GENERAL WASTE & RECYCLING, LLC
SW-620 INDUSTRIAL WASTE LANDFILL

CCR Run-on and Run-off Management Plan

Prepared For:

GENERAL WASTE & RECYCLING, LLC

Prepared by:

Northeast Technical Services, Inc.
526 Chestnut Street
Virginia, Minnesota 55792

(218) 741-4290

October 2016

Project Number: 6385C

"I certify under penalty of law that this document and all attachments were prepared under my direct supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete." I certify that this Run-on and Run-off Management Plan has been prepared consistent with recognized and generally accepted good engineering practices and meets 40 CFR §257.81 requirements.

10/14/2016

Jacob Crispo, P.E. — Date
Minnesota License No. 53648

Table of Contents

1.0 Introduction 2
2.0 Run-on and Run-off Controls Evaluation 2
2.1 Diversion Berms, Ditches, and Collection Ponds 2
2.2 Leachate Management System 2
3.0 Phase Expansion 3

Appendices

Appendix A: General Waste- 2014 Annual Survey
Appendix B: Stormwater Analysis Calculations
Appendix C: Application for Major Permit Modification- Leachate Management Plan, April 08, 2013

References

Figures: General Waste 2014 Annual Survey.
Report: Application for Major Permit Modification- Leachate Management Plan, April 08, 2013
Report: Application for Major Permit Modification- Engineering Report, April 08, 2013
Plan: Stormwater Pollution Prevention Plan, General Permit No MN R050000, September 2014

1.0 Introduction

This initial Run-on and Run-off Management Plan (the Plan) has been prepared by Northeast Technical Services (NTS) on behalf of General Waste & Recycling, LLC (General Waste). The Plan is being submitted in accordance with the requirements of Federal Rules and Regulations 40 CFR §257 and §261. Specifically, the Plan is intended to meet 40 CFR §257.81, Run-on and run-off controls requirements for CCR landfills.

General Waste's stormwater run-on and run-off controls for the CCR Unit were reviewed and the design is compliant with the new requirements per 40 CFR §257.81. As required by §257.81(c)(4), periodic run-on and run-off plans will be prepared every five years to include additional phases of the landfill constructed. The next periodic plan will be prepared prior to October 17, 2021.

The following documents are included as part of this Run-on and Run-off Management Plan:

- General Waste 2014 Annual Survey.
- Application for Major Permit Modification- Leachate Management Plan, April 08, 2013

2.0 Run-on and Run-off Controls Evaluation

2.1 Diversion Berms, Ditches, and Collection Ponds

Surface run-on is prevented from entering the landfill by earthen berms located to the North, West, and South side of the landfill and a transitional berm, for future cell expansion, located to the east. The earthen berms direct run-off from the landfill to stormwater ditches along the North and West side of the landfill. These ditches allow stormwater to infiltrate and convey excess surface run-off to an existing stormwater pond (SW1- 2015 SWPPP) located in the Southwest corner of the landfill. Stormwater runoff from the east side of the landfill is contained and allowed to infiltrate by geographical features that surround the landfill area. Locations of the drainage ditches and stormwater pond are shown on Figure 2 of the 2014 Annual Survey provided in Appendix A and further described in referenced Engineering Report.

In the event a 24 hour- 25 year storm was to occur, the stormwater pond would require a runoff storage volume of 74,000 cubic feet (1.7 acre-ft). Runoff requiring storage primarily occurs from the northern, western, and southern berms of the landfill. The existing stormwater pond was evaluated and found to have a maximum storage capacity of 81,700 cubic feet (1.87 acre-ft). Stormwater calculations are provided in Appendix B.

2.2 Leachate Management System

The CCR industrial landfill is comprised of a liner and leachate collection system that prevents the release of stormwater. Stormwater that contacts waste (i.e., leachate) is collected on the liner and transferred to an underground storage tank (UST). The liner system consists of two feet of clay overlain with a 60-mil high density polyethylene (HDPE) flexible membrane liner (FML) and one foot thick sand drainage layer. The liner system extends along the interior side slopes and floor of the landfill. The liner is designed to meet the Subtitle D liner design required by the MPCA for municipal solid waste landfills. The UST is a double walled HDPE tank with a storage capacity of 30,000 gallons. Leachate stored in the UST is pumped to the leachate load out pad where it is trucked offsite for treatment at an MPCA Approved Waste Water Treatment Facility. Leachate transmission to the UST is controlled by a transducer and float system with high level alarm to prevent the landfill pumps from operating in the event that the UST is full. Further details relating to the leachate collection system can be seen in leachate management plan attached in Appendix C.

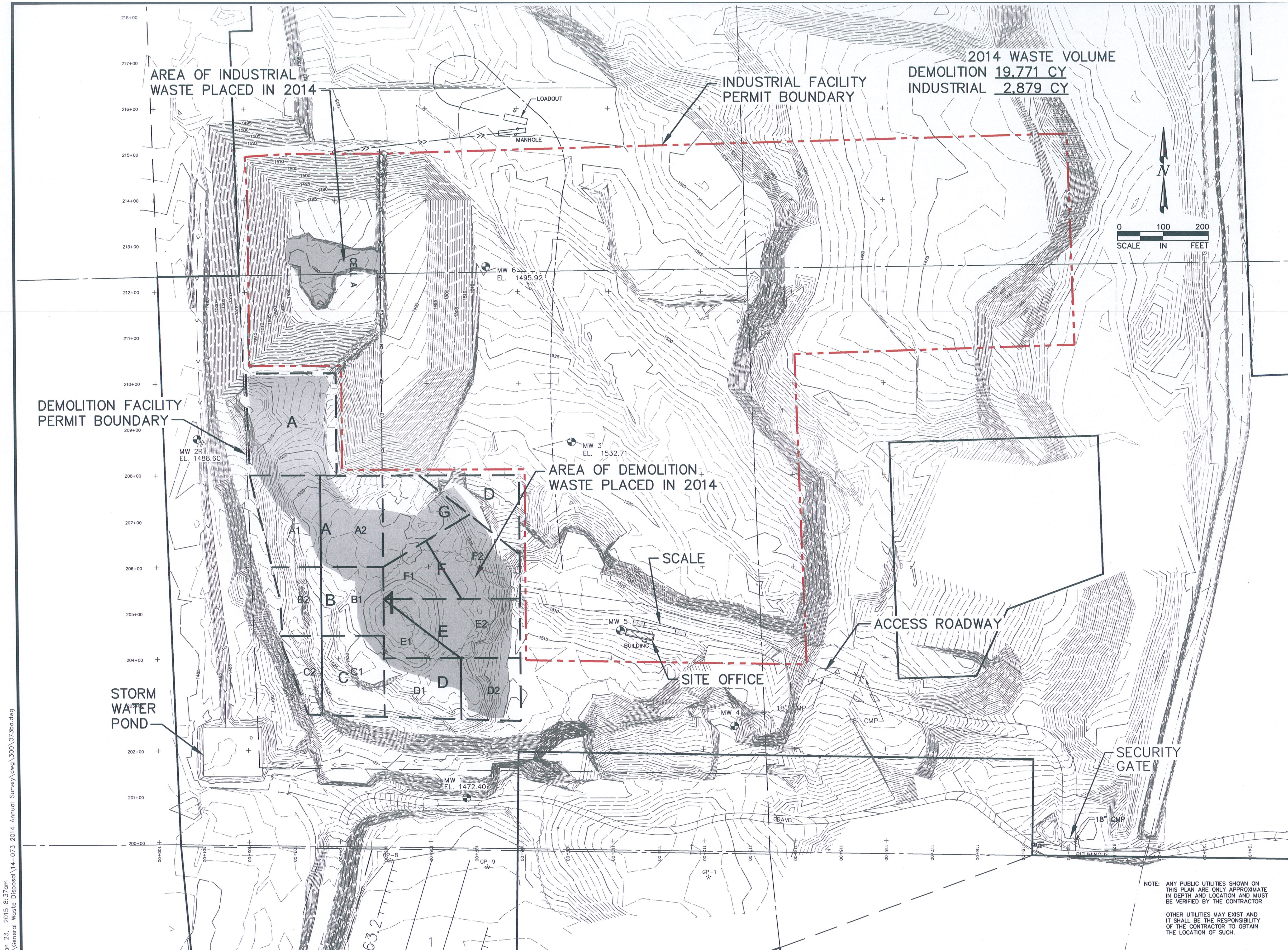
In the event a 24 hour-25 year storm was to occur, the liner system would need to hold approximately 373,000 gallons of leachate based on a rainfall effective area of 126,000 square feet for the landfill. The majority of the leachate will be temporary stored on the liner if the UST reaches maximum capacity. The liner system extends to the top of the interior berms on all sides of the landfill, allowing for significant storage capacity in the sand drainage layer and vacant space of the landfill. Using a porosity of 0.39 for the sand drainage layer, it is estimated that the sand drainage layer can hold 368,000 gallons of leachate. To return leachate levels in the liner to normal, leachate would be regularly pumped from the leachate loadout pad.

3.0 Phase Expansion

According to the Phase Plan detailed in the Engineering Report, additional stormwater berms, ditches and ponds will be constructed in conjunction with construction of new landfill cells. At that time, the run-on and run-off management plan will be revised to include the new construction. Details relating to landfill's Phase plan can be viewed on Sheet 7-9 of Appendix A and Section 6 of the referenced Application for Major Permit Modification, Engineering Report April, 2013.

APPENDICES

Appendix A



NOTE: ANY PUBLIC UTILITIES SHOWN ON THIS PLAN ARE ONLY APPROXIMATE IN DEPTH AND LOCATION AND MUST BE VERIFIED BY THE CONTRACTOR

OTHER UTILITIES MAY EXIST AND IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO OBTAIN THE LOCATION OF SUCH.

JPJ

Engineering
Land Surveying
Economic Development

JPJ ENGINEERING, INC
425 Grant Street
P.O. Box 656
Hibbing, MN 55746
Phone: (218) 262-5528
www.jpjeng.com

Hibbing, MN • Duluth, MN

DATE OF SURVEY
DECEMBER 23, 2014

GENERAL WASTE 2014 ANNUAL SURVEY
KEEWATIN, MINNESOTA

REVISION DATE:	DESCRIPTION:

SURVEYED ZZ
DESIGNED
DRAWN WEH
CHECKED JDM

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly licensed professional Engineer under the laws of the State of Minnesota.

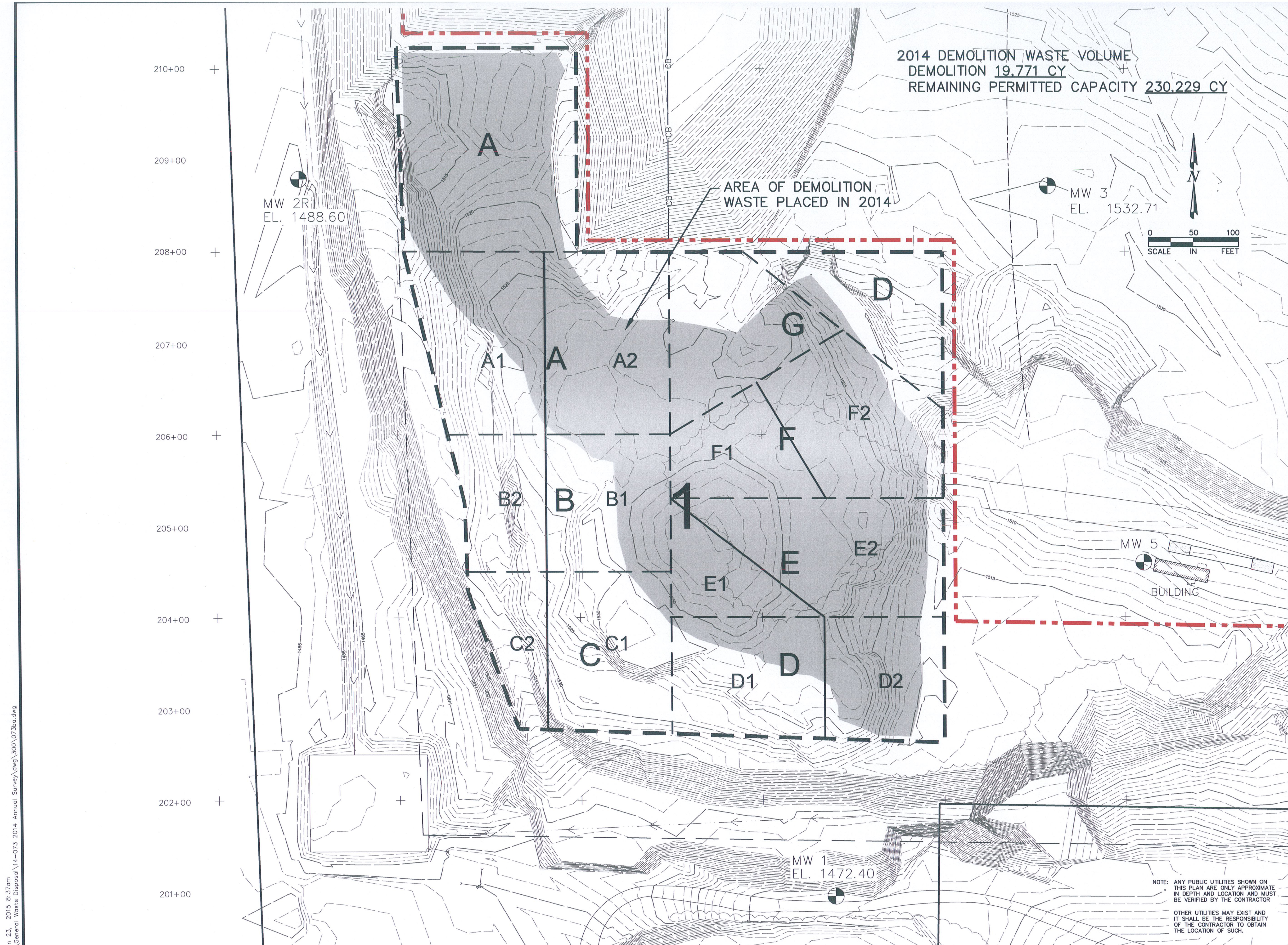
John D Mattonen
JOHN D. MATTONEN

DATE 1/23/2015 LIC. NO. 23998

14-073
PROJECT #

1/3

Jan 23, 2015 8:37am
G:\General Waste Disposal\14-073 2014 Annual Survey\dwg\300\073ba.dwg



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P.O. Box 656
Hibbing, MN 55746
Phone: (218) 262-5528
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DATE OF SURVEY
DECEMBER 23, 2014

GENERAL WASTE
2014 ANNUAL SURVEY
KEEWATIN, MINNESOTA

DEMOLITION
FACILITY

REVISION DATE:	DESCRIPTION:

