260
			One-quarter open	1200
Conduit Pipe Line Gate, Ball, and Plug Valves			Fully open	3**
Check Valves	Conventional Swing		0.5†...Fully open	135
	Clearway Swing		0.5†...Fully open	50
	Globe Lift or Stop; Stem Perpendicular to Run or Y-Pattern		2.0†...Fully open	Same as Globe
	Angle Lift or Stop		2.0†...Fully open	Same as Angle
	In-Line Ball		2.5 vertical and 0.25 horizontal†...Fully open	150
Foot Valves with Strainer		With poppet lift-type disc	0.3†...Fully open	420
		With leather-hinged disc	0.4†...Fully open	75
Butterfly Valves (8-inch and larger)			Fully open	40
Cocks	Straight-Through	Rectangular plug port area equal to 100% of pipe area	Fully open	18
	Three-Way	Rectangular plug port area equal to 80% of pipe area (fully open)	Flow straight through	44
			Flow through branch	140
Fittings	90 Degree Standard Elbow			30
	45 Degree Standard Elbow			16
	90 Degree Long Radius Elbow			20
	90 Degree Street Elbow			50
	45 Degree Street Elbow			26
	Square Corner Elbow			57
	Standard Tee	With flow through run		20
		With flow through branch		60
	Close Pattern Return Bend			50
Pipe	90 Degree Pipe Bends			See Page A-27
	Miter Bends			See Page A-27
	Sudden Enlargements and Contractions			See Page A-26
	Entrance and Exit Losses			See Page A-26

**Exact equivalent length is equal to the length between flange faces or welding ends.

†Minimum calculated pressure drop (psi) across valve to provide sufficient flow to lift disc fully.

‡For limitations, see page 2-11. For effect of end connections, see page 2-10.

For resistance factor "K", equivalent length in feet of pipe, and equivalent flow coefficien... A-31 and A-32.

FLARE EXPANDED FLOW THROUGH TEE ISTREAM + 15'

FIG. 10 - 14

Equivalent length of valves and fittings in feet

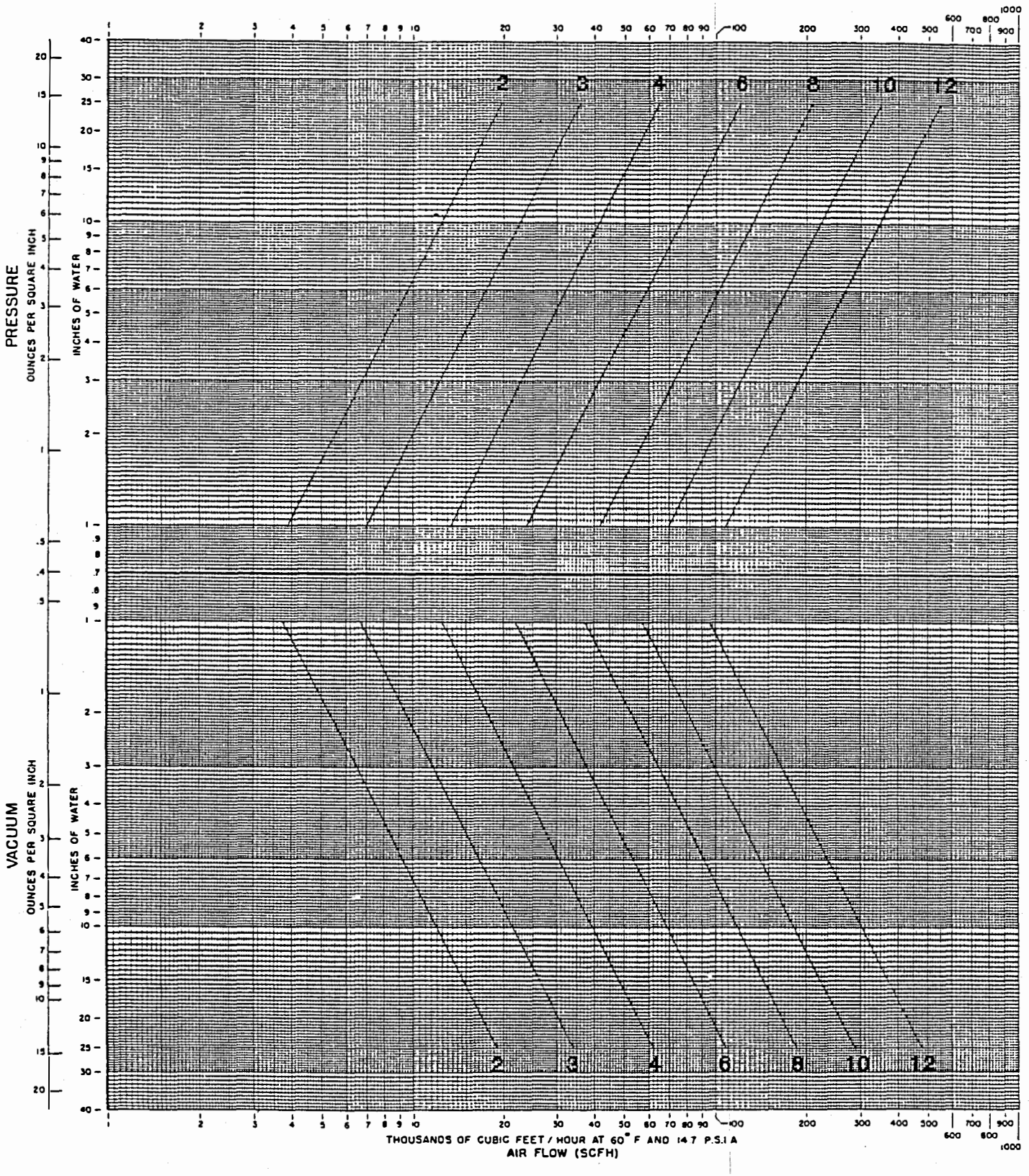
Nominal Pipe size in.	Globe valve or ball check valve	Angle valve	Swing check valve	Plug cock	Gate or ball valve	45° ell		Short rad. ell		Long rad. ell		Hard T.		Soft T.		90° miter bends			Enlargement						Contraction					
																			Sudden			Std. red.			Sudden			Std. red.		
																			Equiv. L in terms of small d											
						Weld	third	Weld	third	Weld	third	Weld	third	Weld	third	2 miter	3 miter	4 miter	d/D=¼	d/D=½	d/D=¾	d/D=½	d/D=¾	d/D=¼	d/D=½	d/D=¾	d/D=½	d/D=¾
1½	55	26	13	7	1	1	2	3	5	2	3	8	9	2	3				5	3	1	4	1	3	2	1	1	—
2	70	33	17	14	2	2	3	4	5	3	4	10	11	3	4				7	4	1	5	1	3	3	1	1	—
2½	80	40	20	11	2	2	..	5	..	3	..	12		3	..				8	5	2	6	2	4	3	2	2	—
3	100	50	25	17	2	2		6		4		14		4					10	6	2	8	2	5	4	2	2	—
4	130	65	32	30	3	3		7		5		19		5					12	8	3	10	3	6	5	3	3	—
6	200	100	48	70	4	4		11		8		28		8					18	12	4	14	4	9	7	4	4	1
8	260	125	64	120	6	6		15		9		37		9					25	16	5	19	5	12	9	5	5	2
10	330	160	80	170	7	7		18		12		47		12					31	20	7	24	7	15	12	6	6	2
12	400	190	95	170	9	9		22		14		55		14		28	21	20	37	24	8	28	8	18	14	7	7	2
14	450	210	105	80	10	10		26		16		62		16		32	24	22	42	26	9	—	—	20	16	8	—	—
16	500	240	120	145	11	11		29		18		72		18		38	27	24	47	30	10	—	—	24	18	9	—	—
18	550	280	140	160	12	12		33		20		82		20		42	30	28	53	35	11	—	—	26	20	10	—	—
20	650	300	155	210	14	14		36		23		90		23		46	33	32	60	38	13	—	—	30	23	11	—	—
22	688	335	170	225	15	15		40		25		100		25		52	36	34	65	42	14	—	—	32	25	12	—	—
24	750	370	185	254	16	16		44		27		110		27		56	39	36	70	46	15	—	—	35	27	13	—	—
30	—	—	—	312	21	21		55		40		140		40		70	51	44										
36	—	—	—		25	25		66		47		170		47		84	60	52										
42	—	—	—		30	30		77		55		200		55		98	69	64										
48	—	—	—		35	35		88		65		220		65		112	81	72										
54	—	—	—		40	40		99		70		250		70		126	90	80										
60	—	—	—		45	45		110		80		260		80		190	99	92										

WARZYN

FLOW CAPACITY

VAREC

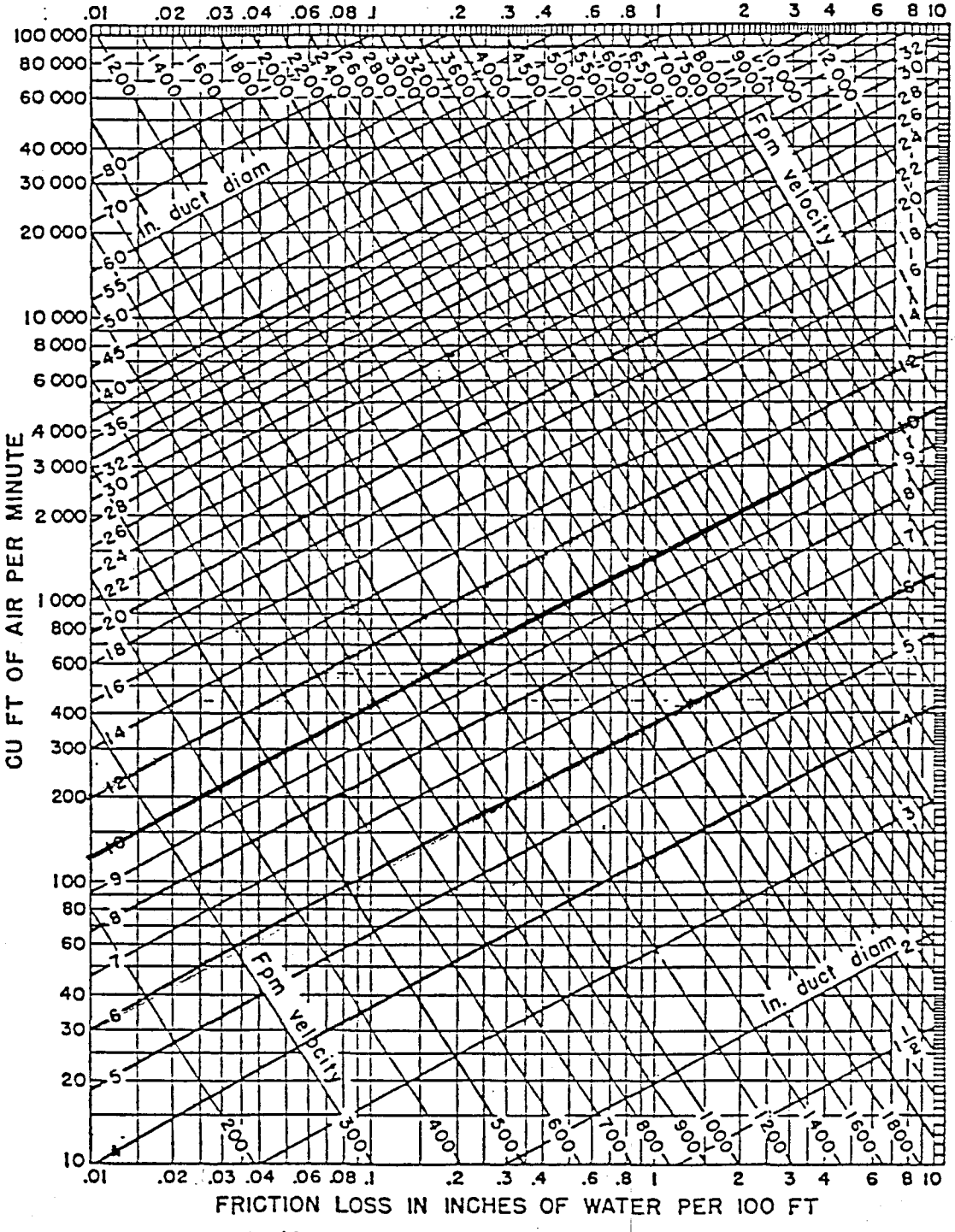
MODEL 5000/5010 FLAME ARRESTERS



Note: Flow stated in SCFH air can be corrected for gas at 0.8 specific gravity and temperature at 90°F by multiplying above flows by 1.09 factor

WARZYN

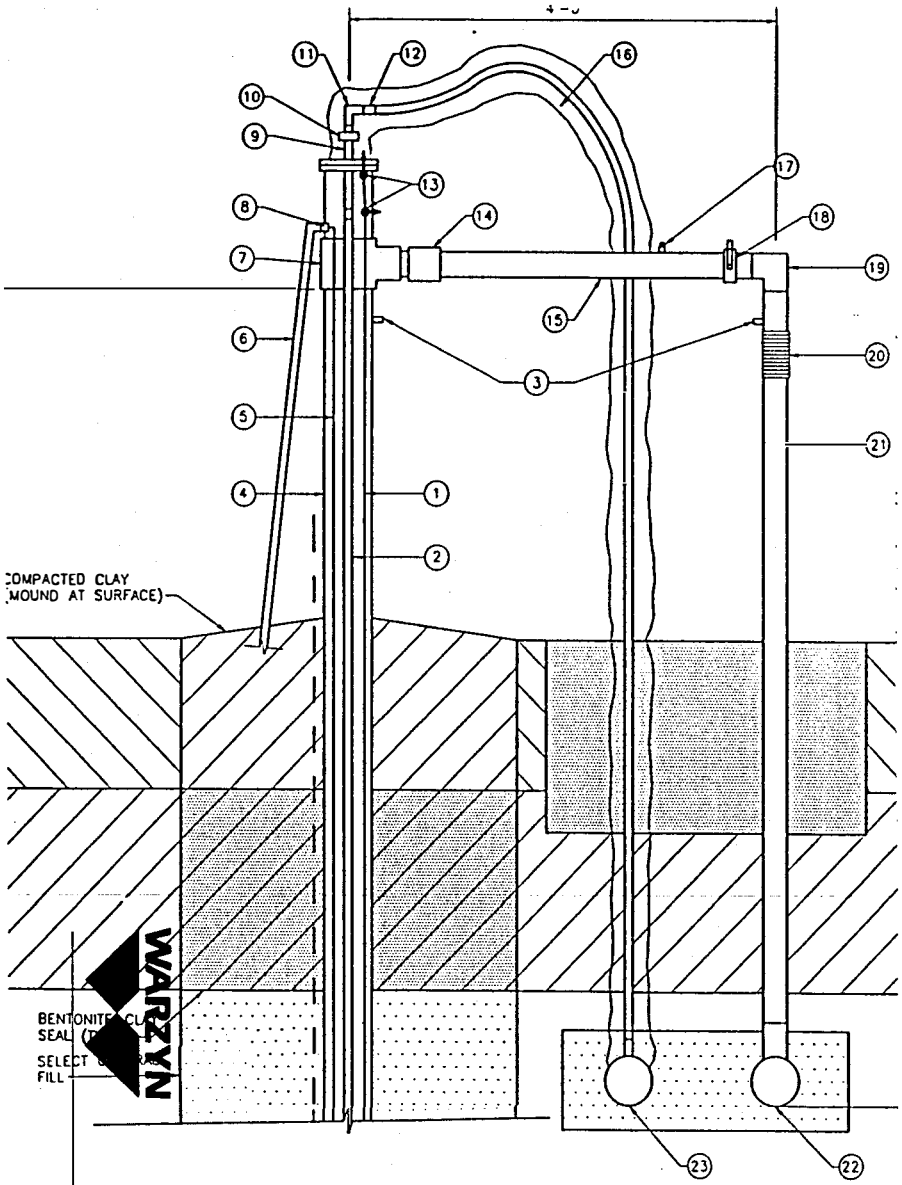
calculation of duct resistance (chart a)



Reprinted from Chapter 41, Heating, Ventilating & Air Conditioning Guide, 1949

To illustrate the use of Chart A, above, in measuring friction of round ducts, assume that the requirement is to pass 10,000 CFM through 50 feet of 24-inch diameter duct. Find the line designating 10,000 CFM on the vertical scale at the left and move horizontally to the right to the point of intersection with the diagonal line marked 24". The water gauge scale, represented by the vertical line, shows that the friction per 100 feet of duct length is .05 inches. Therefore, for 50 feet, friction would be 0.5" x .5 or 0.25 inches water gauge. The intersecting diagonal marked "velocity" indicates, in this case, an air velocity in the duct of 3200 FPM. Similarly, any two variables may be determined by intersecting lines when two known variables are plotted on the chart.