SURVEYED ZZ
DESIGNED
DRAWN WEH
CHECKED JDM

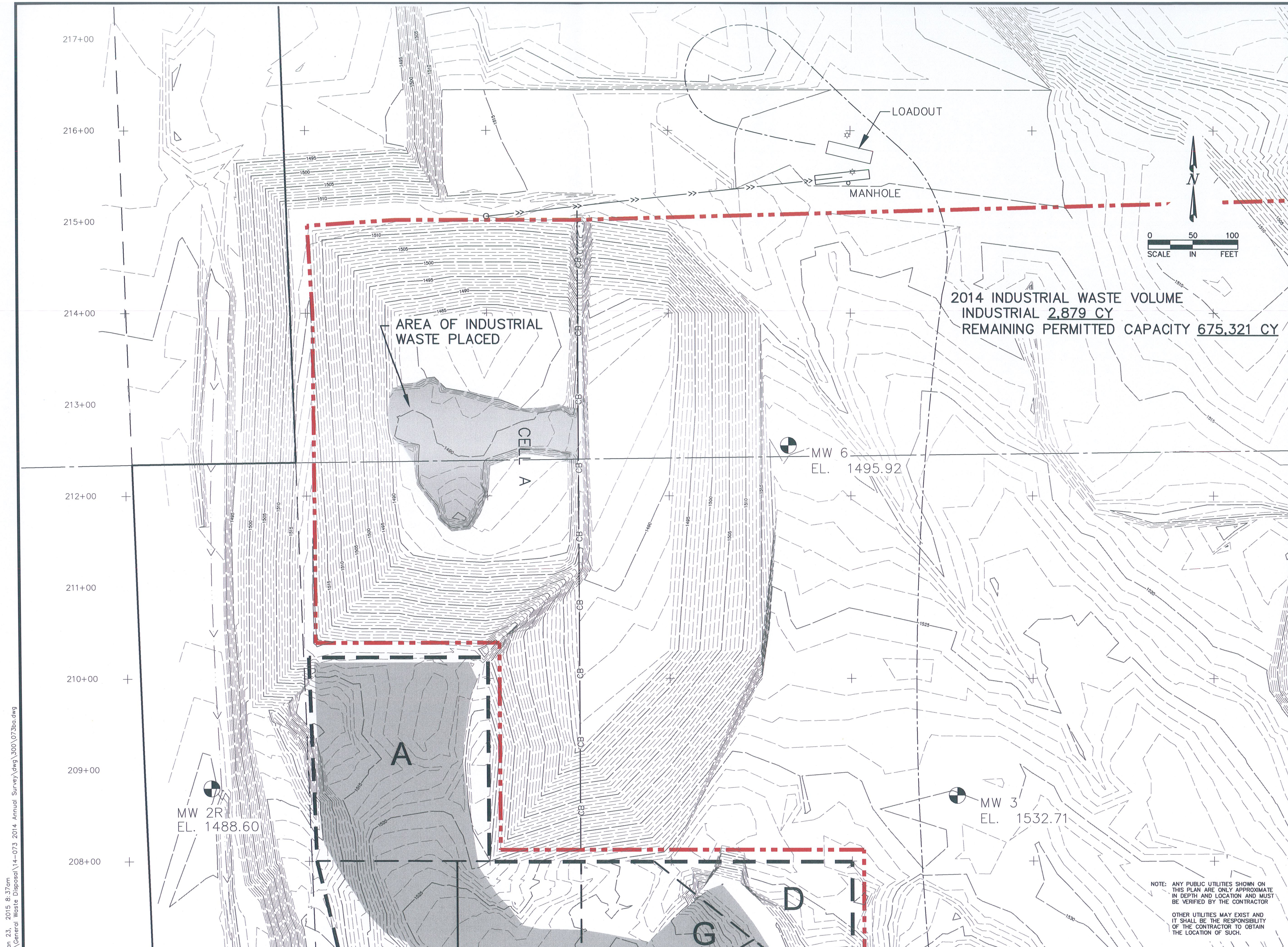
I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly licensed professional Engineer under the laws of the State of Minnesota.

John D Mattonen
JOHN D. MATTONEN

DATE 1/23/2015 LIC. NO. 23998

13–913
PROJECT #

2/3



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JPJ ENGINEERING, INC
425 Grant Street
P.O. Box 656
Hibbing, MN 55746
Phone: (218) 262-5528
www.jpjeng.com

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DATE OF SURVEY
DECEMBER 23, 2014

GENERAL WASTE
2014 ANNUAL SURVEY
KEEWATIN, MINNESOTA

INDUSTRIAL FACILITY
CELL A

REVISION DATE:	DESCRIPTION:

SURVEYED ZZ
DESIGNED
DRAWN WEH
CHECKED JDM

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly licensed professional Engineer under the laws of the State of Minnesota.

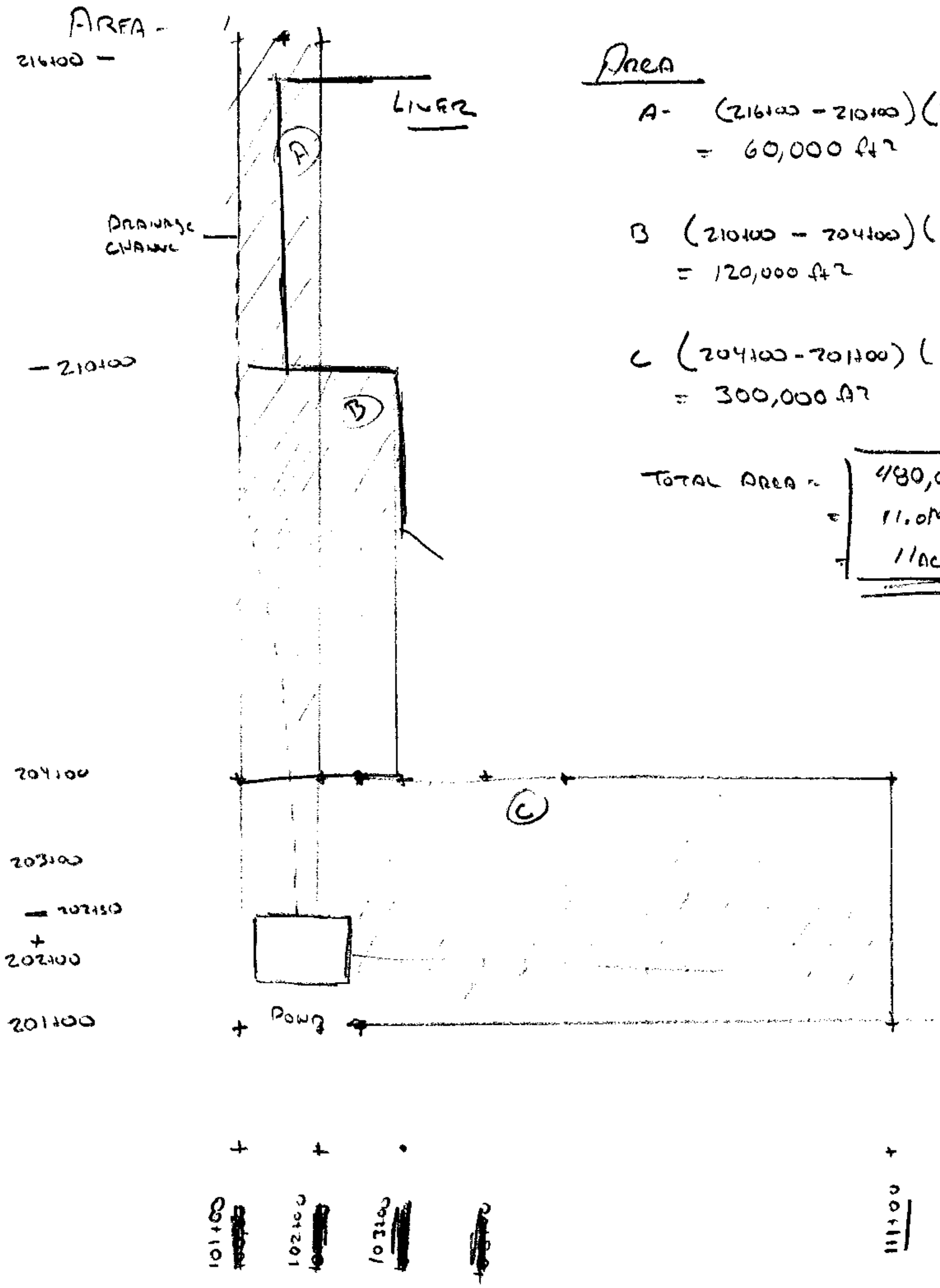
JOHN D. MATTONEN

DATE 1/23/2015 LIC. NO. 23998

13-913
PROJECT #

Appendix B

Client: General Waste	Page: 1 of 3
Project: 6385C	Proj. No:
Calculations For: / Prepared By: JC	Date: 10/07/16
Reviewed By:	Date:



Area

A- $(216+00 - 210+00)(102+00 - 101+00)$
= 60,000 ft²

B $(210+00 - 204+00)(103+00 - 101+00)$
= 120,000 ft²

C $(204+00 - 201+00)(111+00 - 101+00)$
= 300,000 ft²

Total Area = 480,000 ft²
= 11.019 acre
= **11 acres**

Client: GENERAL WASTE		Page: 2 OF 3
Project: 6395C		Proj. No:
Calculations For:	Prepared By:	Date: 10/07/16
	Reviewed By:	Date:

NRCS CURVE NUMBER METHOD

$$V_R = \frac{(P - 0.2S)^2}{P + 0.8S} \quad \text{FOR} \quad P \geq I_a = 0.2S$$

$$S = \frac{1000}{CN} - 10$$

TABLE - 2-2c - USDA - NRCS TR-55 METHOD
BRUSH - BRUSH WEEDS — FAIR - 70
SOIL GROUP C - NRCS

$$S = \frac{1000}{70} - 10 = 4.2857$$

$$V_R = \frac{(4.75 - (0.2)(4.28))^2}{(4.75 + 0.7(4.28))} = 1.85 IN^2$$

AREA - EFFECTIVE — 11 ACRES (480,000 ft²)

TOTAL VOLUME TO STORE

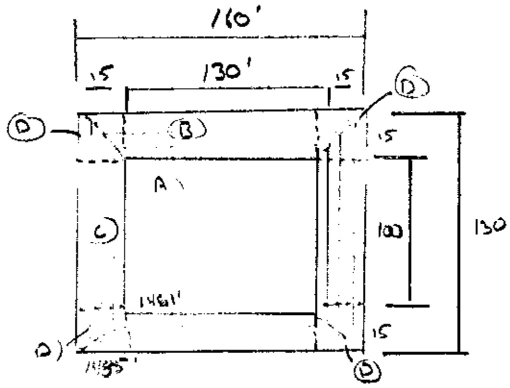
→ $V_R = 1.85 IN$
$A_M = 480,000 ft^2$

$$V_S = \frac{V_R}{12} A_m = \frac{1.85 IN}{12 IN}(1ft)(480,000 ft^3)$$

= 74,000 ft3
= 553,520 GALLONS

Client: General Waste		Page: 3 of 3
Project: 6385C		Proj. No:
Calculations For:	Prepared By:	Date: 10/07/16
	Reviewed By:	Date:

STORMWATER POND CAPACITY



- Volume -

A) $130' \times 130' \times 4 =$ 67,600 ft^3

B) (2) $130' \times \frac{(15' \times 4')}{2} =$ 7,800 ft^3

C) (2) $100' \times \frac{(15' \times 4')}{2} =$ 6,000 ft^3

D= $\frac{15 \cdot 15 \cdot 4}{3} =$ 300 ft^3

TOTAL VOLUME - 81,700 ft^3

MAX CAPACITY - 611,116 gallons

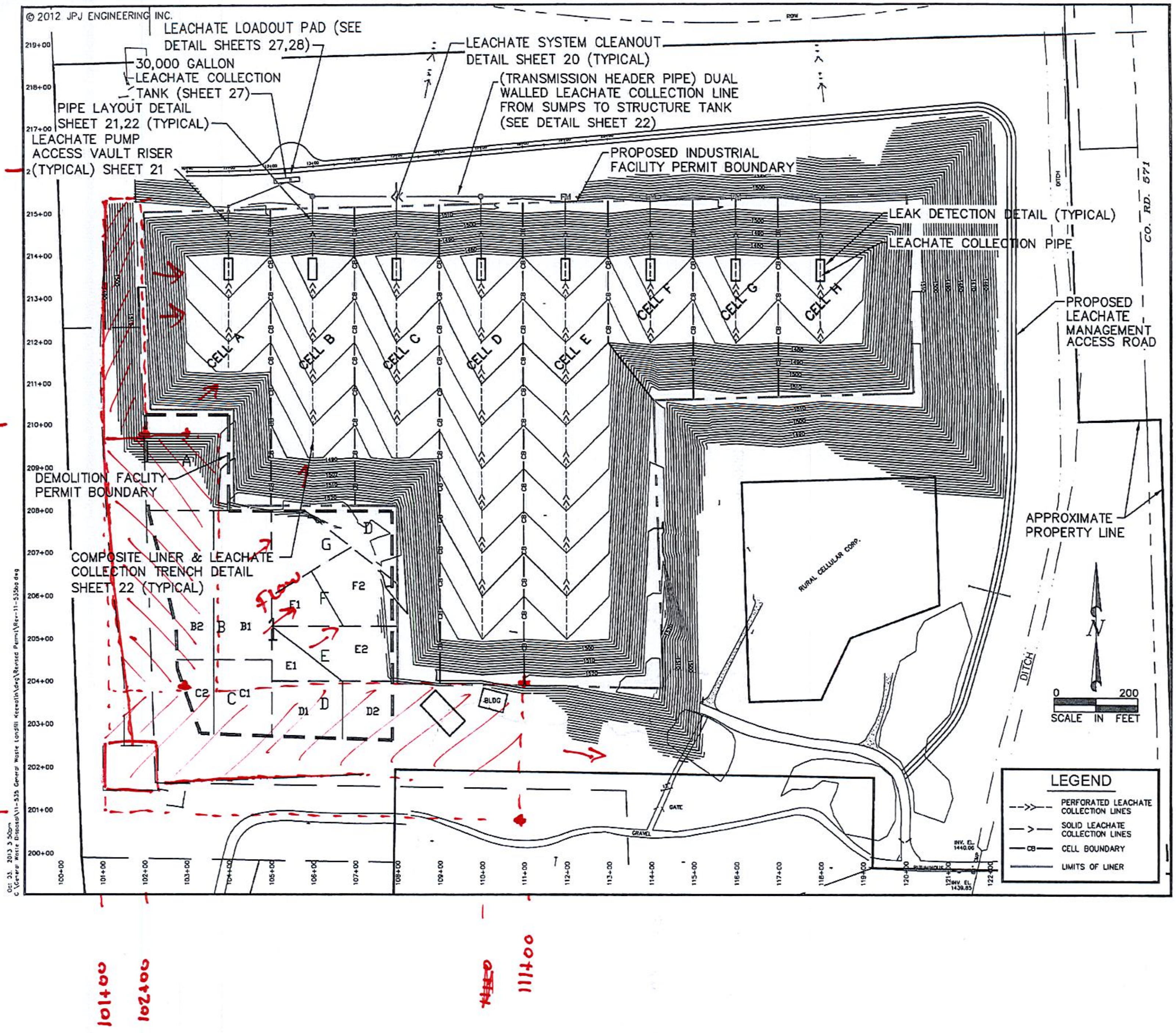
- 0 FREEBOARD

1.875 ACRE-ft

Summary

As Volume of storage > Volume of Runoff,
(81,700 ft^3 > 74,000 ft^3)

Pond will sufficiently contain Runoff from a 24-HR, 25 Year storm.



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303 East 19th Street
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Hibbing, MN 55746
Phone: (218) 262-5528
Fax: (218) 262-5059
www.jpjeng.com
Hibbing, MN • Duluth, MN

General Waste Disposal & Recovery Services Inc

LIESCH A Terracon COMPANY

NTS

GENERAL WASTE INDUSTRIAL LANDFILL
KEEWATIN, MINNESOTA

LEACHATE MANAGEMENT AND COLLECTION SYSTEM

REVISION DATE:	DESCRIPTION:
3-25-13	PLAN REVISIONS
10-03-2013	LEACHATE TANK LOCATION AND COLLECTION PIPING

SURVEYED ZZ
DESIGNED JDM
DRAWN WEH
CHECKED

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly licensed professional Engineer under the laws of the State of Minnesota.

JOHN D. MATTONEN
DATE 10/03/2013 LIC. NO. 23998

PROJECT #

5

APPENDIX C

General Waste Disposal and Recovery Services, Inc.
SW-620

APPLICATION FOR MAJOR PERMIT MODIFICATION

Leachate Management Plan

Prepared for:

General Waste Disposal and Recovery Services, Inc.

Prepared by:

Liesch Associates, Inc.
13400 15th Avenue North
Plymouth, MN 55441
(612) 559-1423

April 8, 2013

Project Number: 59118.00

"I certify under penalty of law that this document and all attachments were prepared under my direct supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete."

Eric C. Hesse, P.E.
Minnesota Registration No. 22743

April 8, 2013
Date

TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION 1
- 1.1 PURPOSE AND SCOPE 1
- 1.2 SITE INFORMATION AND BACKGROUND 1

2.0 LEACHATE MANAGEMENT SYSTEM 2
- 2.1 DESIGN OF THE LEACHATE SYSTEM 2
  - 2.1.1 Future Landfill Development 3
- 2.2 LEACHATE TREATMENT 3
- 2.3 LANDFILL CONTACT INFORMATION 3
- 2.4 LEACHATE QUANTITY 3
- 2.5 LEACHATE GENERATION 4
  - 2.5.1 HELP Model 4
- 2.6 LEACHATE QUALITY MONITORING 5
  - 2.6.1 Responsibilities 5
- 2.7 LEACHATE MANAGEMENT SYSTEM 6
  - 2.7.1 Leachate Collection System 6
  - 2.7.2 Access Vaults, Access Pipes and Cleanouts 6
  - 2.7.3 Gravity Header to UST 7
  - 2.7.4 Storage Tank and Load Out 7

3.0 OPERATIONS AND MAINTENANCE 8
- 3.1 LEACHATE PUMPS 8
- 3.2 LEACHATE COLLECTION AND TRANSMISSION LINES 9
- 3.3 LEACHATE HEAD MONITORING 9
- 3.4 RAIN FLAP 9

4.0 SAMPLING AND REPORTING 9

5.0 SAFETY PROCEDURES 10

6.0 CONTINGENCIES 10
- 6.1 POWER OUTAGE 10
- 6.2 EXCEEDANCE OF TANK CAPACITY 11
- 6.3 LEACHATE SPILLS 11

7.0 POTENTIAL FOR LEACHATE SPILLS AND SPILL REPONSE 11
- 7.1 POTENTIAL EQUIPMENT FAILURES 11
- 7.2 SPILL COUNTERMEASURES 12
- 7.3 CONTAINMENT AND DIVERSIONARY STRUCTURES 12

APPENDICES

Appendix A	Figure 1 –	Overall Base Grade Plan
	Figure 2 –	Leachate Collection System
Appendix B	Table 1 –	Leachate Generation Summary (HELP Model)
	Table 2 –	Pump Calculations
Appendix C	Leachate Production and HELP Model Calculations	
Appendix D	Industrial Wastewater Discharge Permit, WLSSD	
Appendix E	Pump Design Calculations	
Appendix F	Leachate Collection Pipe Strength and Capacity Analyses	

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document has been prepared as a plan for the management of leachate from the lined portions of General Waste Disposal and Recovery Services, Inc. Industrial Waste Landfill (the Landfill) located in Keewatin, Minnesota. This plan outlines design of the leachate management system and the responsibilities and procedures involved with managing leachate from the Landfill. Specific aspects of operation and maintenance of the leachate management system discussed within the plan include: sampling and analysis of leachate, maintenance and monitoring of the leachate system, transmission and disposal of leachate, reporting requirements, safety procedures, and contingencies.

This plan has been developed and is submitted as part of the Minnesota Pollution Control Agency (MPCA) permitting documents for the Landfill. It also serves as a stand-alone document for the management of leachate in support of Minnesota Solid Waste Rules, Part 7001.3300, Item R. The plan will be revised as necessary as facility conditions or regulatory requirements change.

Please note the figures and tables discussed in this report are included as **Appendices A** and **B**, respectively.

1.2 SITE INFORMATION AND BACKGROUND

The Landfill is located off U.S. Highway 169 and Itasca County Road 571, within the City Limits of Keewatin near the easterly boundary, in Section 25, Township 57 North, Range 22 West, Itasca County, Minnesota. The location of the Landfill is illustrated on the Sheet 1 of Engineering Plan Sheets.

The Landfill was originally permitted as a demolition debris disposal facility in November 29, 2004. Therefore, initial landfill operations have been conducted in unlined cells, and thus did not include a leachate management system. The overall base grade plan for the lined disposal area and the location of the unlined cells is illustrated in **Figure 1** in **Appendix A**.

The leachate management system at the Landfill will include the following components:

- Leachate collection piping, including: perforated collection pipes, solid transmission pipes (gravity and pressure) and double walled header pipes (gravity)
- Leachate Sumps and Lysimeters
- Pumps and controls
- Head monitors and level controls
- Pipe cleanout access points
- Flow meters

- Manholes
- Valves
- Underground leachate storage tank
- Load-out piping and containment pad

The Landfill will haul leachate to Western Lake Superior Sanitary District (WLSSD) wastewater treatment plant (see **Section 2.2**). Leachate generated at the Landfill is regulated by permits from both the MPCA and WLSSD.

Additional information about the leachate management system is contained in the *Engineering Report*, which discusses details of the leachate collection system. The *Operations and Maintenance Plan (Appendix D), Closure, Post-Closure, Contingency Action Plan and Financial Assurance Plan (Appendix B)* also give supplementary information about the leachate management system as it pertains to the intent of each report.

2.0 LEACHATE MANAGEMENT SYSTEM

The leachate management system collects and manages liquids from each of the lined cells via the leachate sumps. Leachate collected at the sumps located in the base of lined areas of the landfill is pumped to the underground leachate storage tank where it is loaded to tanker trucks for transport to WLSSD for disposal.

2.1 DESIGN OF THE LEACHATE SYSTEM

The leachate generated at the Landfill will be collected in a granular layer of sand placed directly above the liner system. Leachate will be directed to a collection sump at the low end of the liner system of each major cell by gravity through the sand drainage layer and a centrally located leachate collection pipe. Leachate levels on the liner will be monitored by a pressure transducer located on the leachate pumps in the sump areas. Leachate collected in the sump will be pumped via a side slope riser system to a double walled underground storage tank (approximately 30,000 gallons) (UST). Leachate header lines outside the area of the liner system will be double-walled pipes.

Operations of the side slope pump will be controlled by liquid level sensors located at the base of the side slope riser to automatically activate and deactivate the pump at predetermined leachate levels. Electronic sensors within the UST will prevent the pump from overfilling the tank. Also, a high level alarm will notify the operator of high tank or sump levels.

Leachate in the UST will be transferred to a tanker truck on the load out pad for disposal at the WLSSD. The pumping mechanism will be manually activated. The truck will be filled while contained on a load out pad. The pad is constructed of concrete with curbs surrounding the truck to contain any possible overfill of the truck during load out. The load out pad collects spillage in a drain which gravity drains back to the UST.

2.1.1 Future Landfill Development

With additional phase development, leachate will be pumped into the same dual contained HDPE forcemain along the northern edge of the lined area. This forcemain will serve all new and future cells constructed at the Landfill. Check valves are installed on the forcemain between each individual cell to prevent leachate from being pumped from one cell to the next.

2.2 LEACHATE TREATMENT

As previously described, the Landfill will collect the leachate for shipment to the WLSSD wastewater plant for treatment. WLSSD and the Landfill have entered into an agreement for the treatment of leachate generated at the facility. See the current copy of "Landfill Leachate Treatment Agreement" between WLSSD and General Waste, presented in **Appendix D**. In accordance with the agreement, either party many terminate the agreement on 150 days written notice. Transportation to the facility will be by an approved Minnesota Department of Transportation (MNDOT) and WLSSD carrier with appropriate handling, contingency actions plans, and insurance in place. The Landfill may also choose to self-haul leachate to the WLSSD as long as the appropriate permits and licenses are obtained from MNDOT and WLSSD.

2.3 LANDFILL CONTACT INFORMATION

Landfill Contact Person: Scott Allison Manager

Phone Numbers:	Landfill	218.345.6302
	Fax	218.345.6401
	Cell	218.966.8334
	Home	218.721.4865

Address: 35005 Highway 571
Keewatin, MN 55753

2.4 LEACHATE QUANTITY

As part of permitting documents, Liesch Associates has calculated the leachate generation for the landfill using the HELP model. As future cells are constructed it is anticipated that the leachate generation rate (as predicted by the HELP model) will be approximately 1.87 million gallons per year. The facility design also assumes there will be short periods (less than four days) when WLSSD cannot receive leachate and there is sufficient capacity available in the leachate tank to store leachate during these occasions. Refer to Volume II, Engineering Report, of this Major

Permit Modification Application (permit application) for further discussion of leachate management system design.

2.5 Leachate Generation

The amount of leachate generated at the Landfill is dependent on many factors. These factors include, but are not limited to, the amount of precipitation received at the Landfill, the size of the open and closed portions of the Landfill, and the types of wastes received.

2.5.1 HELP Model

The USEPA Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07, developed by the U.S. Army Corps of Engineers, has been used to project leachate generation volumes on a per acre basis for both open and closed conditions at the Landfill. Documentation for the analysis is presented in **Appendix C** of this report. The HELP Model calculations were performed using conservative assumptions and site design values to predict representative leachate generation values for the Landfill. These input parameters are summarized in the model output sheets in **Appendix C** of this report.

Historically, HELP Model results using average annual values have had a tendency to under estimate leachate generation values. Based on the leachate generation rates observed at other similar landfills, the results of the HELP Model analysis were calibrated to more accurately reflect the projected leachate generation rates. The calibrated HELP Model results uses 90% of the HELP model's average annual leachate generation and 10% of the HELP model's peak daily leachate generation rate. The maximum leachate generation rate during the life of the facility is projected to reach a maximum of 1.87 million gallons per year during active filling of Cell F based on the calibrated HELP model results. Using this same method of estimation, post-closure leachate generation is estimated at less than 37,500 gallons per year. Documentation for the analyses is presented as HELP Model results in **Appendix C**. All calculations were made assuming the waste is placed near the field capacity moisture content. This approach is conservative in that the waste will have excess absorptive capacity as it exists in-place.

The estimated leachate head build-up and efficiency of the final cover system were also determined in conjunction with the HELP Model analysis. Maximum daily leachate head on the composite liner system is estimated at 11.8 inches during the operational life of the Landfill and less than 1 inch following Landfill closure. The efficiency of the final cover system is calculated by the HELP Model to be 100% percent of the total incident precipitation, exceeding the Solid Waste Management Rules minimum standard.

2.6 Leachate Quality Monitoring

Currently the Landfill receives demolition and construction waste in an unlined cell southwest of the lined industrial cells. As part of this permit application, General Waste is proposing to accept industrial wastes on the proposed lined areas. Industrial wastes are accepted only after product review and testing has been completed, and found to be in compliance with the *Industrial Solid Waste Management Plan* (ISWMP). Records of all industrial wastes accepted annually will be kept on file at the Landfill. The Landfill does not accept municipal solid wastes (MSW).

Leachate management and monitoring is completed in accordance with this plan and the permit from the WLSSD. Leachate will be sampled as required in the agreement with WLSSD. Updates regarding the leachate sampling schedule and sampling parameters will be made annually as part of the Annual Report. See **Appendix D** for *Industrial Wastewater Discharge Permit, WLSSD*.

2.6.1 Responsibilities

General Waste works with multiple parties in the completion of the required leachate sampling and reporting. The following outlines the responsibilities of each party:

Landfill or a designated Consultant

1. Verify necessary sampling and have received proper sampling bottles from the lab.

2. Obtain the samples and send collected samples to the laboratory for analysis. Ensure proper packing of the samples and verify delivery method will be within sample threshold times.

3. Maintain records of leachate sampling analyses and log sheets for volumes hauled to the disposal site; provide copies to consultant.

4. Submit required reports to WLSSD and MPCA as required by the respective permits.

Laboratory and/or Consultant

1. Provide General Waste with sample bottles, preservatives for samples, and a shipping container. Bottles and preservatives must be properly labeled.

2. Analyze all samples for appropriate parameters and prepare summary reports.

3. Submit lab analyses and summaries to Landfill.

4. Perform periodic reviews of all data; make recommendations to modify/revise sampling plan as necessary.

5. Submit electronic data to MPCA per permit.

2.7 LEACHATE MANAGEMENT SYSTEM

2.7.1 Leachate Collection System

The leachate collection system has been designed to collect and convey leachate from the liner by gravity flow through perforated leachate collection pipes to collection sumps constructed on the northern edge of the lined cells. The leachate collection system is illustrated on **Figure 2** and is discussed in greater detail in the *Engineering Report* of this permit application.

The leachate collection lines will be constructed of heat-fusion welded six-inch SDR 11 perforated polyethylene pipe placed at a minimum two-percent slope. The leachate collection lines will convey the leachate by gravity flow to collection sumps constructed on the north end of each cell drainage area. The flow capacity of the pipe greatly exceeds the peak leachate generation rate of approximately 3.6 gallons per minute predicted by the HELP model for the largest (15.4-acres) cell drainage area, Cell G, during open conditions. The buckling capacity and compressive strength of the SDR 11 polyethylene pipe also exceeds the anticipated pressure forces within the Landfill, considering the depth of wastes, temperature, pipe bedding, and collection pipe trench geometry. The pipe capacity and strength analyses are contained in **Appendix F**. As discussed in the *Engineering Report*, new resin technologies may allow use of different SDR ratings in the future. Analyses of the pipe capacity and strength of any alternative piping material will be conducted prior to their use to confirm they meet or exceed those currently specified.

The polyethylene collection pipes will be placed in a trench excavated into the liner using a backhoe or grader blade. The clay liner has been designed such that the minimum required thickness of the clay will be maintained around the trench by oversizing the trench geometry in the liner system subgrade. After placement and seaming of the geomembrane within the trench, filter fabric will be placed in the collection trench on top of the geomembrane to protect the liner from damage. The perforated pipe bedding material, consisting of 1.5-inch aggregate, will be placed over the filter fabric. The pipe will then be laid in the trench and 1.5-inch aggregate is used to backfill the trench. An aggregate filter is used to prevent migration of sand from the sand drainage layer into the collection pipe.