WARZYN



KEY

1. 1/4" DIA. STAINLESS STEEL PULLOUT CABLE
2. 1" DIA. FLEXIBLE DISCHARGE PIPE
3. STAINLESS STEEL SAMPLE PORT
4. 6" DIA. SCH. 80 PVC GAS WELL PIPE
5. ELECTRICAL WIRING FOR PUMP
6. SEAL-TIGHT ELECTRICAL CONDUIT AND WIRING FOR PUMP
7. 6" x 6" x 3" SCH. 80 PVC TEE
8. EXPLOSION PROOF ELECTRICAL PLUG MOUNTED AND SEALED INTO WELL CASING
9. 1" DIA. STAINLESS STEEL NIPPLE THREADED THROUGH BLIND FLANGE
10. 1" DIA. STAINLESS STEEL UNION
11. 1" DIA. STAINLESS STEEL 90° ELL
12. 1" DIA. STAINLESS STEEL TO HDPE TRANSITION FITTING
13. 1/4" STAINLESS STEEL EYEBOLT WITH WASHERS AND NUT
14. 3" DIA. FLEXIBLE COUPLING WITH CLAMPS (FERNCO)
15. 3" DIA. SCH. 80 PVC PIPE
16. 1" DIA. HDPE PIPE (INSULATED AND HEAT TRACED)
17. 3/4" x 1/2" SCH. 80 PVC REDUCING BUSHING WITH 1/2" DIA. SCH. 80 PVC PLUG (MONITORING PORT)
18. 3" DIA. BUTTERFLY VALVE (TILT FOR CONDENSATE DRAINAGE)
19. 3" DIA. SCH. 80 PVC 90° ELL
20. 3" DIA. FLEXIBLE TUBING WITH CLAMPS
21. 3" DIA. HDPE PIPE
22. 6" x 6" x 3" HDPE TEE (ON GAS HEADER PIPE)
23. 6" x 6" x 1" HDPE TEE (ON LEACHATE CONVEYANCE PIPE)

1/3 TYPICAL GAS/LEACHATE EXTRACTION WELL HEAD DETAIL

SCALE: 1" = 1'-0"

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY LCK DATE 11/3/89
CHKD. BY ___ DATE ___
SUBJECT KEWAUNEE HIDEAWAY GAS/LEACHATE EXTRACTION WELL DETAIL
SHEET NO. 17 OF 18
JOB NO. 13922.3

SEE DETAIL 3/4

LEACHATE/HOLDING TANK
SEE DRAWING 13928-6
CENTER LINE WEST EDGE = 400,600 N, 2,112,890 E
CENTER LINE EAST EDGE = 400,600 N, 2,112,921 E

FLARE STATION
400,643 N
2,112,732 E
SEE DETAIL 1/5

BLOWER STATION
400,590 N
2,112,746 E
SEE DETAIL 1/5

DL2
DL1
CO1
CO2
CO3
CO4

VARIES 70'
10.0%
6.1%
1.0%
100'
2.0%
980
220'
2.0%
990
50'
2.0%
40'
2.0%
2.0%

LH-2
LH-1
LH4
LH5
LH6
GW1
GW2
GW3
GW4
GW5

90'
2.0%
2.0%
50'
2.0%
2.0%
25'
2.0%
2.0%
210'
2.0%
215'
2.0%
250'
2.0%

1020
1010
1000
990
980
970
960
950
940
930

N

APPENDIX C

FLARE SIZING/SELECTION

WARZYN

A. Objective - Establish design criteria necessary to size a flare and make flare selection.

B. Assumptions

- Maximum estimated flow (@ 50 cfm/well conservative) Based on the more conservative method of the two methods used to determine gas flow (See Gas Flow Estimate calculations) and based on five well system (as directed by WDNR) is;

  Flow = 5 wells x 50 cfm/well = 250 CFM
  = 15,000 CFH

- Waste Gas;

Composition - Assume	50% methane 49% Carbon Dioxide 1% Other
Temperature - Assume	70°F
Moisture Content - Assume	Saturated
BTU Value - Assume	500/CF (7.5 Million BTUH)

- Flare is sized for Partial System only; may be used back-up for full system.

Selection

Based on the information above, a 6 in. VAREC 239A Series Waste Gas Burner was selected. See pages 2-5 for manufacturers data and specifications.

WARZYN

VAREC

PDS 239WT
11/88

239A SERIES

WASTE GAS BURNER

- "Curtain of Flame" Ring-Type Pilot
- 304SS Pilot Orifices
- Insulated Pedestal Protects Pilot Lines
- Separable Mounting Base

INTRODUCTION

The VAREC 239A Series Waste Gas Burner is designed for burning excess waste gas generated in the anaerobic digestion process to reduce the potential odor nuisance from venting directly to the atmosphere. This burner is suitable for burning low volumes of waste gas which is typically very "wet", with a low BTU value (between 550 and 600 BTU), and composed primarily of methane.

OPERATION AND FEATURES

The VAREC 239A Burner is designed to ignite the waste gas by passing it through a "curtain of flame" developed by the ring-type pilot. The pilot gas mixes with air at the pilot ring and the pilot flame burns on top of the ring. The waste gas is deflected across the pilot flame by an integral baffle. A manually adjustable shutter is provided at the bottom of the burner stack to change the available air volume should the waste gas flow rate fluctuate.

Dual pilot lines in the larger models are located 180° apart to distribute the pilot flame around the entire ring. The burner pedestal is insulated internally, enclosing the pilot line(s) and waste gas piping. A gasketed, separable mounting base is included for pre-installation on a concrete foundation or other suitable support. A covered pilot observation and ignition port with separate inspection port are provided on the burner stack.

A low pressure natural gas pilot supply is recommended with the VAREC 239A Burner. Since Waste Gas is typically moist and dirty with fluctuating pressure and BTU value, it may not provide the reliable pilot flame necessary when using an automatic pilot ignition and monitoring system. The Model 239A Waste Gas Burner is not suitable for a propane or butane pilot gas supply.

AUXILIARY EQUIPMENT

Flame Check, Model 52: Recommended for field installation in the pilot gas piping just upstream of the burner to protect from possible flashbacks generated in the pilot line. See PDS 52WT for details.

Electric Pilot Ignitor: Recommended for all burners for improved operator safety. VAREC manufactures several ignition systems. These systems are described in data sheets PDS 240WT, PDS 240HOA, PDS 241WT, and PDS 242WT.

Secondary Stacks (by others): "Self-supporting" secondary stacks should be specified for field installation on all 4", 6", and 8" burners to protect from winds which can cause an unstable pilot and/or waste gas flame. Consult VAREC for details.

SPECIFICATIONS

Sizes: 2", 3", 4", 6" and 8"

Connections:

Waste Gas — Nominal pipe size/weld connection
Pilot Gas — Single 1/2" NPT (2" through 4" sizes)
Dual 1/2" NPT (6" and 8" sizes)

Mounting: Concrete pad or other suitable support

Waste Gas:

Composition: Primarily methane
BTU Value: 550 to 600
Maximum Inlet Pressure: 20" WC (508 mm WC)

Material:

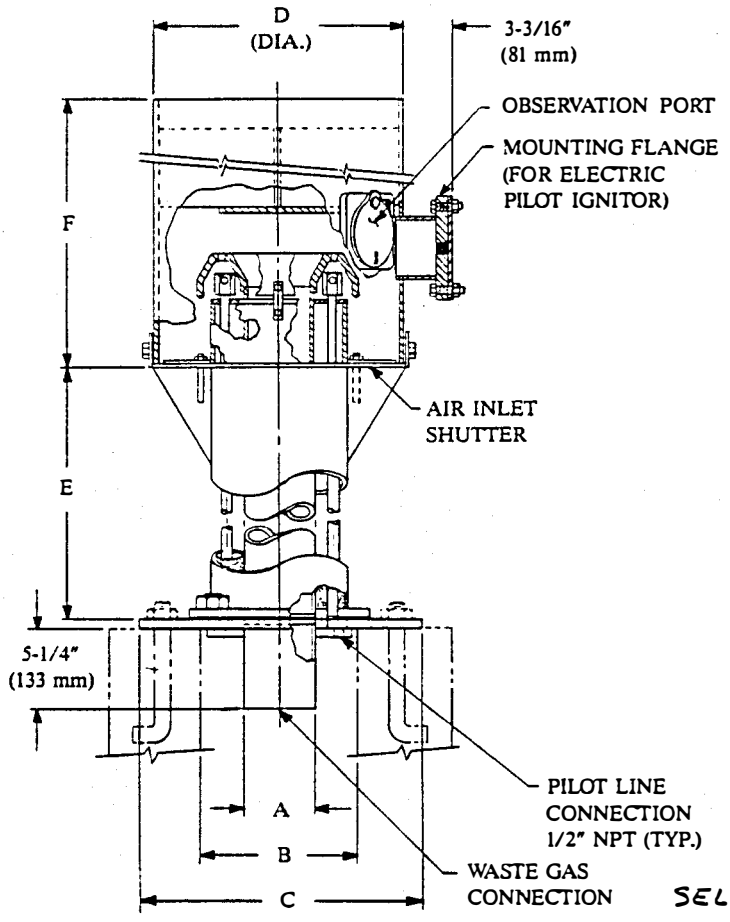
Burner — Fabricated carbon steel
Pilot Flame Ring — Heat resistant cast iron
Pilot orifice/fittings — 304 stainless steel
Observation/Ignition Port — Cast iron

VAREC

239A SERIES WASTE GAS BURNER

SELECT

DIMENSIONAL DRAWING



SIZE CODE	02	03	04	06	08
A	**2** 50	**3** 75	**4** 100	**6** 150	**8** 200
B	**8 3/4** 222	**10** 254	**11** 279	**13** 330	**15** 381
C	**17 1/2** 444	**18 3/4** 476	**20** 508	**22** 559	**24** 610
D	**12 3/4** 324	**14** 356	**16** 406	**20** 508	**24** 610
E	**68** 1730	**68** 1730	**68** 1730	**96** 2440	**96** 2440
F	**20 1/4** 514	**24 1/4** 616	**24 1/4** 616	**32 1/4** 819	**48 3/8** 1229
SHIPPING WEIGHT	**465** 211	**590** 268	**700** 318	**860** 391	**1500** 682

Inches and lb in bold, mm and kg in light

Installation, mounting arrangement, and dimensions are preliminary general information not to be used for construction. Certified drawings are available.

BURNING CAPACITY

Flow stated in air at 60°F and 14.7 PSIA at 1/2" WC (13 mm WC) pressure drop, at sea level. For capacities at higher site elevations, consult factory.

SIZE	FT3/HR	M3/HR
2"	1,850	52
3"	4,025	114
4"	7,875	223
6"	20,100	569
8"	33,475	948

SELECT

Note: Flow stated in SCFH air can be corrected for waste gas at other specific gravities and temperatures. (See Technical Section)

ORDERING INFORMATION

239A	WASTE GAS BURNER	
	Code	**Size (Select One)**
	02	2"
	03	3"
	04	4"
	06	6"
	08	8"

239A	06	(EXAMPLE)

VAREC
a Rosemount Division
10800 Valley View St., Cypress, CA 90630 (714) 761-1300 Telex: 4722044 FAX: (714) 952-2701

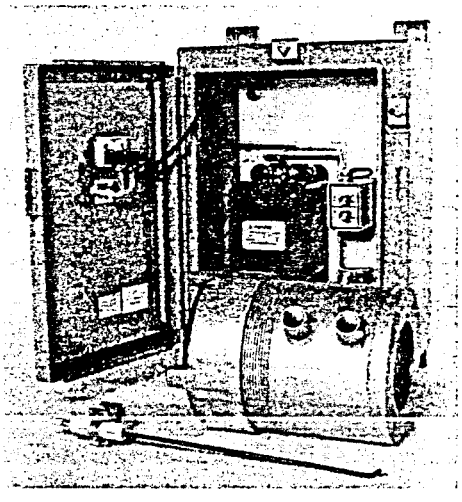
VAREC

PDS 240HOA
11/88

240 H-O-A SERIES

MANUAL/CYCLING ELECTRIC PILOT IGNITOR

- Unattended Ignition Spark
- Adjustable "On" and "Off" Cycles
- Hand-Off-Auto Functions



INTRODUCTION

The VAREC Model 240HOA Manual/Cycling Electric Pilot Ignitor is designed for use with the VAREC 239A Series Waste Gas Burner. The unit provides a manually initiated ignition spark and provision to continuously cycle the spark on and off. This model is recommended when an electrical means of pilot ignition is desired, yet automatic pilot monitoring and status alarms are not required.

The ignition control enclosure should be located at least **10 feet** (3 m) **away** from the waste gas burner to protect operating personnel and enclosure components from radiant heat.

OPERATION AND FEATURES

A compact ignition transformer with a dual cycling timer switch are provided inside a weatherproof enclosure. The enclosure is fitted with an external "Hand-Off-Auto" switch, and is suitable for panel or wall mounting. The transformer and switches are pre-wired to a terminal strip at the factory. An ignition electrode assembly with weatherproof housing are also provided, and are easily field mounted to the primary stack of the VAREC 239A Burner.

With the three-way switch in the "Hand" position, the ignition transformer is energized. The transformer delivers a continuous high voltage to the ignition electrode which sparks across an air gap to the pilot flame ring, igniting the pilot gas. Once the pilot flame has been established, the switch is turned off.

To provide for unattended re-ignition in the event of pilot flame failure, the switch is placed in the "Auto" position. In this position the timer is activated, alternately energizing and de-energizing the transformer, cycling the ignition spark. The dual cycling timer provides separate adjustment for the spark duration and the time between sparking.

CONSTRUCTION

The Model 240HOA Ignitor is housed in a NEMA 4 rated enclosure. The ignition electrode housing is steel with an aluminum cover. Both the control enclosure and electrode housing are provided with 1/2-inch NPT female conduit connections.

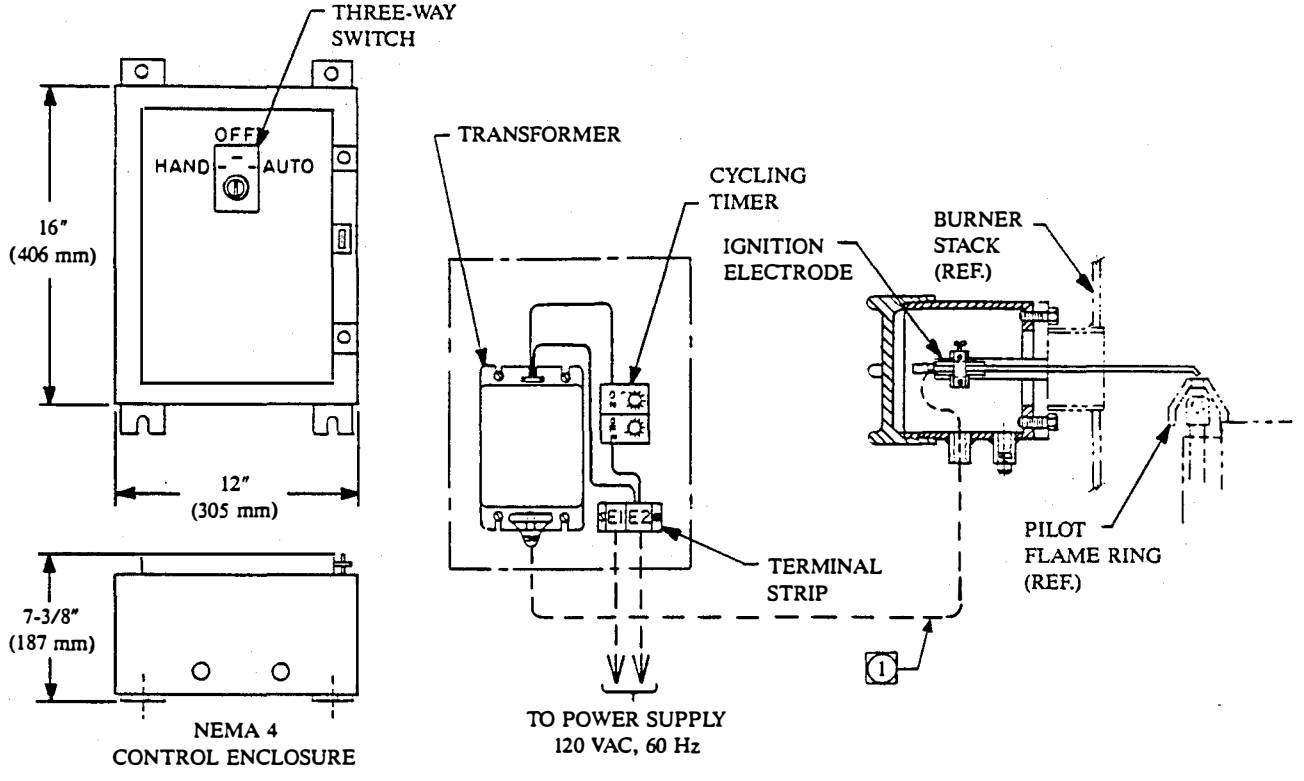
The transformer is rated for continuous duty with 110 VAC, 60 Hz primary, and 6000 VAC secondary. The timer is adjustable from 3 to 300 seconds for both the "Ignition Spark On" and the "Ignition Spark Off" cycle.

OPTIONAL IGNITION SYSTEMS

VAREC manufactures several additional models of electric pilot ignition systems for use with the 239A Waste Gas Burner. These systems include Model 240 Manually Operated Ignitor, Model 241UV Manual Start/Automatic Re-Ignition, and Model 242UV Automatic Start/Automatic Re-Ignition. These ignition systems are described fully in their respective data sheets, PDS 240WT, PDS 241WT and PDS 242WT.

VAREC 240 H-O-A SERIES MANUAL/CYCLING ELECTRIC PILOT IGNITOR

DIMENSIONAL DRAWING



NOTES:

1. USE 18 AWG WITH 7 mm INSULATION RATED FOR 10,000 VAC AT 250°C.
2. ALL FIELD WIRING AND CONDUIT BY OTHERS.
3. CONTROL PANEL TO BE MOUNTED NOT LESS THAN 10 FEET (3 m) AWAY FROM WASTE GAS BURNER.
4. SHIPPING WEIGHT: 50 LBS (23 KG).

Installation, mounting arrangement, and dimensions are preliminary general information not to be used for construction. Certified drawings are available.