2.7.2 Access Vaults, Access Pipes and Cleanouts

Submersible leachate pumps designed for side slope applications will be installed in the leachate collection sumps through 12-inch-diameter or 18-inch-diameter SDR 11 polyethylene access pipes positioned in the drainage layer of the landfill cell sideslopes as shown on the engineering plans. Leachate will be pumped from the collection sumps at rates of up to 22 gpm to a 6x10-inch double-walled HDPE SDR 11 header line for conveyance to the UST installed outside the lined area. The gravity header line is described in **Section 2.7.3**.

The sump access pipes and connections to the leachate header will be contained within access vaults. The access vaults will have approximate dimensions of 6 feet in diameter by 3.5 feet deep and will be constructed of reinforced concrete. Entrance to the vaults will be through hinged, locking metal doors. The vault and the lined area on which they are built will be incorporated into the final cover when cell closure occurs.

A control panel will be installed at each leachate pump access vault. Pressure transducers on the submersible leachate sump pump will activate the pump when the leachate head reaches a predetermined level in the sump area. Each panel will also be connected to a high level sensor in the leachate storage pond. When the high level is reached in the UST, power will be cut off to the leachate pump control panels and lift station until capacity has been made available in the UST.

Cleanouts will be provided near each access vault to enable cleaning of the leachate collection pipes by mechanical means or high-pressure water flow. The cleanouts will also provide access for pipe inspection by means of closed circuit video. The design includes cleanout risers to allow access from either end of the leachate collection pipes.

2.7.3 Gravity Header to UST

Leachate will be pumped from the collection sumps to a 6x10-inch double-walled HDPE SDR 11 header line for gravity conveyance to the UST installed outside the lined area on the northeast end of the Landfill. The double-wall design provides for secondary containment and leak detection for the leachate header line.

The gravity leachate header will be constructed of welded HDPE SDR 11 pipe and fittings placed on a prepared base at a minimum slope of 0.4 percent to the UST. All 8-inch pipe sections will be pressure-tested in the field at 5 psi for 15 minutes prior to burial with zero pressure loss as the acceptance criteria.

2.7.4 Storage Tank and Load Out

Leachate will drain from the gravity header line into the UST located north end of Phase 4. The UST is a double walled underground storage tank (approximately 30,000 gallons). Details of the UST are provided on the accompanying plan sheets. Piping connections through the concrete will be made through watertight neoprene waterstops. Piping connections through the HDPE sleeve will be made with a water-tight boot welded to the sleeve and fastened to the pipe with stainless steel bands. The interior of the concrete manholes will be coated with a bituminous or epoxy coating compatible with the leachate.

Leachate will be pumped from the UST through a 4x8-inch double-walled HDPE SDR 11 transfer pipe to the loadout pad. The UST pump will be a submersible pump that will be capable of pumping at a rate of up to 400 gallons per minute. The UST pump is controlled by a transducer with a float system which includes a high level alarm and a float to prevent the landfill pumps from operating if the leachate storage tank is full.

Once the leachate is in the UST, the system can continue to transfer leachate to the site load out pad.

The leachate transfer pipe is constructed of 4x8-inch double-walled HDPE SDR 11 and fittings placed on a prepared base. All 4-inch pipe sections will be pressure-tested in the field at 5 psi for 15 minutes prior to burial, with zero pressure loss as the acceptance criteria.

Leachate is pumped from the UST to the loadout pad, located adjacent to the tank. The loadout facility consists of a concrete pad (upon which the leachate hauler parks the tanker truck) and a drain to capture spillage and carry it back to the UST. The discharge pipe ends with a flexible hose that is connected to the tanker. A switch to operate the pump is located next to the concrete loadout pad that the leachate hauler uses to start and stop the pump.

3.0 OPERATIONS AND MAINTENANCE

3.1 LEACHATE PUMPS

The leachate collection sump pumps are 1/2-hp submersible pumps having a maximum capacity of 22 gallons per minute and designed for side-slope applications. A pressure transducer mounted on the pump housing will control pump operation. The pump will operate when the leachate level in the sump is above the high-liquid-level setting and will stop operating when the leachate level is below the low-liquid-level setting. The pump controls will be equipped with a low-level automatic shut-off and a high-liquid-level alarm. The high-level alarm will be connected to an external light at the pump control panel to alert the operator of a malfunction. This alarm will also light when the UST has reached capacity and the high-level signal from the pump results in an interruption of power to the individual leachate pumps within the landfill cells.

An explosion-proof submersible pump, having a capacity of up to 400 gallons per minute will be installed in the UST to transfer leachate to the load out. The transfer pump is controlled with a transducer and a high level float. The transducer controls the normal operation of the transfer pump and the high level float is used to activate a high-water alarm and to interrupt power to the sump pumps in the fill area. The discharge line from the pump to the inlet manifold to the UST is sloped to drain back to the UST should maintenance be required on the transfer pipe.

3.2 Leachate Collection and Transmission Lines

Sediments will be cleaned from the leachate collection and transmission pipes on an annual basis. This will be accomplished by high-pressure jetting equipment, water flushing, or other mechanical means. Access to the pipes will be available through clean-out structures at various points in the piping system. It will be possible to conduct all cleaning processes from aboveground.

3.3 Leachate Head Monitoring

Leachate head is monitored using electronic pressure transducers installed in the collection sump of each cell. The pressure transducers, which will be calibrated prior to installation, send a signal that indicates the leachate depth near the low point of each cell. Digital meters provide constant real-time readouts of the leachate depths. The meters are located at the control panels of the respective leachate pump. The leachate head on the liner must be kept below 12 inches at all times. Head levels will be checked regularly in each cell, and the levels will be recorded in accordance with permit requirements.

3.4 Rain Flap

A design of a geomembrane rain sheet over the upper portions of each cell will be delivered as part of future construction documents for each cell. This rain sheet will be installed during construction to divert precipitation falling on areas of the cells not containing waste for management of storm water runoff, thereby reducing the volume of leachate generated during the initial operation of the cell.

4.0 SAMPLING AND REPORTING

As outlined in the agreement between the WLSSD and the Landfill, the WLSSD will receive monthly haulage reports and laboratory analysis data twice annually. The reports will list the volumes of the leachate hauled to the WLSSD for the current month and a summary of the volume hauled to date for the current year.

Significant changes in volumes, quality, or operating problems will be summarized by the Landfill as detailed in the WLSSD Permit.

The annual report to the MPCA will include a summary of the volumes and analysis of the leachate generated as well as an operation and maintenance summary (MPCA Solid Waste Rules, 7035.2585).

Accurate records will be maintained at the site and submitted to the MPCA in accordance with any reporting requirements included in the Landfill Permit (SW-620). The Annual Report will include a summary of records kept in accordance with solid waste management rules Chapter 7035.2815 Subp. 14.Q, and will include maintenance preformed on the system.

5.0 SAFETY PROCEDURES

Leachate may contain constituents potentially harmful to human health and the environment. Certain safety procedures should be adhered to in order to maintain a safe working situation. Care must be exercised when working near the leachate collection system. Only trained employees should be allowed near the facilities. Sumps, tanks, and other appropriate portions of the leachate management system must be signed and locked for restricted access and confined space entry.

Landfill personnel will be provided with a range of values from the analytical results of leachate sampling to apprise them of the potential hazards of handling leachate. Landfill personnel must maintain caution at all times when handling leachate. Caution should be exercised when leaning over the tanks or manholes for the purpose of obtaining a sample or for any other reason.

Absolutely no smoking will be allowed around the leachate-management-system facilities due to the possibility of leachate and the adjacent landfill producing combustible gases. "No Smoking" signs will be posted at the leachate load out area.

The *Emergency Response Plan* and *Contingency Action Plan* should also be referenced for information on potential safety issues.

The contract hauler employed by the Landfill will provide a Safety Plan for review by the Landfill representatives and WLSSD. If the Landfill chooses to self-haul, a safety plan should be prepared and submitted to WLSSD.

In the event of an accident during the load out process, emergency procedures outlined in the permitting documents should be followed.

6.0 CONTINGENCIES

The contingencies presented in this section do not represent an all-inclusive list. The contingencies presented include those with the most reasonable probability of occurring.

6.1 POWER OUTAGE

In the event of a power outage at the Landfill, the leachate pump and storage tanks will shut down. A power outage is not expected to last long enough to affect the leachate management system or to threaten exceedance of leachate capacity. Leachate can be stored on the cell liner until power is returned, in the case of an extended power outage. Temporary generators can also be brought to the Landfill and the pumps rewired to run off the generators if there is an extended power outage.

6.2 Exceedance of Tank Capacity

The evaluation of leachate generation quantities was undertaken using conservative assumptions in order to avoid the potential for exceedance of the tank design capacity of 30,000 gallons. There are several design considerations that reduce the potential for capacity exceedance. First, the UST is designed to hold 16 days of leachate generation at the Landfill's projected production rate. Additional capacity could be gained by temporarily storing up to one foot of leachate on the liner around the sump area.

6.3 Leachate Spills

Leachate spills can potentially occur during the transfer of leachate from the tanks to the Loadout. The potential for leachate spill and the associated response is detailed in the following **Section 7.0**.

7.0 POTENTIAL FOR LEACHATE SPILLS AND SPILL REPONSE

The potential for a leachate spill exists at locations where leachate or other liquids are stored or transferred. A spill could also be the result of discharge from leachate seeps from the Landfill. The most probable locations of a leachate spill are as follows:

- From the leachate load-out pad during filling of a tanker truck,
- As a result of forcemain/transmission line infrastructure failure, or
- From seeps in the Landfill, most likely from areas where final cover has not been constructed.

A potential spill during the filling of a tanker would most likely result in the leachate being contained within the load-out pad, and draining into the UST. Potential leachate spills from a forcemain or transmission line infrastructure failure would also likely be small as a spill of this nature would be contained within secondary containment piping. Evidence of a breach in the primary piping would be visually evident in the containment manholes and would be detected during the Landfills standard inspection procedures.

Leachate spilled within secondary containment structures would be readily removed utilizing tanker trucks, or by pumping the liquid back into the UST.

7.1 Potential Equipment Failures

Potential Event: Leaking pipe or pipe fitting

Spill Description:	Spill will be contained in Secondary Containment and forcemain manholes
Volume Released:	Nothing released from containment system
Spill Rate:	Up to 30 gallons per minute

Potential Event:	Tank truck leak or failure
Spill Description:	Surface Spill, 1,000 – 6,000 gallon tank should be contained in loadout pad, with potential for some to migrate to drainage ditches
Volume Released:	0 to 6,000 gallons
Spill Rate:	Gradual to instantaneous

Potential Event:	Hose leak during truck loading
Spill Description:	Surface Spill, 1,000 – 6,000 gallon tank should be contained in loadout pad, with potential for some to migrate to drainage ditches
Volume Released:	0 to several gallons
Spill Rate:	Up to 1 gallon per minute

7.2 SPILL COUNTERMEASURES

If a release of leachate occurs, report it immediately to the site manager. If the spill is in excess of 5 gallons, the site manager will need to be report to regulatory agencies.

Site staff should attempt to immediately stop the source of the spill, and contain any spilled material. Spill kits and heavy equipment are available to assist with spill response.

All wastes generated from the spill response shall be hauled to the lined disposal area and handled in accordance with state and federal regulations.

Training on spill response for leachate related spills will be done at the same time as training related to the emergency response activities.

7.3 CONTAINMENT AND DIVERSIONARY STRUCTURES

1. The UST is double-walled and located within a containment area.

2. The loading and unloading of tank trucks and equipment is carefully monitored to limit the potential for a significant release of leachate to occur.

3. Surface drainage at the facility is engineered so that in the event leachate is spilled at the facility, it will drain into the stormwater management system, where it can be contained and either removed or remediated.

4. Leachate transmission and forcemain piping located outside the waste limits is double walled. The majority of on-site riser pipes and cleanouts are located in containment structures with monolithic bases to contain spills.

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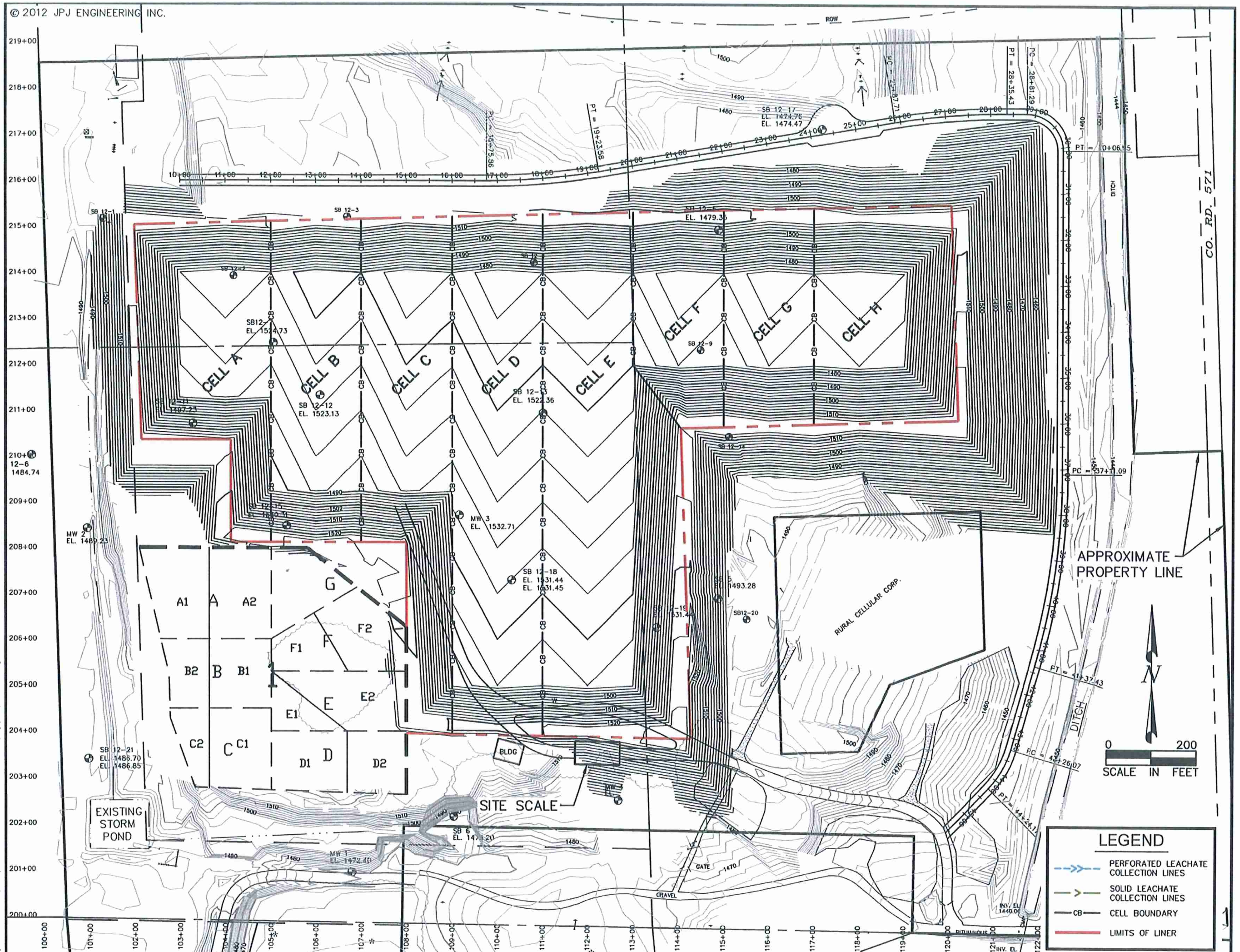
Appendix A
FIGURES