ORDERING INFORMATION

240	MANUAL/CYCLING ELECTRIC PILOT IGNITOR		
	Code	**Model**	
	HOA	Hand-Off-Auto Switch with Cycling Timer	
	Code	**Size**	(Same as Model 239A Burner Size — Select One)
	02	2"	
	03	3"	
	04	4"	
	06	6"	
	08	8"	
	Code	**Enclosure Rating** (Select One)	
	4	NEMA 4 (Standard)	

240	HOA	04	4	(EXAMPLE)

VAREC
a Rosemount Division
10800 Valley View St., Cypress, CA 90630 (714) 761-1300 Telex: 4722044 FAX: (714) 952-2701
WARZYN

APPENDIX D

LEACHATE EXTRACTION AND STORAGE CALCULATIONS

WARZYN

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY JCK DATE 10.31.89 SUBJECT REFUSE HIDEAWAY LEACHATE EXTRACTION WELL PUMP SHEET NO. 1 OF 10
CHKD. BY MAL DATE 11/1/89 JOB NO. 13723

A. OBJECTIVE: CALCULATE PUMP SIZE NECESSARY TO WITHDRAW LEACHATE FROM 6" ϕ EXTRACTION WELLS

B. ASSUMPTIONS:

1) WELL DEPTH RANGES FROM 50' TO 90' CALC ASSUMES 90' (FULL SYSTEM)
2) SUBMERSIBLE SS WELL PUMP CONTROLLED BY AMPERAGE SENSOR AND TIMER (≈ 5 HOUR CYCLE TIME)
3) WELL PUMPS ALSO STOPPED BY HIGH LEVEL IN LEACHATE HOLDING TANK OR LIQUID DETECTED IN TANK INTERSTICE
4) 1/4" HOLE DRILLED IN DISCHARGE ABOVE PUMP ALLOWS FOR DRAIN BACK FOR FROST PROTECTION
5) PUMP DISCHARGES THROUGH 1" HOSE, 1" HDPE AND THEN TO GRAVITY FLOW IN 6" HDPE
6) 1" ABOVE GRADE PORTION OF PIPE IS INSULATED AND HEAT TRACED
7) ALL ELECTRICAL CONNECTIONS THRU WELL CASING ARE SEALED
8) PUMPING RATE OF 2 - 7 GPM IS BASED ON THEORETICAL PROJECTIONS AND FIELD EXPERIENCE AT SIMILAR SITES. IT IS ESTIMATED THAT WELL RECHARGE RATES WILL BE WITHIN THIS RANGE OR LESS.

WARZYN

C. CALCULATION:

STATIC HEAD = 90'

SYSTEM HEADLOSS:

ITEM	LENGTH	EQ. LENGTH 1"
1. 1" ϕ EPDM HOSE	90'	—
2. 1" ϕ ss 90° ELBOW	—	2.6'
3. 1" ϕ HDPE PIPE	10'	—
	100'	2.6'

TOTAL EQ. LENGTH 1" HDPE PIPE = 100 + 2.6 = 102.6'

Q	h_L	STATIC	TDH
2 GPM	0.90'	90'	90.9'
5	2.82	↓	92.8
7	5.17		95.2
10	9.86		99.9

∴ WHEN THE SYSTEM TDH CURVE IS COMPARED WITH PUMP CURVE IT IS APPARENT THE PUMP HAS MORE THAN ADEQUATE CAPACITY.

WARZYN

Flow Capacity and Friction Loss for Schedule 80 Thermoplastic Pipe Per 100 Ft.

GALLONS PER MINUTE	½ in. VELOCITY FEET PER SECOND	½ in. FRICTION HEAD FEET	½ in. FRICTION LOSS POUNDS PER SQUARE INCH	¾ in. VELOCITY FEET PER SECOND	¾ in. FRICTION HEAD FEET	¾ in. FRICTION LOSS POUNDS PER SQUARE INCH	1 in. VELOCITY FEET PER SECOND	1 in. FRICTION HEAD FEET	1 in. FRICTION LOSS POUNDS PER SQUARE INCH	1¼ in. VELOCITY FEET PER SECOND	1¼ in. FRICTION HEAD FEET	1¼ in. FRICTION LOSS POUNDS PER SQUARE INCH	1½ in. VELOCITY FEET PER SECOND	1½ in. FRICTION HEAD FEET	1½ in. FRICTION LOSS POUNDS PER SQUARE INCH	2 in. VELOCITY FEET PER SECOND	2 in. FRICTION HEAD FEET	2 in. FRICTION LOSS POUNDS PER SQUARE INCH	2½ in. VELOCITY FEET PER SECOND	2½ in. FRICTION HEAD FEET	2½ in. FRICTION LOSS POUNDS PER SQUARE INCH	3 in. VELOCITY FEET PER SECOND	3 in. FRICTION HEAD FEET	3 in. FRICTION LOSS POUNDS PER SQUARE INCH
1	1 48	4 02	1.74	0 74	0.86	0.37																			
2	2.95	8 03	3.48	1 57	1 72	0.74	0 94	0 88	0.38	0.52	0.21	0.09	0 38	0 10	0.041										
5	7.39	45.23	19.59	3.92	9 67	4 19	2.34	2 75	1 19	1 30	0.66	0.29	0 94	0 30	0 126	0 56	0.10	0 040	0 39	0 05	0 022	0.25	0.02	0 009	
7	10.34	83.07	35.97	5 49	17.76	7.69	3 28	5 04	2 19	1 82	1 21	0 53	1 32	0 55	0 24	0 78	0 15	0 065	0 54	0 07	0 032	0 35	0 028	0 012	
10				7 84	33 84	14 65	4 68	9 61	4 16	2 60	2 30	1 00	1 88	1 04	0 45	1 12	0 29	0 13	0 78	0 12	0 052	0 50	0 04	0 017	
15		4 in.		11 76	71 70	31 05	7 01	20 36	8 82	3 90	4 87	2.11	2 81	2 20	0 95	1 68	0 62	0 27	1 17	0 26	0 11	0 75	0 09	0 039	
20	0.57	0 04	0 017				9 35	34 68	15 02	5 20	8 30	3 59	3 75	3 75	1 62	2 23	1 06	0 46	1 56	0 44	0 19	1 00	0 15	0 065	
25	0 72	0 06	0 026				11 69	52 43	22 70	6 50	12 55	5 43	4 69	5 67	2 46	2 79	1 60	0 69	1 95	0 67	0 29	1 25	0 22	0 095	
30	0 86	0 08	0 035				14 03	73 48	31 82	7 80	17 59	7 62	5 63	7 95	3 44	3 35	2 25	0 97	2 34	0 94	0 41	1 49	0 31	0 13	
35	1 00	0 11	0 048							9 10	23 40	10 13	6 57	10 58	4 58	3 91	2 99	1 29	2 73	1 25	0 54	1 74	0 42	0 18	
40	1 15	0 14	0 061							10 40	29 97	12 98	7 50	13 55	5 87	4 47	3 83	1 66	3 12	1 60	0 69	1 99	0 54	0 23	
45	1 29	0 17	0 074					8 in.		11 70	37 27	16 14	8 44	16 85	7 30	5 03	4 76	2 07	3 51	1 99	0 86	2 24	0 67	0 29	
50	1 43	0 21	0 091				0 63	0 03	0 013	13 00	45 30	19 61	9 38	20 48	8 87	5 58	5 79	2 51	3 90	2 42	1 05	2 49	0 81	0 35	
60	1 72	0 30	0 13				0 75	0 04	0 017				11 26	28 70	12 43	6 70	8 12	3 52	4 68	3 39	1 47	2 99	1 14	0 49	
70	2 01	0 39	0 17				0 88	0 05	0 022							7 82	10 80	4 68	5 46	4 51	1 95	3 49	1 51	0 65	
75	2.15	0.45	0.19				0 94	0 06	0 026							8 38	12 27	5 31	5 85	5 12	2 22	3 74	1 72	0.74	
80	2 29	0 50	0.22				1 00	0 07	0 030							8 93	13 83	5 99	6 24	5 77	2 50	3 99	1 94	0 84	
90	2 58	0 63	0 27				1 13	0 08	0 035		8 in.					10 05	17 20	7 45	7 02	7 16	3.11	4 48	2 41	1 04	
100	2.87	0.76	0.33				1 25	0 10	0 043							11.17	20 90	9 05	7 80	8 72	3 78	4 98	2 03	1 27	
125	3 59	1 16	0 50				1 57	0 16	0 068	0 90	0 045	0 019		10 in.					9 75	13 21	5 72	6 23	4 43	1 92	
150	4.30	1 61	0.70				1 88	0 22	0 095	1 07	0 05	0 022							11 70	18 48	8 00	7 47	6 20	2 68	
175	5.02	2 15	0 93				2 20	0 29	0 12	1 25	0 075	0 033										8 72	8 26	3 58	
200	5.73	2.75	1 19				2 51	0 37	0 16	1 43	0 09	0 039	0 90	0 036	0 015							9 97	10.57	4 58	
250	7.16	4.16	1 81				3 14	0 56	0 24	1.79	0 14	0 61	1 14	0 045	0 02		12 in.					12 46	16.00	6 93	
300	8 80	5.83	2.52				3 76	0 78	0 34	2 14	0 20	0 087	1 36	0 07	0 03										
350	10 03	7.76	3.36				4 39	1 04	0 45	2 50	0 27	0 12	1 59	0 085	0 037	1 12	0 037	0 016							
400	11 47	9.93	4.30				5 02	1 33	0 58	2 86	0 34	0.15	1 81	0.11	0 048	1 28	0 05	0 022							
450							5 64	1 65	0 71	3 21	0 42	0 18	2 04	0.14	0 061	1 44	0 06	0 026							
500							6 27	2 00	0 87	3 57	0 51	0 22	2 27	0 17	0 074	1 60	0 07	0 030							
750							9 40	4 25	1 84	5 36	1 08	0 47	3 40	0 36	0 16	2.40	0 15	0 065							

Equivalent Length of Pipe, Feet

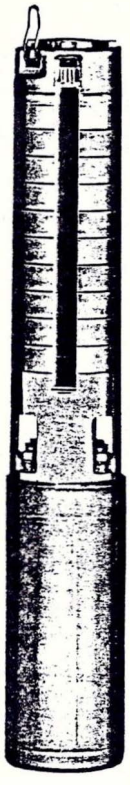
			¼"	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	6"	8"	10"	12"
FITTINGS	90° Standard Elbow		0.9	1.6	2.1	2.6	3.5	4.0	5.5	6.2	7.7	10.1	15.2	20.0	25.1	29.8
	40° Standard Elbow		0.5	0.8	1.1	1.4	1.8	2.1	2.8	3.3	4.1	5.4	8.1	10.6	13.4	15.9
	90° Long Radius Elbow		0.6	1.0	1.4	1.7	2.3	2.7	4.3	5.1	6.3	8.3	12.5	16.5	20.7	24.7
	90° Street Elbow		1.5	2.6	3.4	4.4	5.8	6.7	8.6	10.3	12.8	16.8	25.3	33.3	41.8	49.7
	45° Street Elbow		0.8	1.3	1.8	2.3	3.0	3.5	4.5	5.4	6.6	8.7	13.1	17.3	21.7	25.9
	Square Corner Elbow		1.7	3.0	3.9	5.0	6.5	7.6	9.8	11.7	14.6	19.1	28.8	37.9	47.6	56.7
	Standard Tee	With Flow through run	0.6	1.0	1.4	1.7	2.3	2.7	4.3	5.1	6.3	8.3	12.5	16.5	20.7	24.7
		With Flow through branch	1.8	4.0	5.1	6.0	6.9	8.1	12	14.3	16.3	22.1	32.2	39.9	50.1	59.7

WARZYN

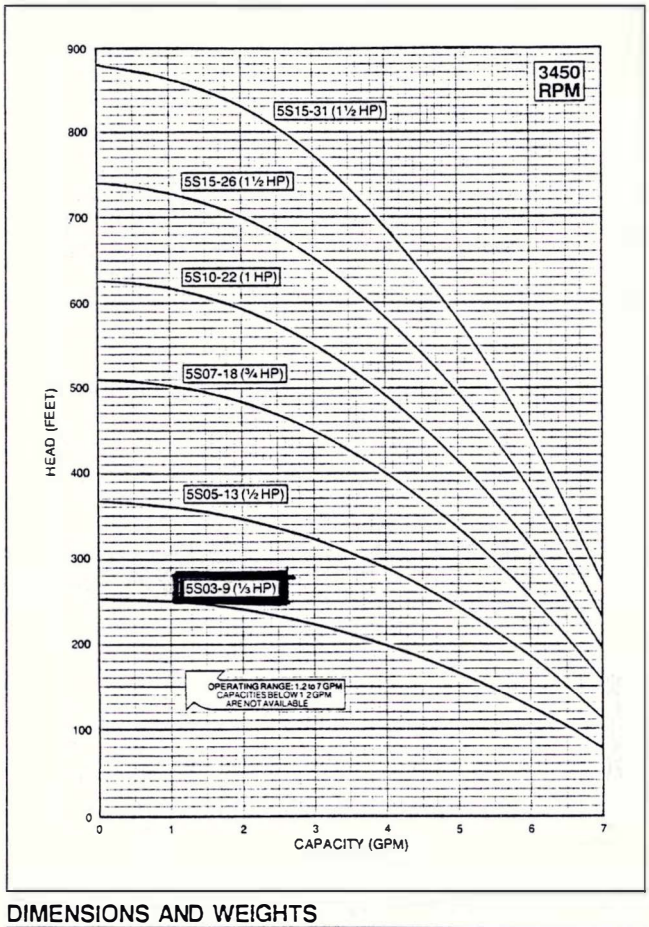
MODEL 5S — 5 GPM — GRUNDFOS

FLOW RANGE
1.2 to 7 GPM

PUMP OUTLET
1" NPT



PERFORMANCE CURVES



DIMENSIONS AND WEIGHTS

MODEL NO.	HP	LENGTH (INCHES)	WIDTH (INCHES)	APPROX. UNIT SHIPPING WT. (LBS.)
5S03-9	⅓	24⅜	3¾	27
5S05-13	½	28½	3¾	31
5S07-18	¾	33¼	3¾	34
5S10-22	1	37⅛	3¾	42
5S15-26	1½	42	3¾	46
5S15-31	1½	47⅞	3¾	58

Specifications are subject to change without notice.

WARZYN

GRUNDFOS 5 GPM MODEL 5S

SELECTION CHARTS
(Ratings are in GALLONS PER HOUR–GPH)

FLOW RANGE 1.2 to 7 GPM

PUMP OUTLET 1" NPT

PUMP MODEL	HP	PSI	DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																								
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
5S03-9	1/3	0				428	401	374	347	320	268	256	191	127													
		20		420	393	366	339	312	277	242	169	95															
		30		389	362	335	306	276	225	174	37																
		40	400	358	330	303	265	228	143																		
		50	369	327	296	265	208	150	75																		
		60	337	294	253	211	114																				
	Shut-off PSI:		102	94	85	76	68	59	50	42	33	24	16	7													
5S05-13	1/2	0						423	435	386	367	349	330	311	289	267	233	137									
		20			437	418	399	380	362	343	324	305	282	259	222	185	117										
		30		434	415	396	377	359	340	322	301	281	251	222	170	117											
		40	431	412	393	375	356	338	318	299	275	250	210	170	94												
		50	409	390	372	353	335	316	295	273	242	210	153	95													
		60	388	369	350	332	312	293	267	241	197	153	75														
	Shut-off PSI:		152	143	134	126	117	108	100	91	92	74	55	56	48	39	30	13									
5S07-18	3/4	0								427	413	400	386	373	360	346	333	305	254	163							
		20						423	409	396	382	369	355	342	329	315	300	267	193								
		30					421	407	394	380	367	353	340	327	313	299	282	242	149								
		40			432	419	405	392	378	365	351	338	325	311	296	281	261	212	92								
		50		430	417	403	390	376	363	349	336	323	308	294	277	259	235	173									
		60	428	415	401	388	374	361	347	334	320	307	291	275	255	234	203	123									
	Shut-off PSI:		213	204	195	187	178	169	161	152	143	135	126	117	109	100	91	74	48	22							
5S10-22	1	0										426	415	404	393	382	371	349	316	279	228	103					
		20								423	412	401	390	379	368	357	346	324	289	241	167						
		30							421	410	399	388	377	366	355	344	334	311	273	216	126						
		40						420	409	398	387	376	365	354	343	332	321	297	255	186	75						
		50				429	418	407	396	385	374	363	352	341	330	319	307	282	233	149							
		60			427	416	405	394	383	372	361	350	340	329	317	306	293	265	207	103							
	Shut-off PSI:				245	237	228	219	211	202	194	185	176	168	159	150	142	124	98	72	46	12					
5S15-26	1 1/2	0												427	418	408	399	381	353	325	296	245	126				
		20										424	415	406	396	387	378	359	332	303	269	202					
		30									423	414	404	395	386	376	367	349	321	290	253	175					
		40								422	412	403	394	384	375	366	357	338	310	277	235	142					
		50							420	411	401	392	383	374	364	355	346	327	298	262	214	102					
		60						419	409	400	391	381	372	363	354	345	335	317	286	245	188						
	Shut-off PSI:							269	260	252	243	234	226	217	208	200	191	174	148	122	96	61	18				
5S15-31	1 1/2	0														425	417	401	378	355	331	299	246	158			
		20												423	415	407	399	383	360	337	313	277	212	94			
		30											421	413	406	398	390	374	351	328	303	265	191	53			
		40										420	413	405	397	389	381	365	342	318	293	252	166				
		50								427	419	411	403	395	388	380	372	357	333	309	283	237	138				
		60							426	418	410	402	395	387	379	371	363	348	324	300	271	219	104				
	Shut-off PSI:								320	311	303	294	285	277	268	259	251	233	207	181	155	121	77	34			

WARZYN

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY JCK DATE 10-31-89 SUBJECT REFUSE HIDEAWAY SHEET NO. 2 OF 10
CHKD. BY MAL DATE 11/1/89 LEACHATE / CONDENSATE JOB NO. 13923
PIPING