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General Waste Industrial Landfill

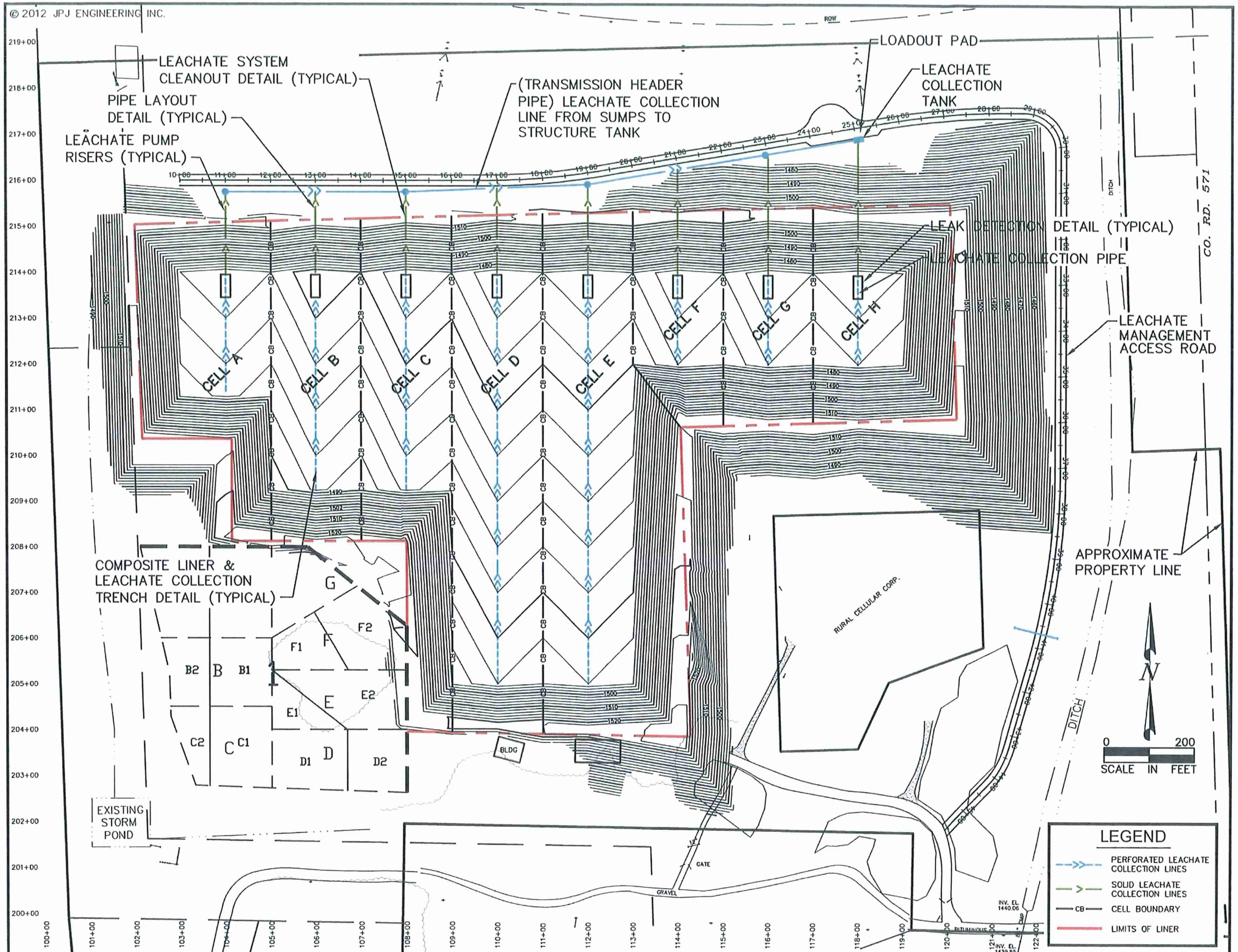
Overall Base Grade Plan

Apr 13

Figure 1

Source: JPJ Engineering, Inc., 2012

w:\l\59118\GIS\Fig1.mxd w:\l\59118\Figures\Fig1.pdf



Source: JPJ Engineering, Inc., 2012

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General Waste Industrial Landfill

Leachate Collection System

Apr 13

Figure 2

Appendix B
TABLES

Table 1:
General Waste Industrial Landfill
Leachate Generation Summary

Leachate generation using the average annual generation rate from HELP model and anticipated closure sequence.

Cell	Total Area (acres)	Active		Closed		Total
		Area (acres)	Annual Leachate Generation (gal/yr)	Area (acres)	Annual Leachate Generation (gal/yr)	
A	3.24	3.24	304560	0	0	304560
B	3.22	6.46	607240	0	0	607240
C	3.54	10	940000	0	0	940000
D	6.15	9.47	890180	6.68	6012	896192
E	6.8	13.13	1234220	9.82	8838	1243058
F	2.23	15.36	1443840	9.82	8838	1452678
G	2.43	7.47	702180	20.14	18126	720306
H	3.34	10.81	1016140	20.14	18126	1034266
Closed	30.95	0	0	30.95	27855	27855

Leachate generation using the peak daily generation rate from HELP model and anticipated closure sequence.

Cell	Total Area (acres)	Active		Closed		Total
		Area (acres)	Annual Leachate Generation (gal/yr)	Area (acres)	Annual Leachate Generation (gal/yr)	
A	3.24	3.24	3240	0	0	3240
B	3.22	6.46	6460	0	0	6460
C	3.54	10	10000	0	0	10000
D	6.15	9.47	9470	6.68	73.48	9543.48
E	6.8	13.13	13130	9.82	108.02	13238.02
F	2.23	15.36	15360	9.82	108.02	15468.02
G	2.43	7.47	7470	20.14	221.54	7691.54
H	3.34	10.81	10810	20.14	221.54	11031.54
Closed	30.95	0	0	30.95	340.45	340.45

Notes:

1) Based on assumed sequencing plan for site construction, operation, and closure.

2) HELP model estimated annual leachate generation from the sand drainage layer (Active) = 94,000 gal/ac/yr

3) Active leachate generation rate is conservative as it assumes only 15' fill during entire operation.

4) HELP model estimated annual leachate generation from the sand drainage layer (Closed) = 900 gal/ac/yr

5) Closure acreage used to estimaate volumes due to piggyback areas.

6) HELP model estimated peak daily leachate generation from the sand drainage layer (Active) = 1,000 gal/ac/yr

7) HELP model estimated peak daily leachate generation from the sand drainage layer (Closed) = 11 gal/ac/yr

N:\Liesch_Projects\lf\59118\Final Docs\Appendix C\[BTables.xlsx]Table 1

Average Annual Leachate Generation (Cell F)

Active Case:	1,443,840 gallons
Closed Case:	8,838 gallons
Total:	1,452,678 gallons

Peak Daily

133 cu ft/ac/day:	Active (1,000 g/ac/day)
1.4 cu ft/ac/day:	Closed (11 g/ac/day)
1,000 * 365 g/acre:	365,000 g/ac/yr
11 * 365 g/acre:	4015 g/ac/yr

For Cell F:

15.36 * 365,000 + 9.82* 4,015:	5,645,827 g/yr
Peak Daily Volume Active:	1,000 g/ac/day
Peak Daily Volume Closed:	11 g/ac/day
15.36 * 1,000 + 9.82 * 11:	15,468 gallons/day
94,000 g/ac/yr ÷ 365:	258 gallons/day
0.9(260) + 0.1(15,500):	1,784 gallons/day

Average Annual (90%) - Peak Daily (10%) Generation

0.9(1,452,678 g/yr) + 0.1(5,645,827 g/yr):
1,871,993 gallons of leachate

Temporary Leachate Storage

Max leachate storage per week:	12,600 gallons
Max leachate storage per day:	1,800 gallons
Maximum leachate storage per 4 day period:	7,200 gallons
Size of leachate storage tank:	30,000 gallons

Table 2
General Waste Industrial Landfill
Pump Calculations

Elevation at Sump:	1472 ft
Elevation at Surface:	1510 ft
Elevation difference:	38 ft

EPG Series 5-2, .50 HP
At 40 ft head: 18 gpm

EPG Series 5-3, .75 HP
At 40 ft head: 29 gpm

Leachate Generation From Previous Help Model Calculations

Average Annual:	94,000 gal/ac/yr
Peak Daily:	1,000 gal/ac/yr

Cell F: 15.36 ac

15.36 ac* 94,000 gal/ac/yr:	1,443,840 gal/yr:	2.75 gal/min
15.36 ac * 1,000 gal/ac/yr:	15,360 gal/yr:	.03 gal/min

Appendix C
Leachate Production and HELP Model Calculations

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP\GWACTIVE.D4
TEMPERATURE DATA FILE:       C:\HELP\GWACTIVE.D7
SOLAR RADIATION DATA FILE:   C:\HELP\GWACTIVE.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\GWACTIVE.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\GWACTIVE.D10
OUTPUT DATA FILE:            C:\HELP\GWACIBDR.OUT


TIME:  14:39      DATE:   2/21/2013


******************************************************************************

     TITLE:  General Waste Active Case

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   9
           THICKNESS                    =       6.00   INCHES
           POROSITY                     =       0.5010 VOL/VOL
           FIELD CAPACITY               =       0.2840 VOL/VOL
           WILTING POINT                =       0.1350 VOL/VOL
           INITIAL SOIL WATER CONTENT   =       0.3024 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =   0.190000006000E-03 CM/SEC