A. OBJECTIVE: CALCULATE SIZE OF HDPE GRAVITY LEACHATE CONVEYANCE PIPE FROM WELL HEAD TO LEACHATE HOLDING TANK

B. ASSUMPTIONS:

1) LEACHATE DENSITY SIMILAR TO WATER
2) PIPE IS SDR 17 HDPE, 6" Φ
3) MINIMUM PIPE SLOPE IS 0.5 %
4) MAX. FLOWRATE IF 13 WELL PUMPS AT 5 GPM EACH IS 65 GPM
5) CONDENSATE GENERATION ESTIMATED AT 0.44* GAL/SCFM/DAY GAS EXTRACTED
13 WELLS @ 50 SCFM (0.44) = 286 GAL/DAY = 0.20 GPM
6) PIPE WILL FLOW AS OPEN CHANNEL GRAVITY FLOW PIPE

*MAXIMUM CONDENSATE PRODUCTION AT EXISTING LANDFILL FOR WINTER CONDITIONS (BASED ON PREVIOUS CONDENSATE VOLUME ANALYSIS NOV. 1988, WARZYN PROJ. NO. 13262)

C. CALCULATION:

BASED ON GRAVITY FLOW NOMOGRAPH THE FOLLOWING FLOW RATES HAVE BEEN ESTIMATED FOR A 6" PIPE:

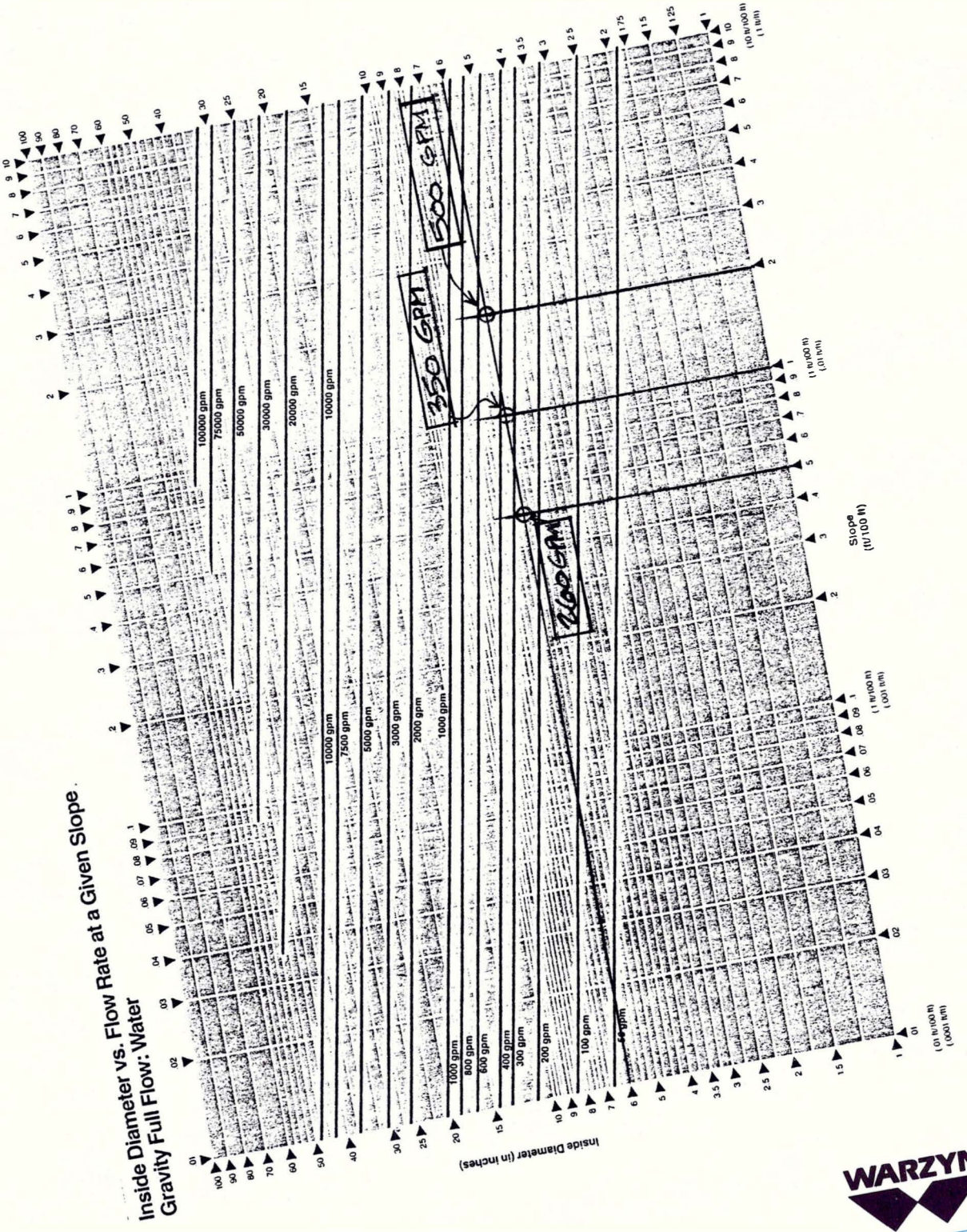
SLOPE	FLOWRATE
0.5%	360 GPM
1.0%	[illegible] GPM
2.0%	[illegible] GPM

CAPACITY FAR EXCEEDS MAX. FLOW GENERATION.

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY JCK DATE 10.31.89 SUBJECT BEECHE HIDEAWAY
CHKD. BY MAC DATE 11.1.89 HDPE GRAVITY FLOW

SHEET NO. 7 OF 16
JOB NO. 13923



WARZYN

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY LCK DATE 10-31-89 SUBJECT REFUSE HIDEAWAY SHEET NO. 3 OF 16
CHKD. BY MAL DATE 11/1/89 LEACHATE TANK SIZING JOB NO. 13928

A. OBJECTIVE: ESTIMATE STEADY STATE LEACHATE PRODUCTION RATE FROM SITE AND SIZE HOLDING TANK

B. ASSUMPTIONS:

1) THREE DAY LEACHATE HOLDING
2) REFUSE POROSITY ≈ 30%
3) COVER TO BE UPGRADED TO NR 504.07 REQUIREMENT (FUTURE) 10^{-7} CM/S CONDUCTIVITY
4) COVER AREA ESTIMATED AT 19 ACRES
5) PRESENT LEACHATE VOLUME STANDING IN REFUSE CANNOT BE ACCURATELY ESTIMATED BECAUSE OF INACCESSIBLE (DAMAGED) LEACHATE HEAD WELLS & OUTDATED DATA
6) COVER INFILTRATION ESTIMATED AT 3"-5"/YR. WITH MAX OF 12"/YR.
7) BASE PERMIABILITY ALLOWS HEAD TO FORM

C. CALCULATION:

LEACHATE PRODUCTION

$$Q_{3"/YR} = 19\ Ac.\left(\frac{43560\ SF}{Ac}\right)\frac{3}{12}\left(\frac{7.48}{365}\right) = 4240\ GAL/D$$

$$Q_{5"/YR} = 19\,(43560)\frac{5}{12}\left(\frac{7.48}{365}\right) = 7067\ GAL/D$$

$$Q_{12"/YR} = 19\,(43560)\ \frac{7.48}{365} = 16{,}961\ GAL/D$$

TO BE CONSERVATIVE ASSUME 5"/YR. INFILTRATION RATE. TANK SIZE = 3 DAY STORAGE @ 7067 = 21,201 GAL

∴ USE A 25,000 GALLON HOLDING TANK

AREA AND VOLUME COMPUTATIONS
WARZYN ENGINEERING INC.

USER INITIALS: JCK DATE: 9-18-89

PROJECT INFORMATION
PROJECT NAME: REFUSE HIDEAWAY
PROJECT NUMBER: 13926

INITIALIZATION DATA
HORZ. SCALE(FT/IN): 60
VERT. SCALE(FT/IN): 60
PRECISION(%): 995

AREA ID.: 1
VOLUME TYPE: LEACHATE
AVERAGE DEPTH(FT)= 6
AREA(SI)= 112.0713
AREA(SF)= 403457
AREA(SY)= 44829
AREA(ACRES)= 9.262
VOLUME(CY)= 89657
NOTE: A PRECISION OVERRIDE OF 99.84 % WAS ACCEPTED FOR THIS AREA

AREA ID.: 2
VOLUME TYPE: LEACHATE
AVERAGE DEPTH(FT)= 1
AREA(SI)= 112.5592
AREA(SF)= 405213
AREA(SY)= 45024
AREA(ACRES)= 9.302
VOLUME(CY)= 15008
NOTE: A PRECISION OVERRIDE OF 99.46 % WAS ACCEPTED FOR THIS AREA

AREA ID.: 3
VOLUME TYPE: WASTE
AVERAGE DEPTH(FT)= 0
AREA(SI)= 228.5099
AREA(SF)= 822635
AREA(SY)= 91404
AREA(ACRES)= 18.895
VOLUME(CY)= 0
NOTE: A PRECISION OVERRIDE OF 100 % WAS ACCEPTED FOR THIS AREA

WARZYN

MEMORANDUM

November 1, 1989

To: File 13928.40 - H

From: Jan C. Kucher, P.E.

Re: Leachate Generation and Storage
Refuse Hideaway Landfill

The purpose of this memorandum is to summarize and outline analysis performed to estimate leachate generated and holding tank sizing at Refuse Hideaway Landfill.

Based on leachate level data obtained from the January 1988 In-Field Conditions Report, by RMT Inc. a 10 to 12 ft leachate head was documented on the base of the landfill in the area of leachate headwells LH-1 and LH-2. This information was used in conjunction with an infiltration estimate as a basis for estimating the size of leachate holding tank required.

Typically the HELP model (Hydrologic Evaluation of Liner Performance) is used to determine the flow of precipitation into the landfill through the cover. This model takes into consideration many factors, of which we do not have adequate data.

Based on Help model analyses run on covers of a similar design, a conservative conductivity through the cover would be 3 to 5 inches per year, with a maximum of 12 inches per year. The tank will be designed for three days of leachate storage. Using these assumptions, at three inches per year, the infiltration through the cover is estimated at 4,200 gallons per day, with three-day storage at 12,800 gallons. At five inches per year, infiltration through the cover is estimated at 7,100 gallons per day with three-day storage of 21,300 gallons. At 12 inches per year, infiltration though the cover is estimated at 17,000 gallons per day with three-day storage at 51,000 gallons. Assuming an infiltration of five inches per year through the cover, we anticipate that a 25,000 gallon leachate storage tank will be adequate.

A 30-year design life for the tank is assumed. After determining the size necessary for the leachate tank, an analysis was performed to compare various types of tanks, both below grade and above grade. For above-grade tanks, either double-wall tanks would be needed, or single-wall with a containment berm containing the total volume of the tank. Additionally, tank insulation and heat tracing would be essential, with alarms in the event the leachate temperature dropped near freezing. This would of course incur energy costs for the heating of the tanks, as well as maintenance costs associated with frost protection on both the piping and the tank. Based on these factors, we recommend a below-grade tank.

Both steel and fiberglass double wall tanks were evaluated. A steel tank was found to be most cost effective for this application based on warranty, cost, integrity, monitoring capability, delivery time, and compatibility with leachate.

JCK/kjw/JVS
[wpmisc-111-99]
13928.40

WARZYN

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY JCK DATE 10.30.97 SUBJECT REFUSE HIDEAWAY SHEET NO. 11 OF 12
CHKD. BY MAC DATE 11.1.97 LEACHATE EXTRACTION JOB NO. 13923
FROM HOLDING TANK

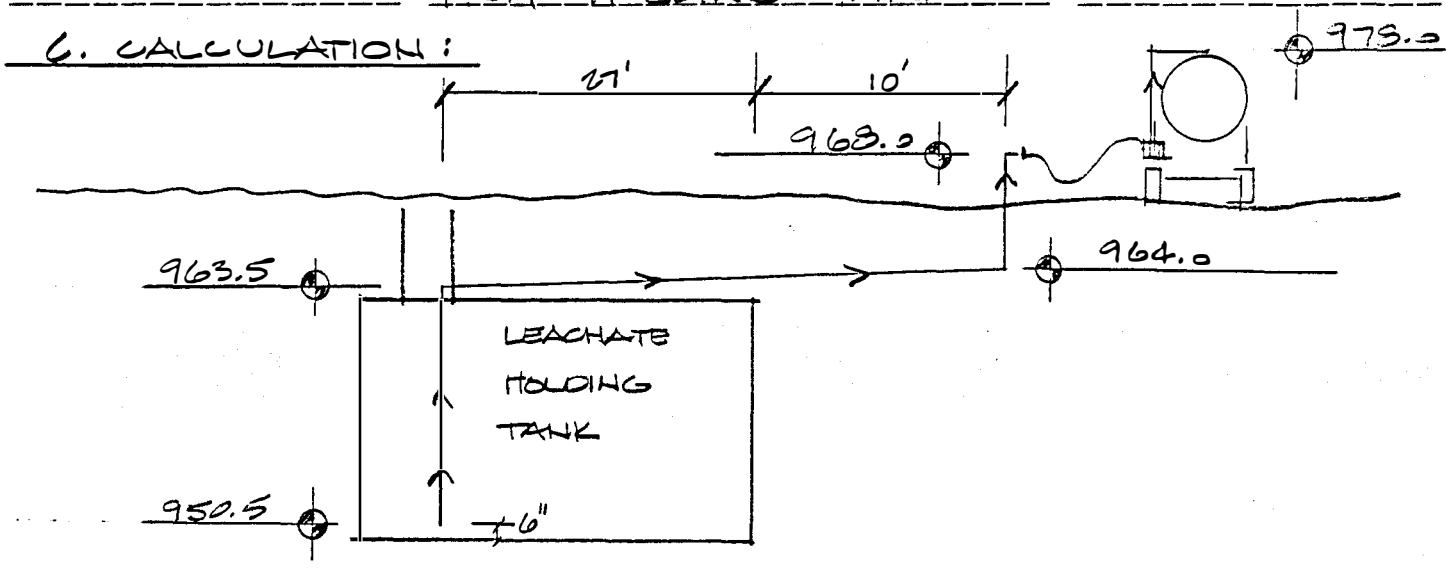
A. OBJECTIVE: CALCULATE PUMP SIZE NECESSARY FOR LEACHATE EXTRACTION FROM HOLDING TANK (USING TRUCK MOUNTED SUCTION PUMP)

B. ASSUMPTIONS:

1) LEACHATE DENSITY SIMILAR TO WATER
2) SEPTIC TANK PUMPOUT TRUCK USED
3) TRUCK HOSE CONNECTS TO DUCTILE IRON STANDPIPE VIA QUICK CONNECT COUPLING
4) 4" SCH 80 PVC SUCTION PIPE SLOPED TO DRAIN BACK TO LEACHATE HOLDING TANK (FOR FROST PROTECTION)
5) 4" SCH 80 PVC PIPE IS RUN TO LOADOUT AREA FOR FUTURE SPILLAGE DRAINBACK

WARZYN

6. CALCULATION :



HYDRAULIC PROFILE
N.T.S.

STATIC HEAD = SUCTION + DISCHARGE = 17.5' + 10' = 27.5'

SYSTEM HEADLOSS :

ITEM	LENGTH	EQ. 4" LENGTH
1. 4"ϕ SCH 80 PVC SUCTION	13.0'	—
2. 4" ϕ SCH 80 PVC 90° ELBOW	—	10.1'
3. 4" ϕ SCH 80 PVC SUCTION	37.0'	—
4. 4" ϕ SCH 80 PVC 90° ELBOW	—	10.1
5. 4" ϕ CLASS 50 D.I.	4.0'	—
6. 4" ϕ CLASS 50 D.I. 90° ELBOW	—	10.1'
7. 4" ϕ EPDM HOSE	10.0'	
SUCTION SUBTOTAL	64.0' +	30.3 = 94.3'
8. 4" ϕ D.I. PUMP DISCHARGE	10'	—
DISCHARGE SUBTOTAL	10'	

TOTAL EQUIVALENT LENGTH SCH 80 PVC = 94.3' + 10.0' = 104.3'

WARZYN

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY JCK DATE 10-30-89 SUBJECT REFUSE HIDEAWAY SHEET NO. 13 OF 16
CHKD. BY MAL DATE 11/1/89 LEACHATE EXTRACTION FROM JOB NO. 13923
HOLDING TANK

Q	SUCTION h_L ①	DISCH. h_L ②	Σh_L	STATIC	TDH	NPSH$_A$ ③
50 GPM	0.20'	0.02'	0.22'	27.5'	27.7'	15.3'
75	0.42	0.04	0.46		28.0	15.1
100	0.72	0.08	0.80		28.3	14.8
125	1.09	0.12	1.21		28.7	14.4
150	1.52	0.16	1.68		29.2	14.0
175	2.03	0.22	2.25		29.8	13.5
200	2.59	0.28	2.87		30.4	12.94

① SUCTION $h_L = 94.3 \left(\frac{h_L}{100'} @ n \text{ GPM}\right)$
② DISCHARGE $h_L = 10 \left(\frac{h_L}{100'} @ n \text{ GPM}\right)$
③ $NPSH_A = P_{ATM} - H - P_V - h_L = 14.7(2.31) - 17.5 - 0.+(2.31) - h_L$
$= 15.53 - h_L$

$NPSH_A > NPSH_{REQ.}$ f(PUMP OPERATING CHARACTERISTICS)

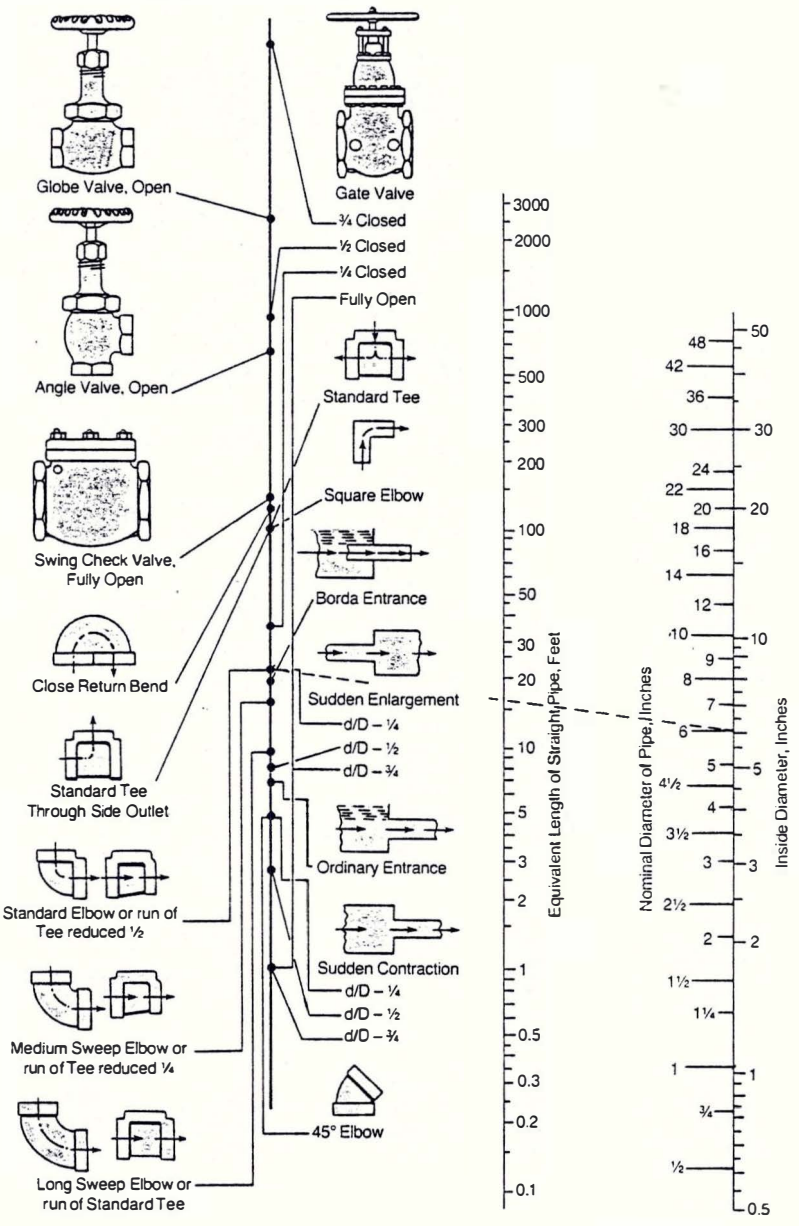
AFTER DISCUSSING APPLICATION WITH PUMP SUPPLIER AND SEPTIC TANK PUMP OUT HAULERS IT SHOULD BE NO PROBLEM TO EXTRACT LEACHATE.