                                   LAYER  2
```

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 19

THICKNESS	=	180.00 INCHES
POROSITY	=	0.1680 VOL/VOL
FIELD CAPACITY	=	0.0730 VOL/VOL
WILTING POINT	=	0.0190 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0732 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 3

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.0830 VOL/VOL
WILTING POINT	=	0.0330 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1340 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.310000009000E-02 CM/SEC
SLOPE	=	2.00 PERCENT
DRAINAGE LENGTH	=	100.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 9 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	92.10	
FRACTION OF AREA ALLOWING RUNOFF	=	90.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.990	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	3.342	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.848	INCHES
INITIAL SNOW WATER	=	0.384	INCHES
INITIAL WATER IN LAYER MATERIALS	=	26.839	INCHES
TOTAL INITIAL WATER	=	27.223	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM Duluth MINNESOTA

STATION LATITUDE	=	46.50	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	144	
END OF GROWING SEASON (JULIAN DATE)	=	261	
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	11.20	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DULUTH MINNESOTA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.60	0.51	0.85	1.63	2.75	4.15
4.26	3.14	3.08	2.41	1.17	0.78

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DULUTH MINNESOTA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
8.10	12.90	25.00	39.50	51.20	60.20
64.90	62.80	53.60	41.20	25.60	13.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DULUTH MINNESOTA AND STATION LATITUDE = 46.50 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.49	0.48	0.89	1.57	3.00	4.19
	3.91	2.88	2.77	1.99	1.18	0.86
STD. DEVIATIONS	0.24	0.25	0.27	0.77	1.21	1.87
	1.52	1.44	0.74	1.22	0.72	0.32
RUNOFF						
TOTALS	0.000	0.016	0.527	0.705	0.262	0.393
	0.443	0.232	0.132	0.203	0.180	0.027
STD. DEVIATIONS	0.000	0.064	0.375	0.448	0.304	0.552
	0.409	0.339	0.115	0.413	0.276	0.082
EVAPOTRANSPIRATION						
TOTALS	0.447	0.428	0.448	0.575	2.826	3.331
	2.946	2.190	2.126	1.360	0.545	0.378
STD. DEVIATIONS	0.087	0.131	0.162	0.588	0.940	1.100
	1.064	0.999	0.793	0.514	0.270	0.088
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.2208	0.1524	0.1264	0.1096	0.2868	0.3027
	0.3945	0.3935	0.3749	0.4292	0.3719	0.2944
STD. DEVIATIONS	0.0966	0.0672	0.0552	0.0448	0.0969	0.0938
	0.1801	0.1497	0.1417	0.1561	0.1696	0.1307
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	2.0272	1.5327	1.1602	1.0396	2.6326	2.8705
	3.5983	3.6023	3.5490	3.9143	3.5125	2.7017
STD. DEVIATIONS	0.8869	0.6699	0.5065	0.4253	0.8874	0.8852
	1.5931	1.3454	1.3268	1.3787	1.5683	1.1967

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	24.20 (3.598)	87851.5	100.00
RUNOFF	3.120 (1.2887)	11324.76	12.891
EVAPOTRANSPIRATION	17.599 (2.4261)	63884.33	72.719
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.45724 (0.85573)	12549.795	14.28524
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00144 (0.00032)	5.217	0.00594
AVERAGE HEAD ON TOP OF LAYER 4	2.678 (0.653)		
CHANGE IN WATER STORAGE	0.024 (0.6611)	87.34	0.099

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.60	13068.000
RUNOFF	1.709	6204.8936
DRAINAGE COLLECTED FROM LAYER 3	0.03662	132.93167
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000013	0.04739
AVERAGE HEAD ON TOP OF LAYER 4	9.712	
MAXIMUM HEAD ON TOP OF LAYER 4	11.813	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	43.3 FEET	
SNOW WATER	1.80	6529.3379
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4050	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1060	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.9587	0.3265
2	13.1459	0.0730
3	1.5466	0.1289
4	0.0000	0.0000
5	10.2480	0.4270
SNOW WATER	0.805	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**             HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                   **
**              DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**                USAE WATERWAYS EXPERIMENT STATION                         **
**           FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP\GWCLOSED.D4
TEMPERATURE DATA FILE:       C:\HELP\GWCLOSED.D7
SOLAR RADIATION DATA FILE:   C:\HELP\GWCLOSED.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\GWCLOSED.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\GWCLOSED.D10
OUTPUT DATA FILE:            C:\HELP\GWCLOBDR.OUT


TIME:  15:20     DATE:   2/21/2013


******************************************************************************

     TITLE:  General Waste Closed Case

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                 LAYER  1
                                 --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   9
          THICKNESS                 =       6.00   INCHES
          POROSITY                  =       0.5010 VOL/VOL
          FIELD CAPACITY            =       0.2840 VOL/VOL
          WILTING POINT             =       0.1350 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.2915 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.190000006000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4530 VOL/VOL
FIELD CAPACITY	=	0.1900 VOL/VOL
WILTING POINT	=	0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1291 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.720000011000E-03 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0620 VOL/VOL
WILTING POINT	=	0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0408 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02 CM/SEC
SLOPE	=	20.00 PERCENT
DRAINAGE LENGTH	=	200.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.04 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 9

THICKNESS	=	6.00 INCHES
POROSITY	=	0.5010 VOL/VOL
FIELD CAPACITY	=	0.2840 VOL/VOL
WILTING POINT	=	0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2840 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.190000006000E-03 CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1200.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 3

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.0830 VOL/VOL
WILTING POINT	=	0.0330 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0833 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.310000009000E-02 CM/SEC
SLOPE	=	2.00 PERCENT
DRAINAGE LENGTH	=	100.0 FEET

LAYER 8

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 20.% AND A SLOPE LENGTH OF 200. FEET.

SCS RUNOFF CURVE NUMBER	=	83.10	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.765	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.220	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.512	INCHES
INITIAL SNOW WATER	=	0.384	INCHES
INITIAL WATER IN LAYER MATERIALS	=	366.365	INCHES
TOTAL INITIAL WATER	=	366.748	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM Duluth MINNESOTA

STATION LATITUDE	=	46.50	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	144	
END OF GROWING SEASON (JULIAN DATE)	=	261	
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	11.20	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DULUTH MINNESOTA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.60	0.51	0.85	1.63	2.75	4.15
4.26	3.14	3.08	2.41	1.17	0.78

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DULUTH MINNESOTA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
8.10	12.90	25.00	39.50	51.20	60.20
64.90	62.80	53.60	41.20	25.60	13.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR DULUTH MINNESOTA
AND STATION LATITUDE = 46.50 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.49	0.48	0.89	1.57	3.00	4.19
	3.91	2.88	2.77	1.99	1.18	0.86
STD. DEVIATIONS	0.24	0.25	0.27	0.77	1.21	1.87
	1.52	1.44	0.74	1.22	0.72	0.32
RUNOFF						
TOTALS	0.000	0.017	0.482	0.506	0.113	0.089
	0.062	0.039	0.005	0.046	0.166	0.021
STD. DEVIATIONS	0.000	0.069	0.383	0.362	0.198	0.239
	0.111	0.099	0.018	0.101	0.271	0.063
EVAPOTRANSPIRATION						
TOTALS	0.447	0.428	0.470	0.626	3.249	4.090
	4.171	2.680	1.845	1.178	0.517	0.380
STD. DEVIATIONS	0.087	0.131	0.162	0.548	0.764	1.042
	1.373	1.124	0.513	0.279	0.193	0.087
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0022	0.0001	0.0000	0.1011	0.7066	0.4108
	0.4444	0.1108	0.0628	0.3361	0.2280	0.0361
STD. DEVIATIONS	0.0039	0.0002	0.0000	0.1933	0.4569	0.3738
	0.7778	0.1086	0.0826	0.6126	0.3602	0.0579
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0001	0.0000	0.0000	0.0012	0.0088	0.0058
	0.0057	0.0021	0.0013	0.0042	0.0033	0.0008
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0023	0.0050	0.0039
	0.0074	0.0015	0.0012	0.0062	0.0041	0.0010

LATERAL DRAINAGE COLLECTED FROM LAYER 7

TOTALS	0.0023	0.0016	0.0013	0.0010	0.0022	0.0034
	0.0041	0.0040	0.0033	0.0032	0.0034	0.0031
STD. DEVIATIONS	0.0016	0.0011	0.0009	0.0006	0.0011	0.0014
	0.0021	0.0024	0.0018	0.0017	0.0021	0.0020

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0022	0.0001	0.0000	0.1066	0.7209	0.4331
	0.4534	0.1130	0.0662	0.3429	0.2404	0.0369
STD. DEVIATIONS	0.0040	0.0003	0.0000	0.2038	0.4661	0.3941
	0.7935	0.1108	0.0871	0.6251	0.3798	0.0591

DAILY AVERAGE HEAD ON TOP OF LAYER 8

AVERAGES	0.0209	0.0159	0.0120	0.0096	0.0203	0.0322
	0.0379	0.0368	0.0309	0.0292	0.0320	0.0283
STD. DEVIATIONS	0.0144	0.0110	0.0083	0.0061	0.0100	0.0130
	0.0194	0.0220	0.0173	0.0155	0.0202	0.0183

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	24.20	(3.598)	87851.5	100.00
RUNOFF	1.546	(0.7752)	5613.79	6.390
EVAPOTRANSPIRATION	20.080	(2.2672)	72889.59	82.969
LATERAL DRAINAGE COLLECTED FROM LAYER 3	2.43912	(1.56998)	8854.017	10.07839
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.03327	(0.01665)	120.780	0.13748

AVERAGE HEAD ON TOP OF LAYER 4	0.210 (	0.135)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.03282 (	0.01279)	119.127	0.13560
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00002 (	0.00001)	0.081	0.00009
AVERAGE HEAD ON TOP OF LAYER 8	0.026 (	0.010)		
CHANGE IN WATER STORAGE	0.103 (	0.9056)	374.86	0.427

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.60	13068.000
RUNOFF	1.127	4091.5024
DRAINAGE COLLECTED FROM LAYER 3	0.21658	786.17511
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.001892	6.86701
AVERAGE HEAD ON TOP OF LAYER 4	6.850	
MAXIMUM HEAD ON TOP OF LAYER 4	12.663	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	7.8 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00039	1.39756
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00079
AVERAGE HEAD ON TOP OF LAYER 8	0.110	
MAXIMUM HEAD ON TOP OF LAYER 8	0.212	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	3.4 FEET	
SNOW WATER	1.80	6529.3379

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2987

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0756

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.9284	0.3214
2	1.2633	0.2105
3	1.4570	0.1214
4	0.0000	0.0000
5	1.7040	0.2840
6	350.4000	0.2920
7	1.0082	0.0840
8	0.0000	0.0000
9	10.2480	0.4270
SNOW WATER	0.805	

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Appendix D
Industrial Wastewater Discharge Permit, WLSSD

Permit No. 120

INDUSTRIAL WASTEWATER DISCHARGE PERMIT

Pursuant to the provisions of Minnesota Statutes Chapter 458D and the Industrial Pretreatment Ordinance for the Western Lake Superior Sanitary District, permission is hereby granted to General Waste Disposal & Recovery Service, Inc. Industrial Landfill 35005 County Road 571 in Keewatin, MN mailing address is 611 Industrial Dr., Chisholm, MN 55719 for the discharge of wastewater into the WLSSD system. This Permit is granted in accordance with the plans, specifications, and data contained in the WLSSD files on March 22, 2013, which is considered part of this Permit. Effluent limitations, monitoring requirements, general permit conditions and other specific conditions are hereinafter set forth in this Permit.

Effective Date: 1st day of April, 2013.

Expiration Date: 1st day of April, 2018.

Issued by:____

Executive Director of duly authorized representative

Date:____________________

AUTHORITY STATEMENT

This Permit has been developed consistent with the requirements of the Western Lake Superior Sanitary District's "Industrial Pretreatment Ordinance." This Ordinance was adopted by the District in 1985 pursuant to Minnesota Statute, Chapter 478 (presently 458D) and declared necessary for the efficient, economic and safe operation of the regional wastewater disposal system, and for the protection of the health, safety and general welfare of the public throughout the District.

The Industrial Wastewater Discharge Permit establishes effluent limitations, monitoring and reporting requirements to assure compliance with the District's Industrial Pretreatment Ordinance, the Federal Clean Water Act of 1977 (as amended), and the General Pretreatment Regulations (40 CFR Part 403).