WARZYN

Resistance of Valves and Fittings to Flow of Fluids

Example: The dashed line shows that the resistance of a 6-in. standard elbow is equivalent to approximately 16 ft of 6-in. standard pipe.

Note: For sudden enlargements or sudden contractions, use the smaller diameter, d on the pipe-size scale. Head loss through check valves varies with types manufactured. Consult with manufacturer for correct values.



Courtesy of Crane Co.

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY JCK DATE 12-31-89 SUBJECT LEHIGH HIGHWAY SHEET NO. 15 OF 17
CHKD. BY ___ DATE ___ LEACHATE HOLDING TANK JOB NO. 1355
DEPTH/VOLUME RELATION

REFERENCE: A&S WELDING (TANK MANUFACTURER)

25,000 Gal - 12' x 30'
Tank Chart

144	25,381	109	20,612	74	13,139	39	5,553
143	25,356	108	20,419	73	12,915	38	5,354
142	25,311	107	20,224	72	12,690	37	5,157
141	25,252	106	20,026	71	12,466	36	4,962
140	25,183	105	19,828	70	12,242	35	4,769
138	25,019	103	19,426	68	11,793	33	4,387
137	24,926	102	19,223	67	11,569	32	4,200
136	24,286	101	19,018	66	11,345	31	4,014
134	24,609	99	18,604	64	10,899	30	3,831
133	24,492	98	18,396	63	10,676	29	3,650
132	24,371	97	18,186	62	10,453	28	3,471
131	24,244	96	17,975	61	10,232	27	3,294
130	24,114	95	17,763	60	10,010	26	3,120
129	23,979	94	17,550	59	9,789	25	2,949
128	23,839	93	17,335	58	9,568	24	2,781
127	23,696	92	17,120	57	9,349	23	2,615
126	23,550	91	16,904	56	9,130	22	2,452
125	23,400	90	16,687	55	8,911	21	2,292
124	23,246	89	16,470	54	8,693	20	2,135
123	23,089	88	16,251	53	8,477	19	1,981
122	22,929	87	16,032	52	8,261	18	1,831
121	22,766	86	15,812	51	8,045	17	1,684
120	22,600	85	15,592	50	7,831	16	1,542
119	22,432	84	15,371	49	7,618	15	1,403
118	22,260	83	15,149	48	7,406	14	1,268
117	22,086	82	14,927	47	7,195	13	1,137
116	21,910	81	14,705	46	6,985	12	1,010
115	21,731	80	14,482	45	6,776	11	888
114	21,550	79	14,259	44	6,569	10	772
113	21,367	78	14,035	43	6,363	9	661
112	21,181	77	13,811	42	6,158	8	555
111	20,993	76	13,587	41	5,955	7	455
110	20,804	75	13,364	40	5,753	6	362
						5	276
						4	198
						3	129
						2	70
						1	25

TABLE TO BE USED TO DETERMINE GALLON VOLUME IN TANK FOR OPERATION AND MAINTENANCE PURPOSES.

WARZYN

WARZYN ENGINEERING INC.
MADISON, WISCONSIN

BY LLL DATE 10-31-89 SUBJECT REFUSE HIDEAWAY SHEET NO. 16 OF 16
CHKD. BY DAE DATE 11-1-89 LEACHATE HOLDING TANK JOB NO. 13925
BALLAST CALCULATION

A. OBJECTIVE: CHECK BOUYANCY AND DESIGN BALLAST FOR LEACHATE HOLDING TANK

B. ASSUMPTIONS:

1) 25,000 GALLON EMPTY TANK
2) WATER TABLE AT SURFACE*
3) WT. OF SATURATED SOIL = 60 PCF
4) BALLAST TO CONSIST OF CONCRETE DEADMEN ON EACH SIDE OF TANK ANCHORED WITH STEEL STRAPS

* WATER TABLE ASSUMED AT SURFACE FOR BOUYANCY WORST CASE

C. CALCULATION:

RESTRAINING FORCES:

SOIL ABOVE TANK
$12' (4)\ 30' (60\#/CF) = 86{,}400\ \#$
TANK WEIGHT $= 35{,}000\ \#$
DEADMEN
$2\ (30')\ 2\ (1'\ THK)(150-62.4) = 10{,}512\ \#$
SOIL ABOVE DEADMEN
$2\ (30')\ 2\ (17')\ (60\#/CF) = 122{,}400\ \#$
$254{,}312\ \#$

BOUYANT FORCE:

EMPTY TANK
$25{,}000\ GAL \left(\frac{CF}{7.48\ GAL}\right) \frac{62.4\ \#}{CF} = 208{,}556\ \#$

FACTOR OF SAFETY: $\frac{254{,}312}{208{,}556} =$ 1.22

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
TOWN OF MIDDLETON
DANE COUNTY, WISCONSIN

LIST OF DRAWINGS

SHEET NO.	TITLE	DRAWING NO.
1	PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM LAYOUT	13928-1
2	DETAILS	13928-2
3	DETAILS	13928-3
4	DETAILS	13928-4
5	DETAILS	13928-5
6	LEACHATE HOLDING TANK DETAILS	13928-6

REVISIONS

SITE LOCATION MAP

north

0 8 16
SCALE IN MILES

PREPARED FOR:
WISCONSIN DEPARTMENT OF
NATURAL RESOURCES
MADISON, WISCONSIN

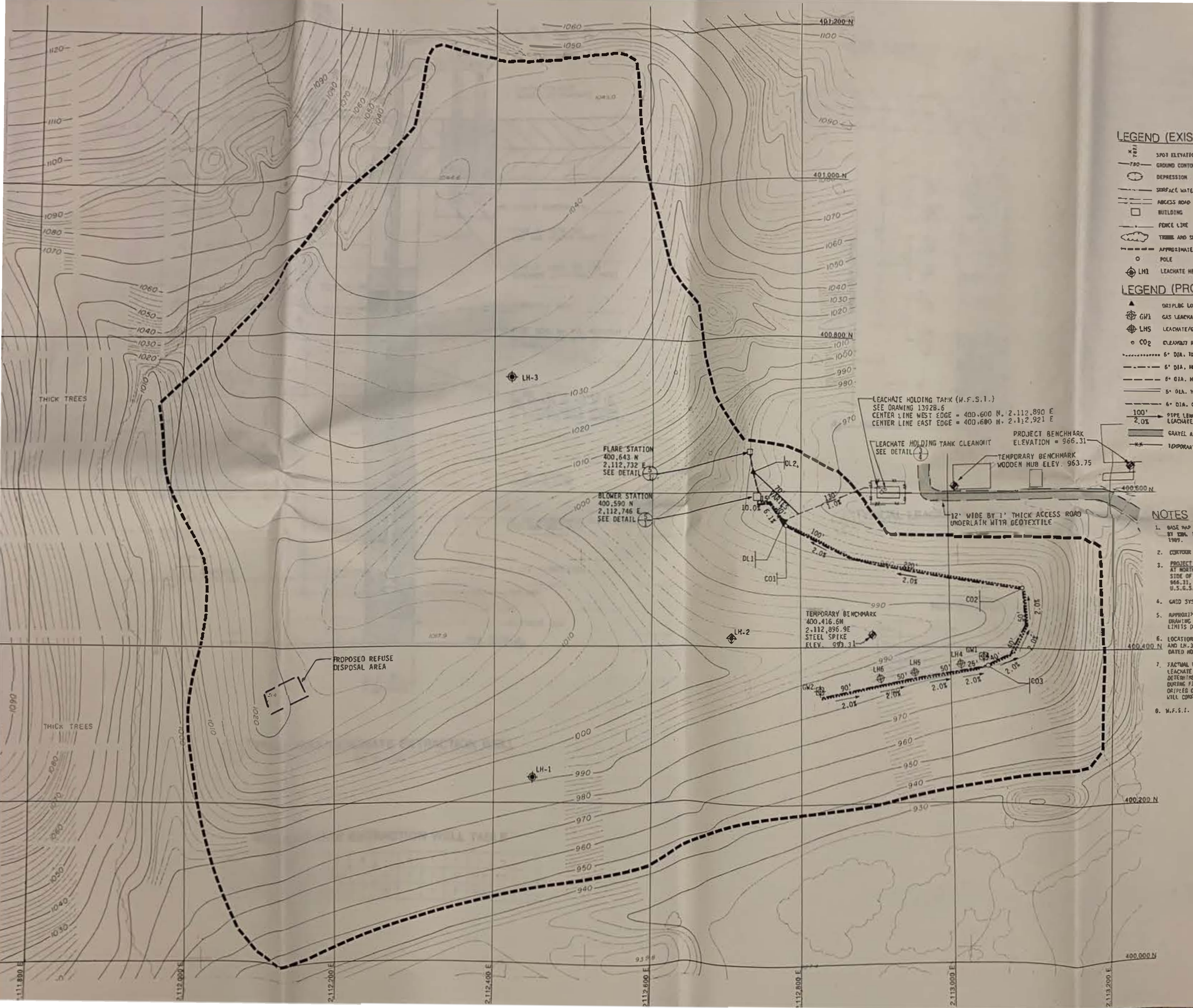
Evanson

WARZYN ENGINEERING INC.
Madison • Milwaukee
Chicago
Minneapolis • Detroit

WARZYN

DECEMBER 1989 13928-7

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
TOWN OF MIDDLETON
DANE COUNTY, WISCONSIN



LEGEND (EXISTING)

- SPOT ELEVATION
- GROUND CONTOUR
- DEPRESSION
- SURFACE WATER
- ABCESS ROAD
- BUILDING
- FENCE LINE
- TREES AND SHRUBS
- APPROXIMATE LIMITS OF LANDFILL
- POLE
- LH1 LEACHATE HEADWELL LOCATION AND NUMBER

LEGEND (PROPOSED)

- DRIPLOC LOCATION AND NUMBER
- GW1 GAS LEACHATE EXTRACTION WELL LOCATION AND NUMBER
- LHS LEACHATE/GAS MONITORING WELL LOCATION AND NUMBER
- CO_2 CLEANOUT RISER LOCATION AND NUMBER
- 6" DIA. HDPE GAS HEADER PIPE
- 6" DIA. HDPE GRAVITY LEACHATE CONVEYANCE PIPE
- 6" DIA. HDPE GRAVITY LEACHATE/CONDENSATE CONVEYANCE PIPE
- 6" DIA. HDPE GRAVITY CONDENSATE CONVEYANCE PIPE
- 6" DIA. GAS DISCHARGE PIPE
- 100' / 2.0% PIPE LENGTH, PIPE SLOPE AND DIRECTION OF LEACHATE/CONDENSATE FLOW
- GRAVEL ACCESS ROAD
- TEMPORARY FENCE

NOTES

1. BASE MAP DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY EDM, INC., GRAND FORKS, ND, DATED AUGUST 21, 1989.
2. CONTOUR INTERVAL IS TWO FEET.
3. PROJECT BENCHMARK IS CHISEL MARK ON TOP STEEL PLATE AT NORTH END OF LOADING DOCK LOCATED ON THE SOUTH SIDE OF MOST EASTERLY SITE BUILDING; ELEV. = 966.31, U.S.G.S. DATUM. ELEVATIONS ARE BASED ON U.S.G.S. DATUM.
4. GRID SYSTEM SHOWN IS STATE PLANE COORDINATE SYSTEM.
5. APPROXIMATE LIMITS OF LANDFILL BASED ON AMT, INC. DRAWING 1181.02-2, DATED NOVEMBER 10, 1986. THESE LIMITS DO NOT REFLECT LIMITS OF REFUSE.
6. LOCATIONS OF EXISTING LEACHATE HEADWELLS LH-1, LH-2 AND LH-3 BASED ON AMT, INC. DRAWING 1184.02.2, DATED NOVEMBER 10, 1986.
7. FACTUAL LOCATIONS AND ELEVATIONS OF GAS AND LEACHATE EXTRACTION SYSTEM COMPONENTS WILL BE DETERMINED BY CONDITIONS ENCOUNTERED IN THE FIELD DURING FIELD STAKING. FIELD STAKING WILL BEGIN AT DRIPLOC DL1 (400,560N, 2,112,778E). PIPE GRADES WILL CONFORM TO SLOPES SHOWN.
8. W.F.S.I. = WARZYN FURNISHED, SUBCONTRACTOR INSTALLED.

DEC 2 0 1989

Designed By BEM, JAL
Drawn By HLH
Approved By Joel V. Hebetter
Checked By JAL, BEM, JVH
Date 12/19/89
Reference
Revisions

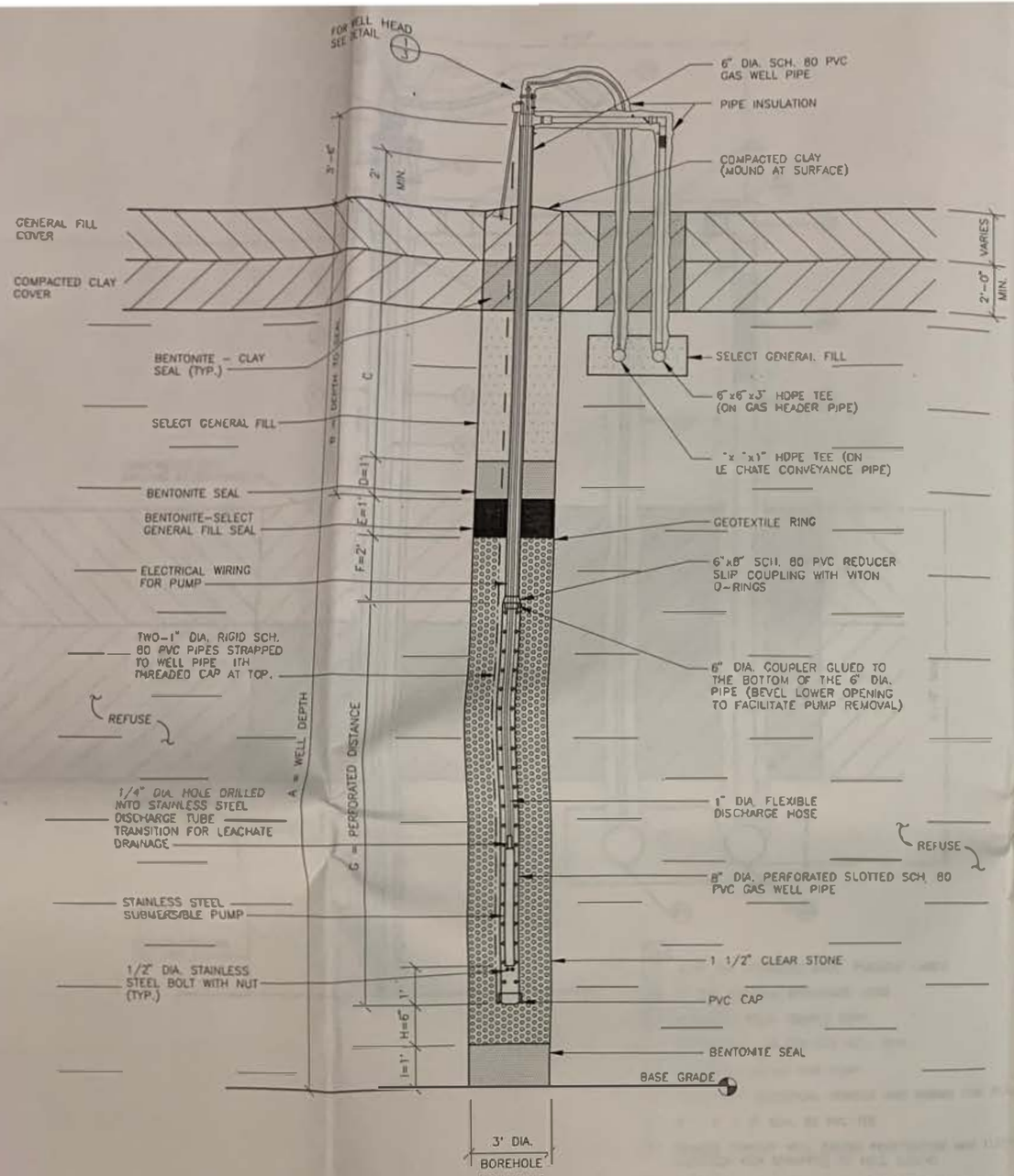
WARZYN ENGINEERING INC.
Madison • Milwaukee
Minneapolis • Chicago
Detroit

Date - By - Appd

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM LAYOUT

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
TOWN OF MIDDLETON

Printed DEC 2 0 1989
Sheet Number 1 OF
Project Number 13928

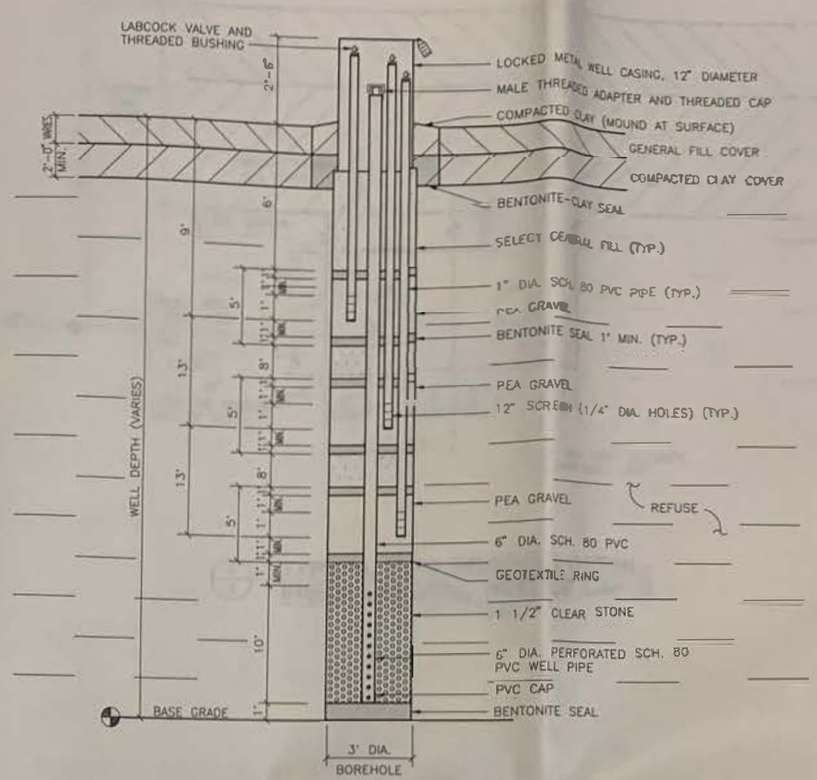


1/2 TYPICAL GAS/LEACHATE EXTRACTION WELL

NOT TO SCALE

GAS/LEACHATE EXTRACTION WELL TABLE

WELL	LOCATION	A	B	C	D	E	F	G	H	I
GW1	400,374N 2,113,054E	49.0'	17'	16'	1'	1'	2'	27.5'	0.5'	1'
GW2	400,340N 2,112,843E	52.3'	17'	16'	1'	1'	2'	30.8'	0.5'	1'



2/2 TYPICAL LEACHATE/GAS MONITORING WELL DETAIL

NOT TO SCALE

MONITORING WELL TABLE

WELL	LOCATION	APPROXIMATE GROUND ELEV.	APPROXIMATE BASE ELEV.	WELL DEPTH
LH4	400,369N 2,113,054E	983.5	933.0	50.5
LH5	400,361N 2,112,981E	984.5	933.0	51.5
LH6	400,354N 2,112,932E	985.5	935.0	50.5

Designed By: SEPI JAL Drawn By: ALK Checked By: SAL SEPI JAL

Approved By: Brad V. Hutton Date: 12/19/89

Reference:

File Path: \13928\2

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Revision a

DETAILS

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
TOWN OF MIDDLETON
DANE COUNTY, WISCONSIN

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Sheet Number 2 OF 6

Project Number 13928 2

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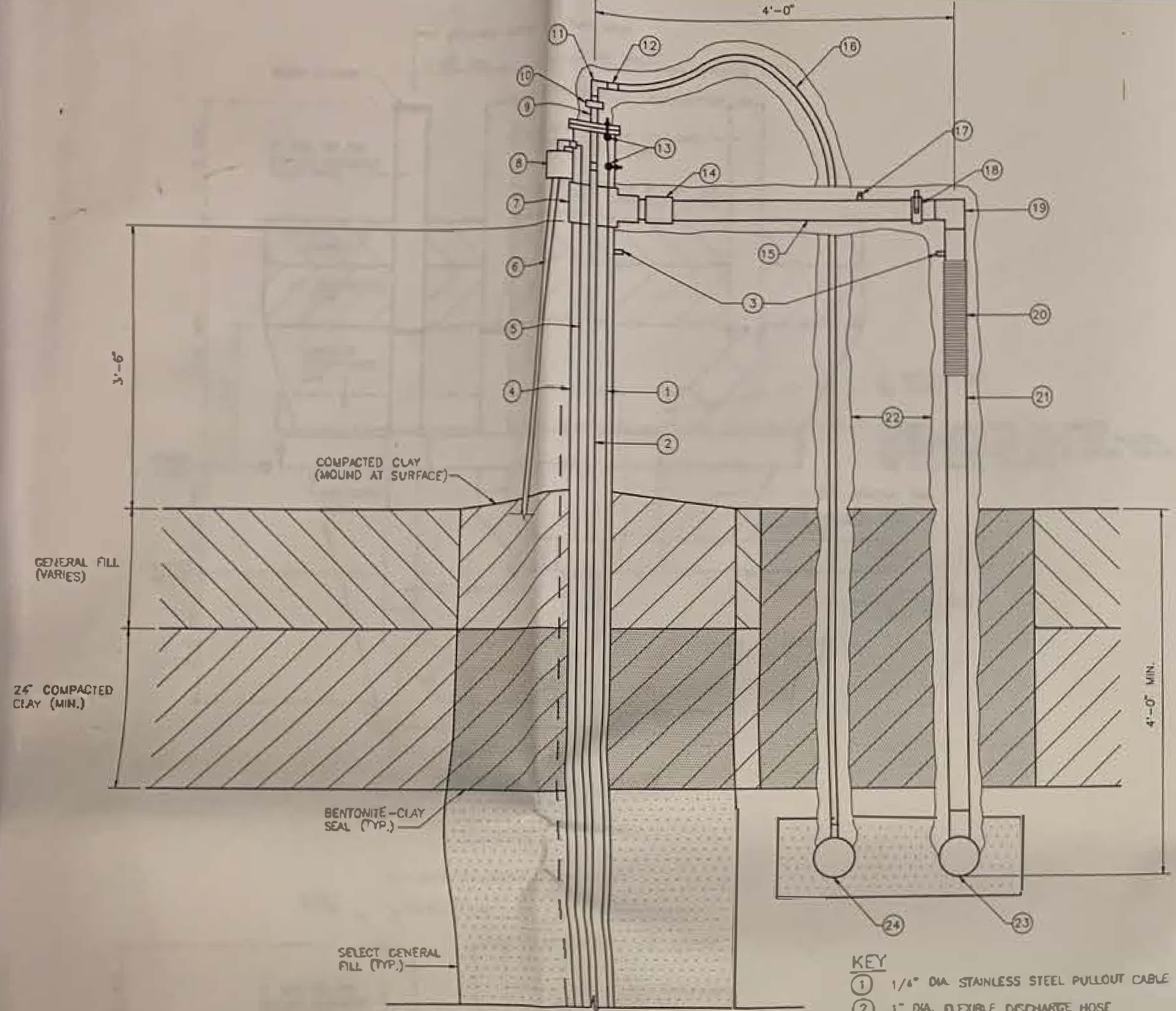
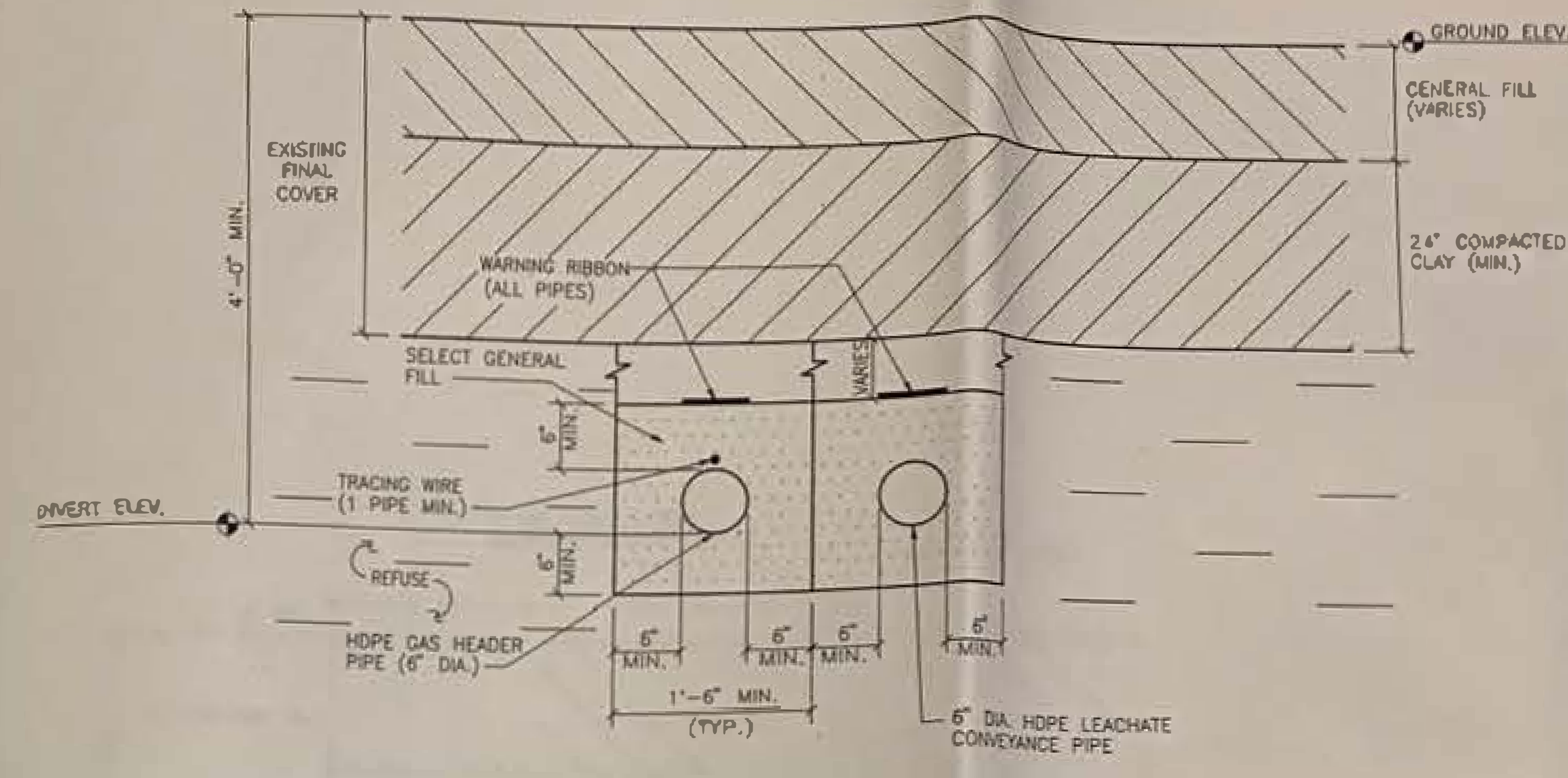


KEY

1. 1/4" DIA. STAINLESS STEEL PULLOUT CABLE
2. 1" DIA. FLEXIBLE DISCHARGE HOSE
3. STAINLESS STEEL SAMPLE PORT
4. 6" DIA. SCH. 80 PVC GAS WELL PIPE
5. ELECTRICAL WIRING FOR PUMP
6. SEAL-TIGHT ELECTRICAL CONDUIT AND WIRING FOR PUMP
7. 6" x 6" x 3" SCH. 80 PVC TEE
8. SEALED CONDUIT WELL CASING PENETRATION AND ELECTRICAL JUNCTION BOX STRAPPED TO WELL CASING
9. 1" DIA. STAINLESS STEEL NIPPLE THREADED THROUGH BLIND FLANGE
10. 1" DIA. STEEL UNION
11. 1" DIA. STEEL 90° ELL
12. 1" DIA. COATED STEEL TO HDPE TRANSITION FITTING
13. 1/4" STAINLESS STEEL EYEBOLT WITH WASHERS AND NUT
14. 3" DIA. FLEXIBLE COUPLING WITH CLAMPS (FERNCO)
15. 3" DIA. SCH. 80 PVC PIPE
16. 1" DIA. HDPE HEATED TRACED PIPE
17. 3/4" x 1/2" SCH. 80 PVC REDUCING BUSHING WITH 1/2" DIA. SCH. 80 PVC PLUG (MONITORING PORT)
18. 3" DIA. BUTTERFLY VALVE (TILT FOR CONDENSATE DRAINAGE)
19. 3" DIA. SCH. 80 PVC 90° ELL
20. 3" DIA. FLEXIBLE TUBING WITH CLAMPS
21. 3" DIA. HDPE PIPE
22. PIPE INSULATION
23. 6" x 6" x 3" HDPE TEE (ON GAS HEADER PIPE)
24. 6" x 6" x 1" HDPE TEE (ON LEACHATE CONVEYANCE PIPE)

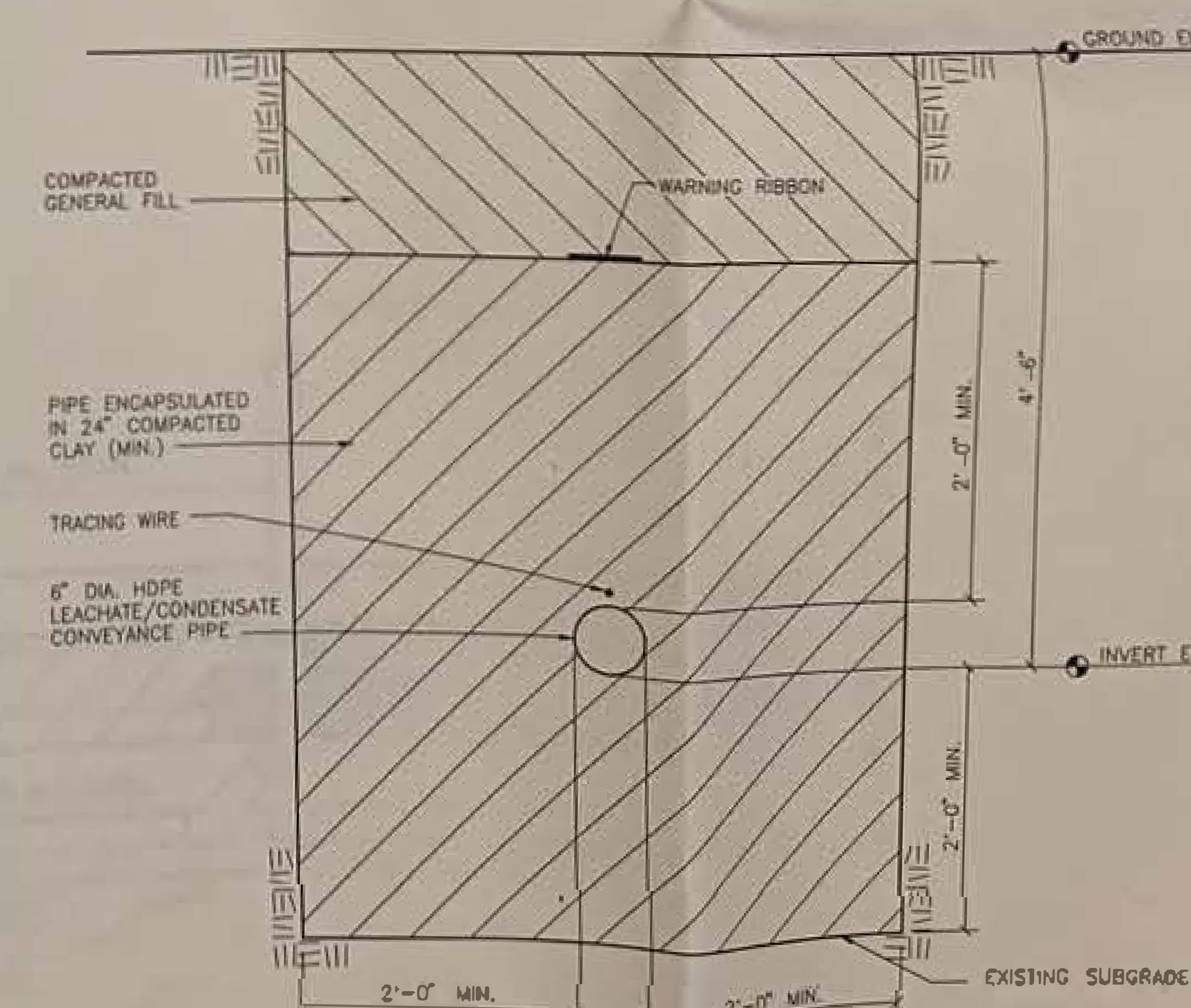
1/3 TYPICAL GAS/LEACHATE EXTRACTION WELL HEAD DETAIL