Permit No. 120

A. **Effluent limitations**

1.) EPA Categorical Industry __Yes X No

2.) Specific Discharge Limitations

Limitations

Pollutant or Pollutant Property	Maximum Concentration	Recommended EPA Methods
Copper (Cu)	3.38 mg/l	220.2 or SW 6010
Zinc (Zn)	2.61 mg/l	289.1 or SW 6010
Nickel (Ni)	3.98 mg/l	249.2 or SW 6010
Cadmium (Cd)	0.03 mg/l	213.2 or SW 6010
Chromium (Cr)	2.77 mg/l	218.2 or SW 6010
Lead (Pb)	0.69 mg/l	239.2 or SW 6010
Mercury (Hg)	0.0001 mg/l	EPA 1631
pH GRAB (Minimum)	5.5	150.1
pH GRAB (Maximum)	12.0	150.1
Biochemical Oxygen Demand (BOD)	No Limit, for billing only.	360.1
Total Suspended Solids (TSS)	No Limit, for billing only.	160.2

B. **Self-Monitoring Schedule**

1.) Following are specific sampling, sampling compositing and volume determination methods required by this Permit. Representative samples shall be collected at each monitoring point by the Permittee. Representative samples will be taken and analyzed of discharge.

a) Monitoring Point: Leachate sample point or truck loading area.

Sample Collection Method: An automatic composite sampler or 3 grab samples composited.

Sample Compositing Method: A flow proportioned representative sample.

Volume Determination: Magnetic Flow Meter, Flume Flow Metering Device, or truck volume.

b) Monitoring Frequency: Section A.2 list: Once per Quarter. Daily Volume Discharge: reported monthly.

2.) Chemical analysis for the previously specified samples representing the total waste discharge shall be performed for the following parameters: pH, and those parameters as listed under Specific Discharge. Limitations. (Section A.2 of this Permit).

3.) Pursuant to the requirements of Article III, Section 7 of the Pretreatment Ordinance, Permittees are required to submit periodic compliance status reports to the WLSSD. For the duration of this Permit, the user shall submit an Industrial Waste Discharge Report Waste Discharge Report Quarterly to the WLSSD on or before January15, April 15, July 15, and October 15.

4.) Categorical users shall comply with the reporting requirements of 40CFR, 403.12 as listed in Article II, Section 3 of the Pretreatment Ordinance.

5.) If it is determined through repeated sampling that any of the parameters are not present at sufficient levels to justify continued analysis, the Permittee may request in writing that it be allowed to discontinue sampling and analysis for said parameters. The WLSSD will consider the results from previous Compliance Status Reports.

6.) In accordance with Article III, Section 4 of the District's Industrial Pretreatment Ordinance, the District may modify the terms and conditions of the Permit as necessary.

C. **Compliance Schedule**

NA

D. **General Conditions**

1.) Industrial wastewater discharges from a Permittee shall be in accordance with applicable provisions of the Industrial Pretreatment Ordinance and this Permit.

2.) The Permittee shall not knowingly make any false statement representation or certification in any record, report, or plan required to be submitted to the WLSSD under the provisions of the Industrial Pretreatment Ordinance.

3.) This Permit shall not release the Permittee from any liability, duty or penalty imposed by Minnesota or Federal statutes or regulations or local ordinance.

4.) The Permittee shall comply with the requirements of Article II, Section 6 of the Industrial Pretreatment Ordinance governing Accidental or Slug Discharges.

5.) Any change in the volume or characteristics of industrial wastewater introduced into the WLSSD system which the Permittee knows or has reason to believe will have either singly or by interaction with other wastes, a negative impact on the wastewater treatment process shall be immediately reported to the Director. In such cases, the Permit will be subject to modification in accordance with Article III, Section 4 of the Industrial Pretreatment Ordinance.

6.) The Permittee shall install, operate and maintain sampling and monitoring devices in proper working order at his own expense.

7.) The Permittee shall allow the District to enter upon the Permittee's premises to inspect the monitoring point and to determine compliance with the Industrial Pretreatment Ordinance of the WLSSD and the Industrial Discharge Permit in accordance with Article III, Section 9 of the Ordinance.

8.) The Permittee shall retain and preserve for no less than 3 years, any records, books, documents, memoranda, reports, correspondence, and any and all summaries thereof, relating to monitoring, sampling and chemical analysis made by or in behalf of the Permittee in connection with its regulated discharge. The District shall have the right to copy such documents as necessary to determine compliance with the Pretreatment Ordinance and this Permit.

9.) The provisions of the Pretreatment Ordinance and all standards, limitations, orders, schedules of compliance and all provisions and conditions of this Permit shall be enforced by the District through the penalties established in Article V, Section 1 and 2 of the Industrial Pretreatment Ordinance.

10.) The District Board may revoke an Industrial Wastewater Discharge Permit for any of the reasons listed in Article IV, Section 2 (a) of the Industrial Pretreatment Ordinance.

11.) The Permittee is not allowed to transfer the Permit to another person or location except as allowed through Article III, Section 6 of the Industrial Pretreatment Ordinance.

12) WLSSD will enforce this permit as describe in in the WLSSD Enforcement Response Plan.

E. **Specific Permit Conditions**

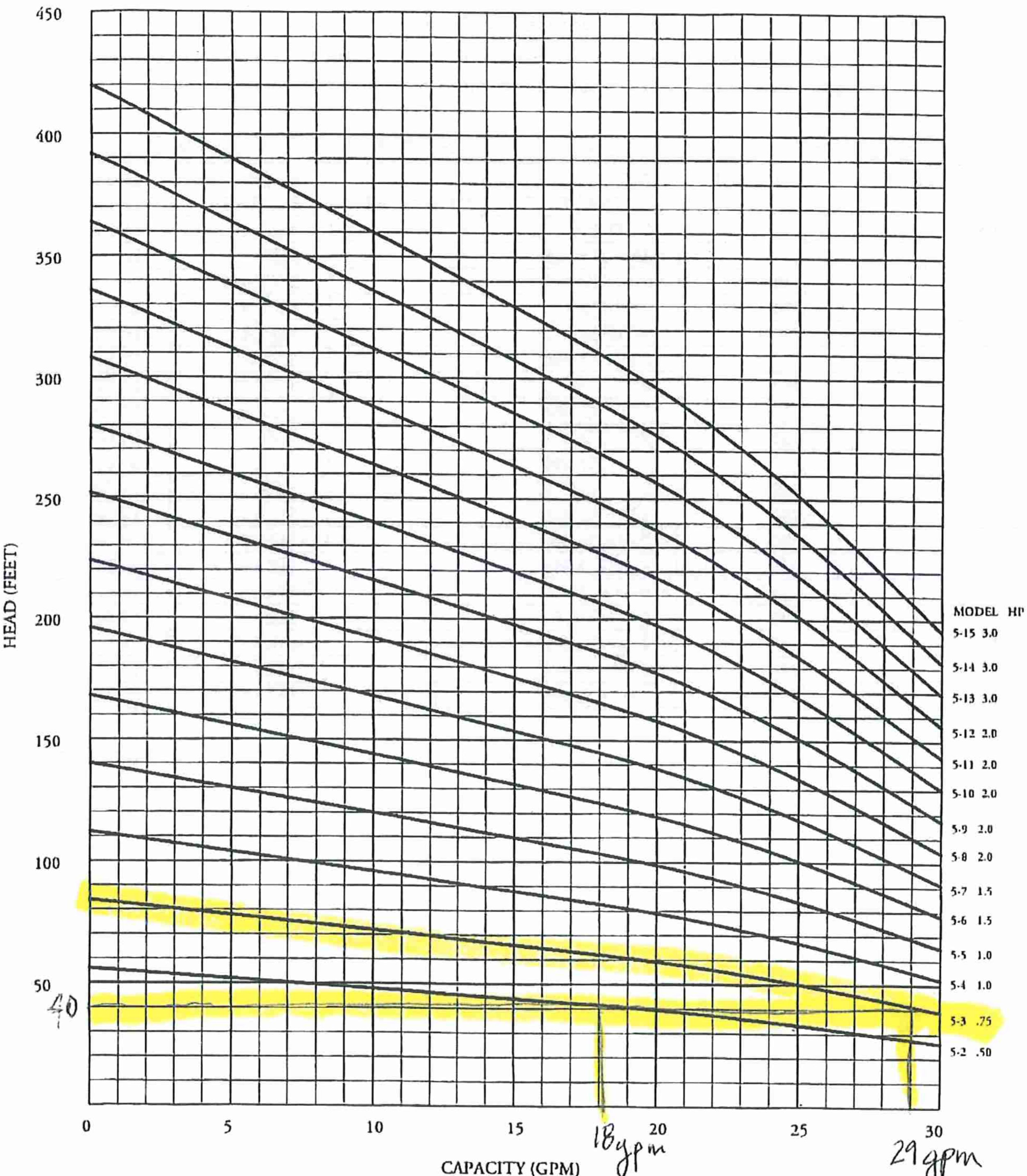
1. Permittee must forward a copy of the MPCA solid waste annual land disposal facility report to WLSSD.
2. Permittee must report volumes discharged to WLSSD monthly.
3. Permittee must use a liquid waste hauler which is licensed to discharge into the WLSSD system.
4. Permittee is limited to discharge a maximum volume of 25,000 gallons per day and not over 4 truckloads in any one day.

Appendix E
Pump Design Calculations

SERIES 5 SurePump™

Flow Range 15-30 GPM

60 Hz



DATA SUBJECT TO CHANGE WITHOUT NOTICE

SERIES 5 SUMP DRAINER SELECTION GUIDE

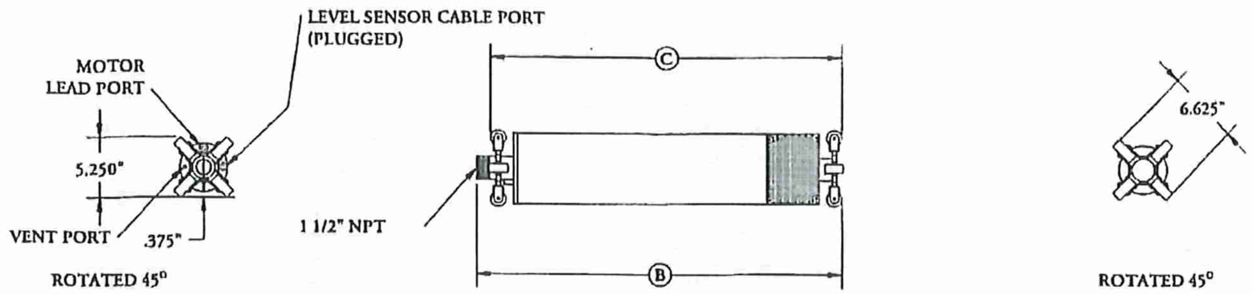
To select the appropriate sump drainer:

1. Select SINGLE or THREE PHASE, motor HORSEPOWER, and system supply VOLTAGE.
2. Determine the DISTANCE from the power supply to the pump.
3. Use the sump drainer size from the SUMP DRAINER column to find its respective dimensions on the following pages. MOTOR LEAD column shows minimum motor power cable size.

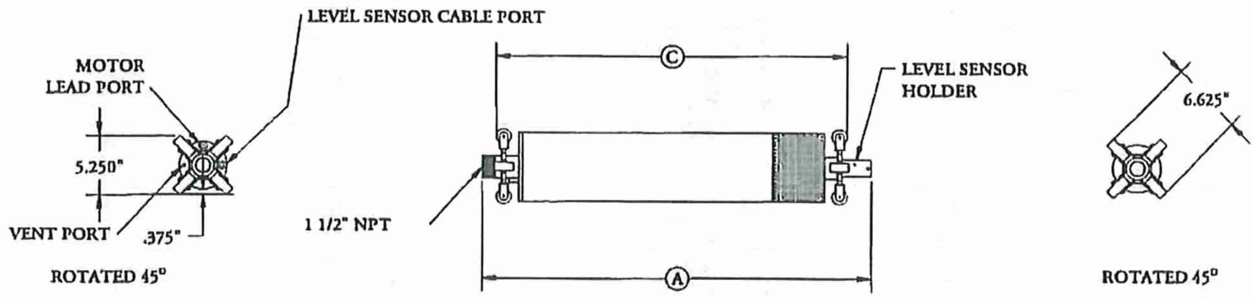
SINGLE PHASE MOTORS				
HORSEPOWER	VOLTAGE	DISTANCE FROM SERVICE ENTRANCE TO PUMP IN FEET	SUMP DRAINER	MOTOR LEAD
0.5	230	0 TO 360'	SIZE 4	14 GA
0.5	230	360' TO 585'	SIZE 4	12 GA
0.75	230	0 TO 270'	SIZE 4	14 GA
0.75	230	270' TO 430'	SIZE 4	12 GA
1	230	0 TO 225'	SIZE 4	14 GA
1	230	225' TO 360'	SIZE 4	12 GA
1.5	230	0 TO 170'	SIZE 4	14 GA
1.5	230	170' TO 280'	SIZE 4	12 GA
1.5	230	280' TO 430'	SIZE 5	10 GA
1.5	230	430' TO 690'	SIZE 6	8 GA
2	230	0 TO 135'	SIZE 4	14 GA
2	230	135' TO 225'	SIZE 4	12 GA
2	230	225' TO 350'	SIZE 5	10 GA
2	230	350' TO 555'	SIZE 6	8 GA
3	230	0 TO 95'	SIZE 4	14 GA
3	230	95' TO 170'	SIZE 4	12 GA
3	230	170' TO 270'	SIZE 5	10 GA
3	230	270' TO 420'	SIZE 6	8 GA
3	230	420' TO 675'	SIZE 6	6 GA

continued on back

SERIES 5 SIZE 4 WHEELED SUMP DRAINER



WSD



WSDPT

MODEL	HP	PHASE	A	B	C	*APPROX. SHIPPING WEIGHT WSD	WSDPT
5-2	0.50	1	31.02	29.90	29.15	61.47	66.47
5-2	0.50	3	31.02	29.90	29.15	61.47	66.47
5-3	0.75	1	32.98	31.86	31.11	66.24	71.24
5-3	0.75	3	32.98	31.86	31.11	66.24	71.24
5-4	1.00	1	34.90	33.78	33.03	70.98	75.98
5-4	1.00	3	34.90	33.78	33.03	70.98	75.98
5-5	1.00	1	35.73	34.61	33.86	71.88	76.88
5-5	1.00	3	35.73	34.61	33.86	71.88	76.88
5-6	1.50	1	38.43	37.31	36.56	79.22	84.22
5-6	1.50	3	36.56	35.44	34.69	72.77	77.77
5-7	1.50	1	39.26	38.14	37.39	80.12	85.12
5-7	1.50	3	37.39	36.27	35.52	73.67	78.67
5-8	2.00	1	41.59	40.47	39.72	85.17	90.17
5-8	2.00	3	40.09	38.97	38.22	81.01	86.01

MODEL	HP	PHASE	A	B	C	*APPROX. SHIPPING WEIGHT WSD	WSDPT
5-9	2.00	1	42.42	41.30	40.55	86.07	91.07
5-9	2.00	3	40.92	39.80	39.05	81.90	86.90
5-10	2.00	1	43.25	42.13	41.38	86.96	91.96
5-10	2.00	3	41.75	40.63	39.88	82.80	87.80
5-11	2.00	1	44.08	42.96	42.21	87.86	92.86
5-11	2.00	3	42.58	41.46	40.71	83.69	88.69
5-12	2.00	1	44.91	43.79	43.04	88.75	93.75
5-12	2.00	3	53.41	52.29	51.54	92.35	97.35
5-13	3.00	1	54.24	53.12	52.37	119.24	124.24
5-13	3.00	3	51.24	50.12	49.37	105.91	110.91
5-14	3.00	1	55.07	53.95	53.20	120.14	125.14
5-14	3.00	3	52.07	50.95	50.20	106.81	111.81
5-15	3.00	1	55.90	54.78	54.03	121.03	126.03
5-15	3.00	3	52.90	51.78	51.03	107.70	112.70

NOTE: ALL DIMENSIONS ARE IN INCHES.

*SHIPPING WEIGHT INCLUDES
WSD: CRATE, 50' OF 14-4 MOTOR LEAD, 50' OF 1/8" SS CABLE.
WSDPT: CRATE, 50' OF 14-4 MOTOR LEAD, 50' OF 1/8" SS CABLE,
LEVEL SENSOR AND CABLE.

SERIES 5 SUMP DRAINER SELECTION GUIDE

THREE PHASE MOTORS				
HORSEPOWER	VOLTAGE	DISTANCE FROM SERVICE ENTRANCE TO PUMP IN FEET	SUMP DRAINER	MOTOR LEAD
0.5	200	0 TO 640'	SIZE 4	14 GA
0.5	200	640' TO 1025'	SIZE 4	12 GA
0.5	230	0 TO 835'	SIZE 4	14 GA
0.5	230	835' TO 1340'	SIZE 4	12 GA
0.5	460	0 TO 3390'	SIZE 4	14 GA
0.5	460	3390' TO 5420'	SIZE 4	12 GA
0.75	200	0 TO 460'	SIZE 4	14 GA
0.75	200	460' TO 730'	SIZE 4	12 GA
0.75	230	0 TO 600'	SIZE 4	14 GA
0.75	230	600' TO 970'	SIZE 4	12 GA
0.75	460	0 TO 2455'	SIZE 4	14 GA
0.75	460	2455' TO 3915'	SIZE 4	12 GA
1	200	0 TO 385'	SIZE 4	14 GA
1	200	385' TO 620'	SIZE 4	12 GA
1	230	0 TO 505'	SIZE 4	14 GA
1	230	505' TO 820'	SIZE 4	12 GA
1	460	0 TO 2070'	SIZE 4	14 GA
1	460	2070' TO 3300'	SIZE 4	12 GA
1.5	200	0 TO 280'	SIZE 4	14 GA
1.5	200	280' TO 450'	SIZE 4	12 GA
1.5	230	0 TO 380'	SIZE 4	14 GA
1.5	230	380' TO 600'	SIZE 4	12 GA
1.5	460	0 TO 1530'	SIZE 4	14 GA
1.5	460	1530' TO 2440'	SIZE 4	12 GA
2	200	0 TO 215'	SIZE 4	14 GA
2	200	215' TO 350'	SIZE 4	12 GA
2	200	350' TO 550'	SIZE 5	10 GA
2	230	0 TO 290'	SIZE 4	14 GA
2	230	290' TO 460'	SIZE 4	12 GA
2	460	0 TO 1170'	SIZE 4	14 GA
2	460	1170' TO 1860'	SIZE 4	12 GA
3	200	0 TO 160'	SIZE 4	14 GA
3	200	160' TO 260'	SIZE 4	12 GA
3	200	260' TO 420'	SIZE 5	10 GA
3	200	420' TO 665'	SIZE 6	8 GA
3	230	0 TO 215'	SIZE 4	14 GA
3	230	215' TO 350'	SIZE 4	12 GA
3	230	350' TO 560'	SIZE 5	10 GA
3	460	0 TO 900'	SIZE 4	14 GA
3	460	900' TO 1440'	SIZE 4	12 GA

Appendix F
Leachate Collection Pipe Strength and Capacity Analyses

Liesch Associates, Inc. ▪ 13400 15th Avenue North ▪ Minneapolis, MN 55441
Phone: (763) 489-3100 ▪ Toll Free: (800) 338-7914 ▪ Fax: (763) 489-3101

MEMORANDUM

TO: **File No. 59118.00 – General Waste Industrial Landfill – 2013 Permit**
FROM: **Bruce Rehwaldt**
DATE: **March 4, 2013**
RE: **Leachate Collection and Extraction Riser Pipe Strength Analysis**

Objective:

Leachate collection pipes that are located at low points on the base liner will be subjected to increased overburden pressures as waste filling progresses. These pipes will also be subjected to live loads associated with truck and landfill compactor traffic during the early stages of filling. The pipes will be evaluated for wall crushing, wall buckling, and pipe deflection.

Design Criteria:

1. Leachate collection pipe will be 6-inch diameter, SDR-11, HDPE with O.D. = 6.625-inches and wall thickness = 0.602-inches.
2. Sideslope riser pipe will be 18-inch diameter, SDR-11, HDPE with O.D. = 17.804-inches and wall thickness = 1.636-inches.
3. The greatest waste height at closure over the leachate collection pipe will be approximately 100'. The maximum waste height over the sump area will be approximately 65'.
4. The unit weight of cover soil and granular is assumed to be 125 lb/ft^3. The unit weight of waste is assumed to be 90 lb/ft^3.
5. A 120,000 pound compactor is assumed at the live load, which will be conservatively modeled as a concentrated load divided equally on the four drum wheels.

Methodology:

The methodology presented is based on the evaluation of buried pipes outlined in the Driscopipe Systems Design Manual, Phillips Driscopipe, Inc., 1991. The methodology is as follows:

1. Calculate total external soil pressure, P_t, at the top of the pipe. P_t is composed of three components: pressure due to static loads, pressure due to live loads, and apparent pressure due to internal vacuum.

2. Determine the total static load pressure, soil dead load, P_s, at the top of the pipe for two cases: one with shallow soil height over pipe and one with the largest soil height over pipe:

$$Ps = \sum (r*H)$$

Where: r = unit weight of waste or soil above the pipe
H = height of waste or soil above the pipe

3. Determine the total external soil pressure, P_t, at the top of the pipe for two cases: one with shallow soil height over the pipe and one with maximum soil height over the pipe.

$$P_t = P_s + P_l + P_i$$

Where: P_s = total "static load" pressure soil dead load