SCALE: 1" = 1'-0"



2/3 TYPICAL PIPE BEDDING DETAIL- INSIDE LANDFILL REFUSE LIMITS

NOT TO SCALE



3/3 HDPE LEACHATE / CONDENSATE CONVEYANCE PIPE BEDDING DETAIL - OUTSIDE LANDFILL REFUSE LIMITS

SCALE: 1" = 1'-0"

DEC 20 1989

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Detroit

Designed By: BEM, JAL
Drawn By: ALK
Checked By: JAL, BEM
Approved By: [signature]
Date: 12/19/89
Reference:
File Path: \13928\3

DETAILS

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
TOWN OF MIDDLETON
DANE COUNTY, WISCONSIN

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Sheet Number 3 OF 6

Project Number 13928

3

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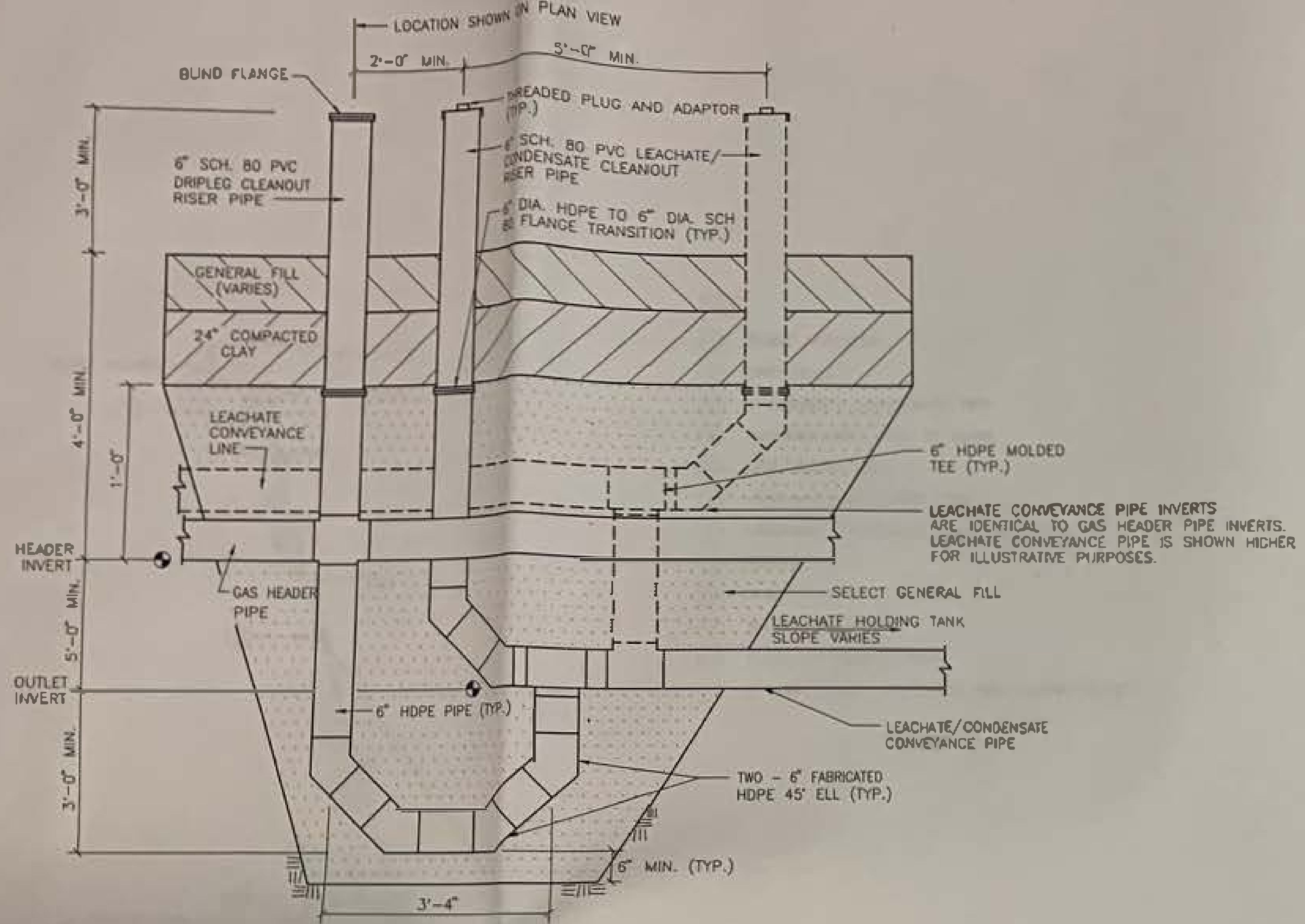
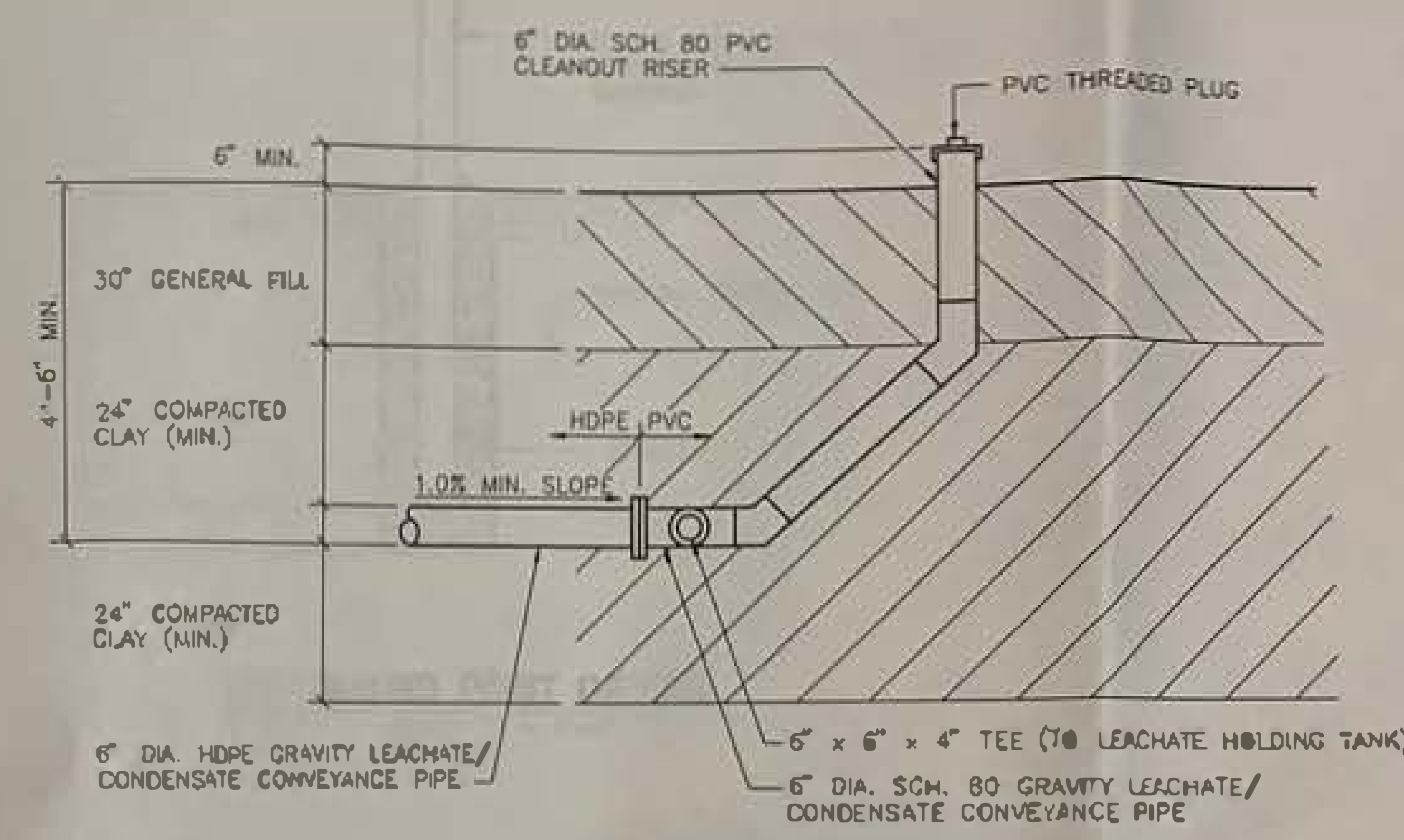


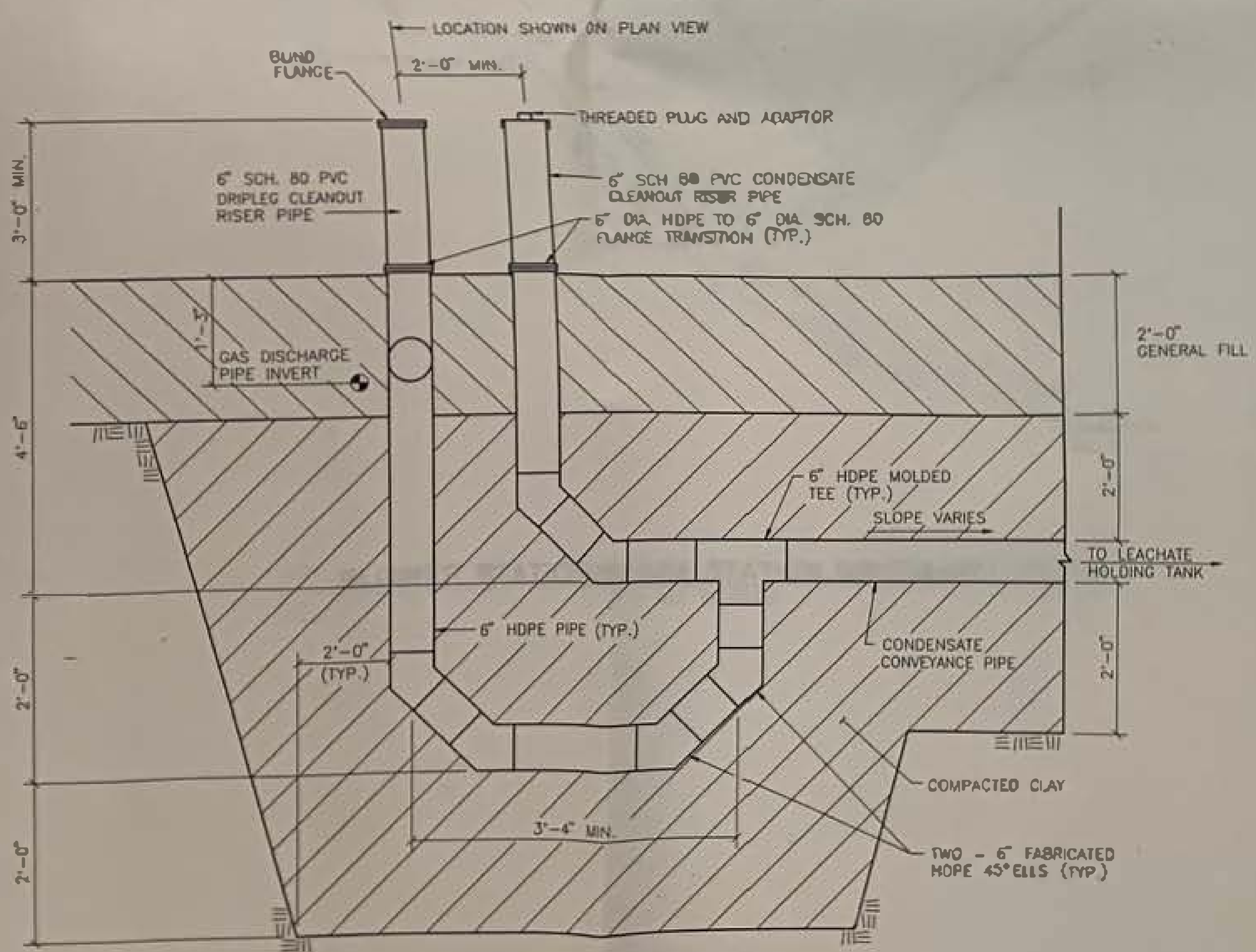
DRIPLEG DETAIL (DL1) (1/4)

NOT TO SCALE



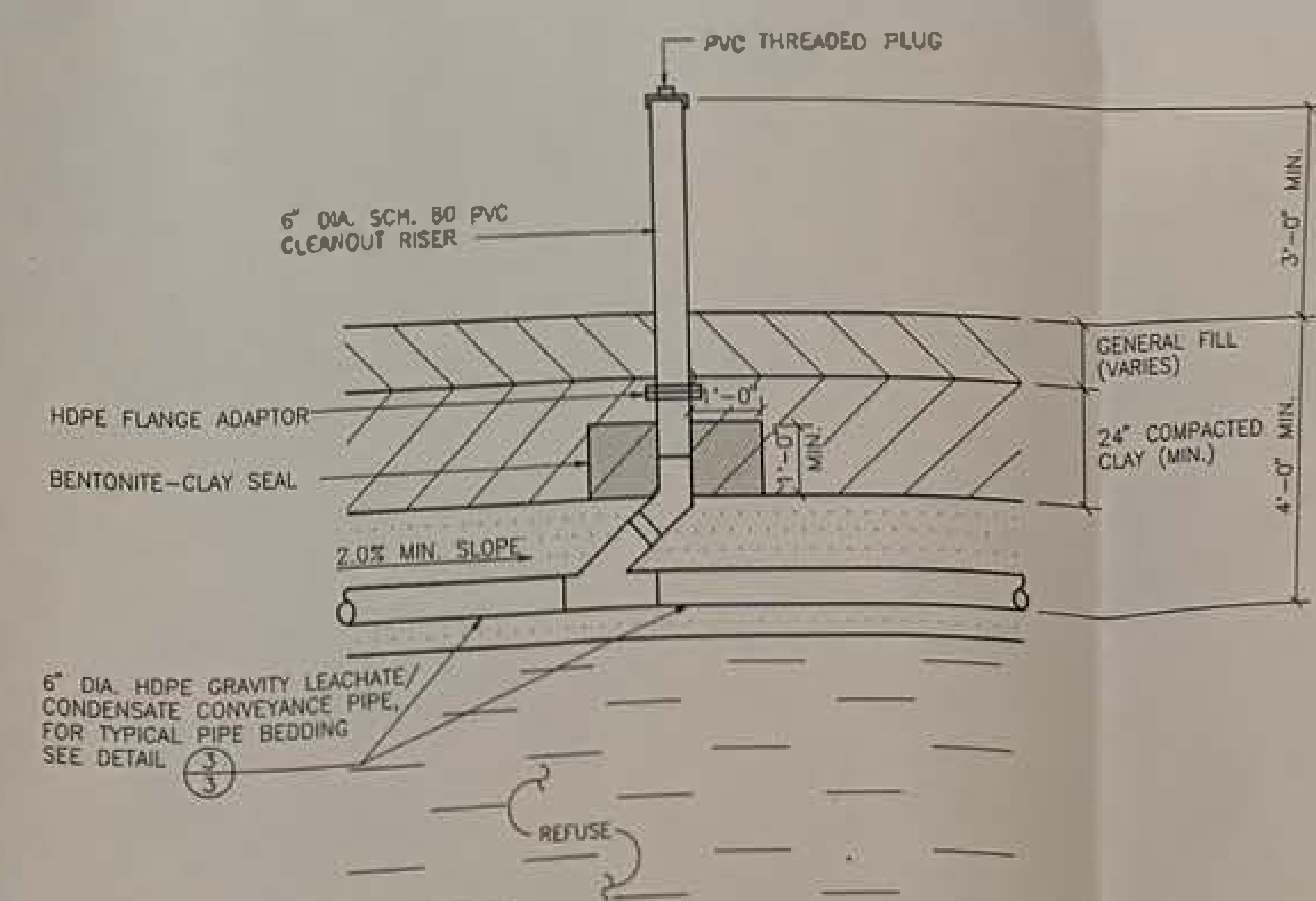
CLEANOUT RISER DETAIL AT LEACHATE HOLDING TANK (CO4) (3/4)

SCALE: 1" = 2'-0"



DRIPLEG DETAIL (DL2) (2/4)

NOT TO SCALE



TYPICAL CLEANOUT RISER DETAIL (4/4)

SCALE: 1" = 2'-0"

Designed By:	BEM, JAL
Drawn By:	ALK
Checked By:	JAL BEM 8/12
Approved By:	Joel V. Schultz
Date:	12/19/89
Reference:	
File Path:	\13928\4

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DETAILS

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
TOWN OF MIDDLETON
DANE COUNTY, WISCONSIN

Printed: DEC 19 1989

Sheet Number: 4 OF 6

Project Number: 13928 — 4

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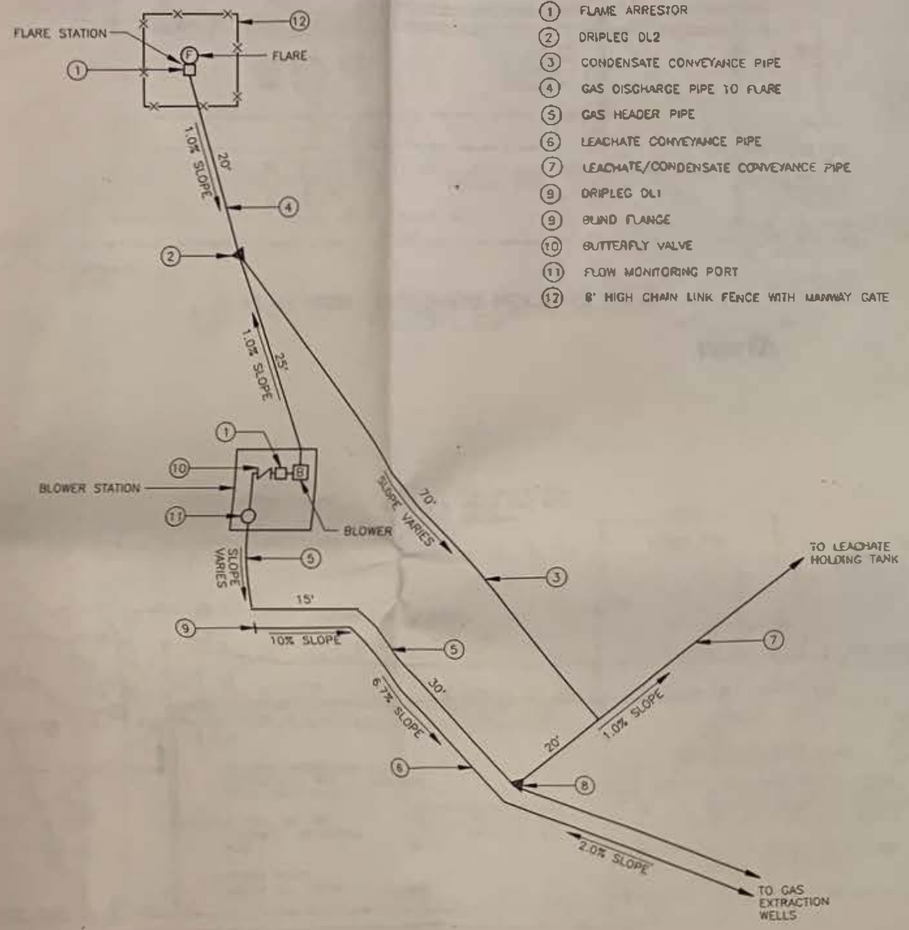
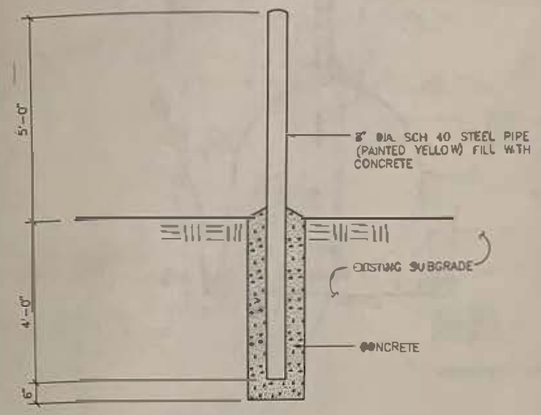


1/5 **BLOWER STATION/FLARE STATION SCHEMATIC LAYOUT**
NOT TO SCALE

KEY

1. FLAME ARRESTOR
2. DRIPLEG DL2
3. CONDENSATE CONVEYANCE PIPE
4. GAS DISCHARGE PIPE TO FLARE
5. GAS HEADER PIPE
6. LEACHATE CONVEYANCE PIPE
7. LEACHATE/CONDENSATE CONVEYANCE PIPE
8. DRIPLEG DL1
9. BLIND FLANGE
10. BUTTERFLY VALVE
11. FLOW MONITORING PORT
12. 8' HIGH CHAIN LINK FENCE WITH MANWAY GATE



2/5 **GUARD POST DETAIL**
SCALE: 1" = 2'-0"

Date • By • Appr'd

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Designed By: BEM, JAL Drawn By: ALK Checked By: JAL, BEM, JVL
Approved By: Joel V. Bratton Date: 12/17/89
Reference:
File Path: \13928\5

Revisions

DETAILS

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
TOWN OF MIDDLETON
DANE COUNTY, WISCONSIN

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Sheet Number 5 OF 6
Project Number 13928 5
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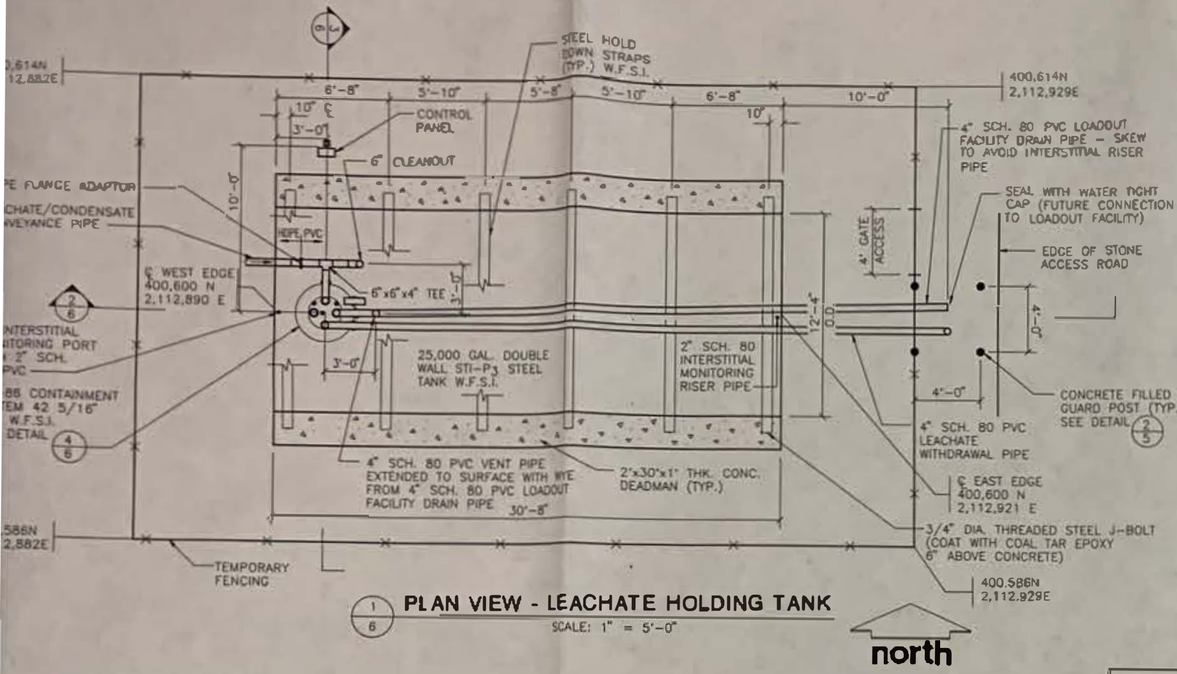
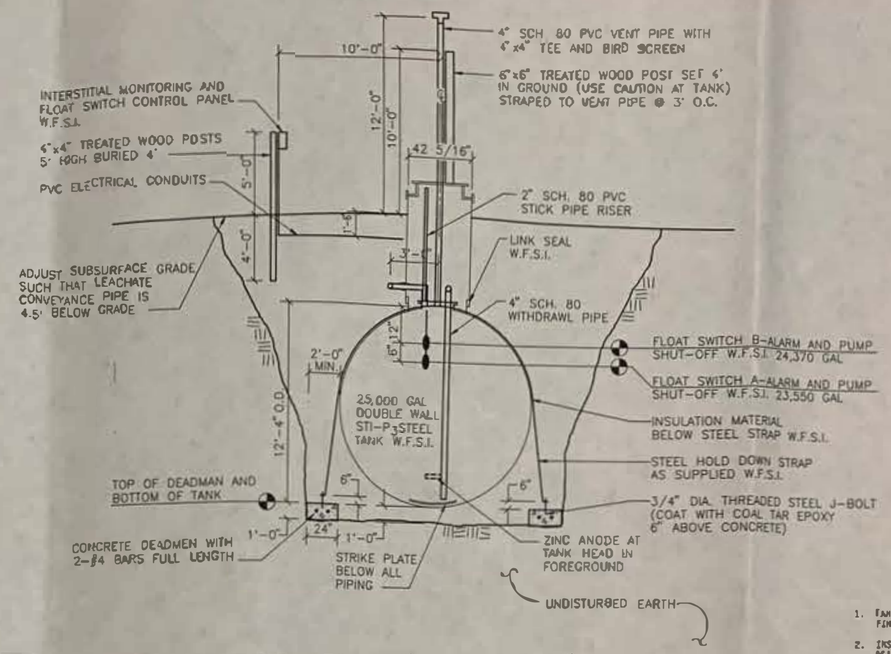


PLAN VIEW - LEACHATE HOLDING TANK

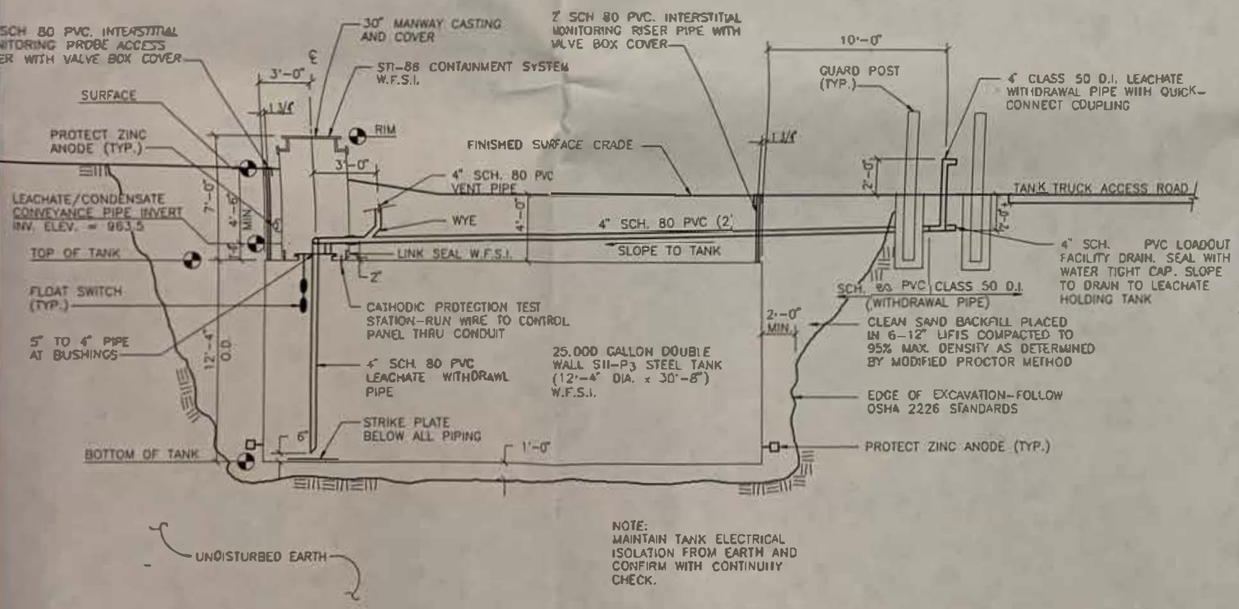
SCALE: 1" = 5'-0"

NOTE:
EXTERIOR PIPING TO BE EXCASED IN 2 FEET OF COMPACTED CLAY



SECTION (LOOKING EAST)

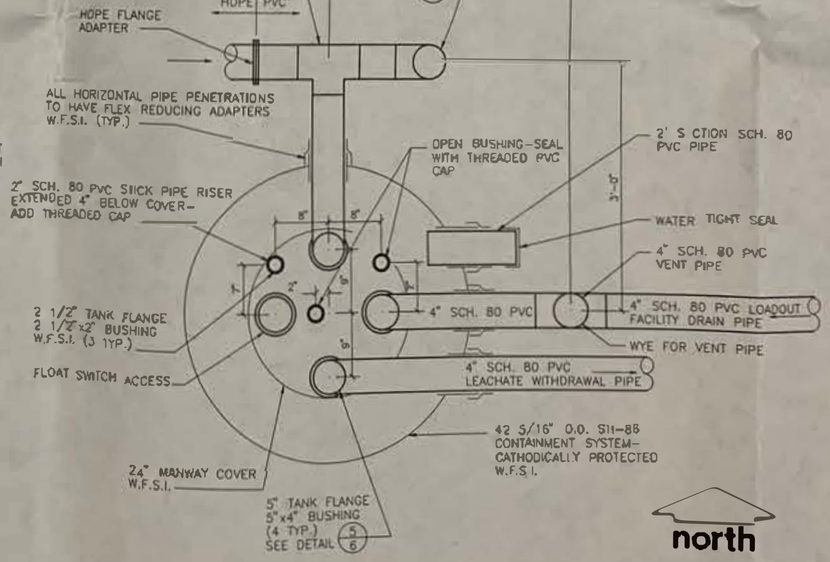
SCALE: 1" = 5'-0"



NOTE:
MAINTAIN TANK ELECTRICAL ISOLATION FROM EARTH AND CONFIRM WITH CONTINUITY CHECK.

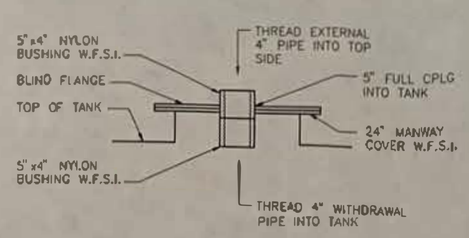
SECTION (LOOKING NORTH)

SCALE: 1" = 5'-0"



STI-86 CONTAINMENT SYSTEM AND PIPING PLAN

SCALE: 1" = 1'-0"



PIPE CONNECTION AT BLIND FLANGE

SCALE: 1" = 1'-0"

TANK INSTALLATION NOTES

1. TANK SHALL BE CHECKED WITH TIRBS AND THE FINISH PROTECTED PRIOR TO TANK INSTALLATION.
2. INSTALLATION SHALL BE IN ACCORDANCE WITH PEI/RP 100-87 RECOMMENDED PRACTICES FOR INSTALLATION OF UNDERGROUND LIQUID STORAGE SYSTEMS AND API 1615 INSTALLATION OF UNDERGROUND PETROLEUM STORAGE SYSTEMS.
3. TANK SHALL BE ELECTRICALLY ISOLATED FROM GROUND AND CONFIRMED BY CONTINUITY TESTING.
4. EXPOSED METAL SURFACES SHALL BE PAINTED WITH TNEMEC 46H13 COAL TAR EPOXY.
5. CATHODIC PROTECTION TEST STATION TO BE INSTALLED.
6. ENTERSTITIAL MONITORING, FLOAT SWITCHES AND TANK INSTALLATION SHALL BE IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.
7. W.F.S.I. - WARZYN FURNISHED, SUBCONTRACTOR INSTALLED.
8. INSTALL NEMA 4X CONTRACTOR PANEL BOX WITH HEATER FOR FLOAT SWITCH, INTERSTITIAL MONITORING, WITH AUDIBLE AND VISUAL ALOS.
9. ALL WORK AND MATERIALS SHALL CONFORM IN EVERY RESPECT TO THE CURRENT RULES AND REQUIREMENTS OF THE NATIONAL FIRE PROTECTION ASSOCIATION, NATIONAL AND STATE ELECTRICAL CODES, LOCAL CODES AND ORDINANCES AND OSHA.
10. SEAL ALL OPENINGS TO TANK AND FITTINGS TO STI-86 SYSTEM WATER TIGHT.

TANK MANUFACTURER NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH STEEL TANK INSTITUTE (STI) SPECIFICATIONS AND PROCEDURES. ENTIRE TANK AND STI-86 SYSTEM TO BE COVERED BY STI 30-YEAR WARRANTY AND "WATCHDOG PROGRAM."
2. TANK SHALL BE STI-P3 DOUBLE-WALL STEEL WITH STI-86 CONTAINMENT SYSTEM MANWAY AND PIPING SYSTEM, INCLUDING DIELECTRIC THREADED BUSHINGS, AND PIPE BOOTS.
3. TANK INTERIOR PREPARATION TO CONSIST OF THE FOLLOWING:
   A. GRIND ALL WELD SPATTER AND PROMINENCES
   B. SOLVENT CLEAN SURFACE
   C. BLAST TANK ACCORDING TO SSPC-SP10, NEAR-WHITE BLAST WITH CLEAN UNUSED SAND OR BLACKJACK TO EFFECT 2.5 TO 3.0 MIL PROFILE
   D. VACUUM ALL BLAST MEDIA
   E. SUBSTRATE MUST BE 70°F TO PAINT
   F. SPRAY APPLY ONE EVEN COAT OF TNEMEC SERIES 61 PRIMER 5002 BEIGE TO MINIMUM DRY FILM THICKNESS (DFT) OF 8 MILS
   G. ALLOW TO CURE FOR ONE WEEK, THEN BRUSH COAT ALL WELDS AND ANOMALIES
   H. FINISH COAT WITH 8 MILS TNEMEC SERIES 61,5002 GREY
   I. AFTER SECOND COAT USE 6-0 LOW VOLTAGE "BIRD DOG" TO CHECK FOR HOLIDAYS
   J. TNEMEC REPRESENTATIVE SHALL PERSONALLY MONITOR COATING AND PREPARE LETTER REPORT ASSURING COMPLIANCE WITH STI WARRANTIES.
4. SAND BLAST AND COAT TANK EXTERIOR IN ACCORDANCE WITH STI.
5. CATHODIC PROTECTION TEST STATION TO BE INCLUDED.
6. INCLUDE TNEMEC TOUCH UP KIT.
7. INTERIOR & EXTERIOR OF STI-86 SYSTEM TO BE COATED IN ACCORDANCE WITH STI.
8. TANK TIGHTNESS TEST SHALL BE PERFORMED ABOVE GRADE PRIOR TO INSTALLATION AT 5 PSI IN ACCORDANCE WITH TANK MANUFACTURERS RECOMMENDATIONS AND API 1615.

DEC 20 1989

Designed By: JCK
Drawn By: ALK
Checked By: JCK
Approved By: Joel V. Whitmore
Date: 12/19/89
Reference:
File Path: \13928\6

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LEACHATE HOLDING TANK DETAILS

PARTIAL GAS AND LEACHATE EXTRACTION SYSTEM
INTERIM REMEDIAL MEASURES
REFUSE HIDEAWAY LANDFILL
TOWN OF MIDDLETON

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6 OF
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