P_l = total "live load" pressure
P_i = total effective external pressure due to internal vacuum

4. Examine wall crushing by calculating the compressive stress in the wall of the pipe at the spring line:

$$S_A = (SDR-1)*P_t/2$$

Where: S_A = actual compressive stress
SDR = Standard Dimension Ratio
P_t = total external soil pressure

5. The factor of safety for wall crushing is defined by:

$$F.S. = 1{,}500\ psi/S_A \geq 2.0$$

Where 1,500 psi is the compressive yield strength of Driscopipe.

6. Calculate the critical-collapse pressure, P_c, using the time dependent modulus of elasticity, E, rated at the compressive stress level, S_A, calculated above.

$$P_c = 2.32\ E/(SDR)^3$$

7. Calculate the critical buckling pressure, P_{cb}:

$$P_{cb} = 0.8\ (E' * P_c)^{1/2}$$

Where: E' = soil modulus calculated as the ratio of the vertical soil pressure to vertical soil strain at a specified density

P_c = See line item 6.

8. The factor of safety for wall buckling is defined by:

$$F.S. = P_{cb}/P_t \geq 2.0$$

9. Determine pipe deflection: Assume pipe deflection is equal to soil strain, ε_s
10. Soil strain should be less than the allowable 2.7% deflection for SDR-11 HDPE pipe. The allowable pipe deflection in the MN solid waste rules is 5%.

Calculations, figures, and reference materials are attached. The results of the factor of safety calculations are summarized below for both the 6-inch and 18-inch SDR-11 HDPE pipes. The SDR of the 18-inch sideslope riser pipe is highly conservative. An SDR of 17 could likely be used.

6-inch pipe LC Pipe	Calculated	Allowable
Wall crushing	3.19	F.S. ≥ 2
Wall buckling	3.70	F.S. ≥ 2
Pipe deflection	1.90	<2.7% for SDR-11

18-inch pipe Sideslope Riser	Calculated	Allowable
Wall crushing	6.37	F.S. ≥ 2
Wall buckling	5.38	F.S. ≥ 2
Pipe deflection	1.80	<2.7% for SDR-11

Note: The allowable pipe deflection in MN Rules Chapter 7035 is 5%.

Wall Crushing Analysis - 6-inch HDPE SDR 11 Collection Piping(refer to design memorandum)

A. Loads on Piping - Total load is combination of static (Ps), live (Pl), and internal vacuum (Pi)(equivalent to external pressure)

1. Shallow Soil/Waste Height over Piping	Pressure	Unit
a. Static (Ps)	3.99	psi
b. Live (Pl)	90.14	psi
c. Internal (Pi)	0	psi
Total (Ps+Pl+Pi)	94.14	psi

2. Maximum Soil/Waste Height over Piping		
a. Static (Ps)	63.72	psi
b. Live (Pl)	0.00	psi
c. Internal (Pi)	2.10	psi
Total (Ps+Pl+Pi)	65.82	psi

***Use 94.14 psi as worst case for consideration of wall crushing.

Ps = sum (H*soil density)		
H soil shallow =	1	ft (sand drainage layer)
H waste shallow =	5	ft (minimum waste thickness)
H soil deep =	5	ft (1' sand drainage plus 4 foot cover)
H waste deep =	95	ft (total depth of 100' less soil depth)
Unit weight soil =	125	lb/ft3
Unit weith waste =	90	lb/ft3

Pl = Ch* (Il*Wl)/(L*D) (Holl's Integration)		
Ch = load coefficient (based on D/2H)=	0.045	See attached reference for Table III)
Il = impact factor =	1.5	(slow moving vehicle)
Wl = wheel load = approx. 1/4 of gross weight of compactor	30,000	lb/per compactor drum for 120000 lb compactor)
L= pipe length =	3	ft standard assumed
D = pipe diameter =	0.052	ft (OD for 6-inch PE)
H = depth of cover (1 foot sand plus 5 feet waste)	6	ft
Pl is negligent for the maximum soil/waste height scenario		

Pi = vacuum on piping from landfill gas operation, typically 3-5 feet of water vacuum = 1.3-2.1 psi

B. Examine wall crushing by calculating Compressive Stress in wall of pipe at spring line

Sa = (SDR-1)*Pt/2	470.69	psi
Factor of Safety (FS): CY/Sa $\geq$ 2.0	3.19	

Sa = Actual Compressive Stress		psi
SDR = Standard Dimension Ratio	11	
CY = compressive yield strength of the piping	1500	psi (compressive yield strength

C. Calculate Critical Collapse Pressure, Pc, using the time dependent modulus of elasticity, E, rated at the compressive stress leve, Sa, calculated above.

$Pc = 2.32*E/(SDR)^3$ = 38.35 psi

Pc = Critical Collapse Pressure		psi
E = Modulus of elasticity, psi =	22000	psi (Chart 25 for 50 years in attached reference)

D. Calculate Critical Buckling Pressure (Pcb) from Pc and soil modulus.

$Pcb = 0.8 (E'*Pc)^{1/2}$	348.71	psi
Factor of Safety (FS): Pcb/Pt $\geq$ 2	3.70	

Pcb = Critical Buckling Pressure		psi
Pt = 94.14 psi (calculated earlier) =	13555.77	psf
E' = soil modulus = Pt/E_s	4954.59	psi
Vertical soil strain extrapolated from Chart 26 in attached ref.	1.9	percent

E. Determine Pipe Deflection, assuming pipe deflection is equal to soil strain E_s

Pipe deflection = 1.90 percent

N:\Liesch_Projects\lf\59118\Final Docs\Appendix C\[F - Wall Crushing Analysis.xls]Wall Crushing Analysis - 6 in

Wall Crushing Analysis - 12-inch HDPE SDR 11 Sideslope Riser (refer to design memorandum)

A. Loads on Piping - Total load is combination of static (Ps), live (Pl), and internal vacuum (Pi)(equivalent to external pressure)

1. Shallow Soil/Waste Height over Piping	Pressure	Unit
a. Static (Ps)	3.99	psi
b. Live (Pl)	3.94	psi
c. Internal (Pi)	0	psi
Total (Ps+Pl+Pi)	7.93	psi

2. Maximum Soil/Waste Height over Piping		
a. Static (Ps)	44.97	psi
b. Live (Pl)	0.00	psi
c. Internal (Pi)	2.10	psi
Total (Ps+Pl+Pi)	47.07	psi

***Use 47.07 psi as worst case for consideration of wall crushing.

Ps = sum (H*soil density)		
H soil shallow =	1	ft (sand drainage layer)
H waste shallow =	5	ft (minimum waste thickness)
H soil deep =	5	ft (1' sand drainage plus 4 foot cover)
H waste deep =	65	ft (total depth of 100' less soil depth)
Unit weight soil =	125	lb/ft3
Unit weith waste =	90	lb/ft3

Pl = Ch* (Il*Wl)/(L*D) (Holl's Integration)		
Ch = load coefficient (based on D/2H)=	0.056	See attached reference for Table III)
Il = impact factor =	1.5	(slow moving vehicle)
Wl = wheel load = approx. 1/4 of gross weight of compactor	30,000	lb/per compactor drum for 120000 lb compactor)
L= pipe length =	3	ft standard assumed
D = pipe diameter =	1.48	ft (OD for 6-inch PE)
H = depth of cover (1 foot sand plus 5 feet waste)	6	ft
Pl is negligent for the maximum soil/waste height scenario		

Pi = vacuum on piping from landfill gas operation, typically 3-5 feet of water vacuum = 1.3-2.1 psi

B. Examine wall crushing by calculating Compressive Stress in wall of pipe at spring line

Sa = (SDR-1)*Pt/2	235.33 psi	Sa = Actual Compressive Stress		psi
Factor of Safety (FS): CY/Sa $\geq$ 2.0	6.37	SDR = Standard Dimension Ratio	11	
		CY = compressive yield strength of the piping	1500	psi (compressive yield strength

C. Calculate Critical Collapse Pressure, Pc, using the time dependent modulus of elasticity, E, rated at the compressive stress leve, Sa, calculated above.

Pc = 2.32*E/(SDR)^3 =	38.35 psi	Pc = Critical Collapse Pressure		psi
		E = Modulus of elasticity, psi =	22000	psi (Chart 25 for 50 years in attached reference)

D. Calculate Critical Buckling Pressure (Pcb) from Pc and soil modulus.

Pcb = 0.8 (E'*Pc)$^{1/2}$	253.32 psi	Pcb = Critical Buckling Pressure		psi
Factor of Safety (FS): Pcb/Pt $\geq$ 2	5.38	Pt = 47.07 psi (calculated earlier) =	6777.4	psf
		E' = soil modulus = Pt/E_s	2614.74	psi
		Vertical soil strain extrapolated from Chart 26 in attached ref.	1.8	percent

E. Determine Pipe Deflection, assuming pipe deflection is equal to soil strain E_s

Pipe deflection = 1.8 percent

N:\Liesch_Projects\lf\59118\Final Docs\Appendix C\[F - Wall Crushing Analysis.xls]Wall Crushing Analysis - 6 in

8700 SERIES INDUSTRIAL PIPE
Sizes and Dimensions

Nom. Size (in)	DR	Weight lb/100ft	Dimensions, Inches OD	Approx. ID	Min.Wall
2	7.0	95.8	2.375	1.696	0.339
	9.0	77.3		1.847	0.264
	11.0	64.7		1.943	0.216
	13.5	53.7		2.023	0.176
	15.5	47.2		2.069	0.153
	17.0	43.3		2.096	0.140
3	7.0	208.1	3.500	2.500	0.500
	9.0	167.9		2.722	0.389
	11.0	140.5		2.864	0.318
	13.5	116.6		2.981	0.259
	15.5	102.6		3.048	0.226
	17.0	94.1		3.088	0.206
	21.0	77.1		3.167	0.167
	26.0	62.9		3.231	0.135
4	7.0	344.0	4.500	3.214	0.643
	9.0	277.5		3.500	0.500
	11.0	232.2		3.682	0.409
	13.5	192.7		3.833	0.333
	15.5	169.6		3.919	0.290
	17.0	155.5		3.971	0.265
	21.0	127.4		4.071	0.214
	26.0	103.9		4.154	0.173
	32.5	83.8		4.223	0.138
6	7.0	745.6	6.625	4.732	0.946
	9.0	601.4		5.153	0.736
	11.0	503.3		5.420	0.602 *
	13.5	417.6		5.644	0.491
	15.5	367.5		5.770	0.427
	17.0	337.1		5.846	0.390
	21.0	276.2		5.994	0.315
	26.0	225.2		6.115	0.255
	32.5	181.6		6.217	0.204

Nom. Size (in)	DR	Weight lb/100ft	Dimensions, Inches OD	Approx. ID	Min.Wall
8	7.0	1263.8	8.625	6.304	1.261
	9.0	1019.3		6.864	0.981
	11.0	853.0		7.220	0.802
	13.5	707.9		7.347	0.639
	15.5	622.9		7.512	0.556
	17.0	571.4		7.787	0.519
	21.0	468.1		7.985	0.420
	26.0	381.7		8.146	0.339
	32.5	307.8		8.282	0.272
10	7.0	1953.2	10.750	7.679	1.536
	9.0	1583.5		8.361	1.194
	11.0	1325.0		8.795	0.977
	13.5	1099.7		9.157	0.796
	15.5	967.7		9.363	0.694
	17.0	887.6		9.485	0.632
	21.0	727.1		9.726	0.512
	26.0	692.9		9.923	0.413
	32.5	478.1		10.088	0.331
12	9.0	2227.5	12.750	9.917	1.417
	11.0	1863.9		10.432	1.159
	13.5	1546.9		10.861	0.944
	15.5	1361.2		11.105	0.823
	17.0	1248.6		11.250	0.750
	21.0	1022.8		11.536	0.607
	26.0	834.1		11.769	0.490
	32.5	672.6		11.965	0.392
16	11.0	2935.3	16.000	13.091	1.455
	13.5	2436.0		13.630	1.185
	15.5	2143.6		13.935	1.032
	17.0	1966.3		14.118	0.941
	21.0	1610.8		14.476	0.762
	26.0	1313.5		14.769	0.615
	32.5	1059.2		15.015	0.492
18	13.5	3083.1	18.000	15.333	1.333
	15.5	2713.0		15.677	1.161
	17.0	2488.7		15.882	1.059
	21.0	2038.6		16.286	0.857
	26.0	1662.4		16.615	0.692
	32.5	1340.6		16.892	0.554

ATTACHMENT 1 (CONT.)

DRISCOPIPE

14/21

8700 Series
Industrial Pipe PE3408

PHILLIPS 66

Nom. Size (in)	DR	Weight lb/100ft	Dimensions, Inches OD	Approx. ID	Min.Wall
20	13.5	3806.3	20.000	17.037	1.481
	15.5	3349.4		17.419	1.290
	17.0	3072.4		17.647	1.176
	21.0	2516.8		18.095	0.952
	26.0	2052.3		18.462	0.769
	32.5	1655.0		18.769	0.615
21.5	15.5	3870.6	21.500	18.726	1.387
	17.0	3550.6		18.971	1.265
	21.0	2908.5		19.452	1.024
	26.0	2371.7		19.846	0.827
	32.5	1912.6		20.177	0.662
22	15.5	4052.7	22.000	19.161	1.419
	17.0	3717.6		19.412	1.294
	21.0	3045.3		19.905	1.048
	26.0	2483.3		20.308	0.846
	32.5	2002.6		20.646	0.677
24	15.5	4832.1	24.000	20.903	1.548 *
	17.0	4424.3		21.176	1.412
	21.0	3624.2		21.714	1.143
	26.0	2955.4		22.154	0.923
	32.5	2383.2		22.523	0.738

DRISCOPIPE ATTACHMENT 2

15/21

TABLE 15: ALLOWABLE RING DEFLECTION OF DRISCOPIPE® POLYETHYLENE PIPE BASED UPON DR

DR	[illegible] Ring Deflection
32.5	8.1%
26	6.5%
21	5.2%
19	4.7%
17	4.2%
15.5	3.9%
13.5	3.4%
11	2.7%

The allowable ring deflection of polyethylene pipe is limited to create no more than 1 to 1.5% tangential strain in the outer surface of the pipe wall. As the wall of a pipe becomes thicker (a "lower" DR value), the distance from the neutral axis to the outer surface increases. As a result, less deflection is required to create the allowable tangential strain. Deflection of the pipe-soil system is controlled by proper specification of the backfill compaction.

Source: Driscopipe Polyethylene Piping Systems Manual

ATTACHMENT 3

Figure 5 AASHTO Standard H20 Static Loading

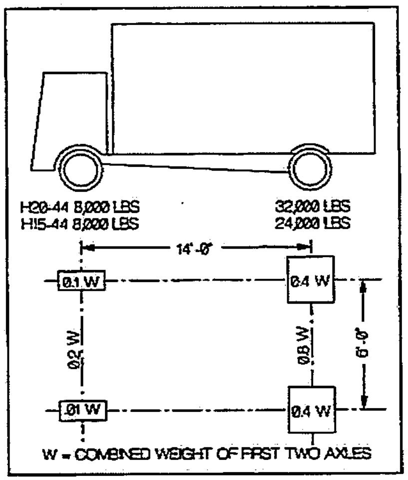
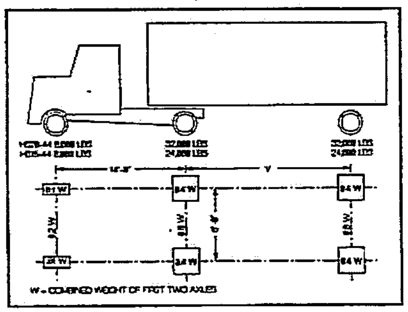
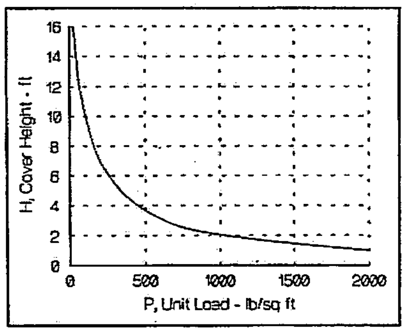


Figure 6 AASHTO Standard HS20 Static Loading



The AISI H20/HS20 highway loading assumes that the axle load is equally distributed over two, 18 by 20 inch areas, spaced 72 inches apart, and applied through a 12-inch thick rigid pavement. To account for speed, an impact factor of 1.5 is incorporated in the graph values. For other loadings, such as heavier trucks, or trucks on unpaved surfaces the AISI graph cannot be used and one of the methods discussed below should be considered.

Figure 7 H20 and HS20 Highway Loading



Off-Highway and Unpaved Road Loads

Off-highway vehicles may be considerably heavier than H20 or HS20 trucks, and these vehicles frequently operate on unpaved roads which may have uneven surfaces. Thus impact factors higher than 1.5 may be reached depending on the vehicle speed. Except for slow traffic, an impact factor of 2.0 to 3.0 should be considered. *

During construction, both permanent and temporary underground pipelines may be subjected to heavy vehicle loading from construction equipment. A designated vehicle crossing with special design measures such as temporary pavement or structural sheeting may be advisable, as well

Source: Plexo/Spirolite Engineering Manual, 1992

ATTACHMENT 3 (CONT.)

as vehicle speed controls to limit impact loading.

VEHICULAR LOADS AS POINT LOADS

There are generally two approaches for calculating vehicle live load surcharge pressure. The more conservative approach is to treat the wheel load as a concentrated (point) load. The other is to treat it as a distributed load spread over the contact area of the tire with the ground (imprint area). The pressure due to a distributed load and the pressure due to a concentrated load begin to approach the same value at a depth of about twice the square root of the loaded area.

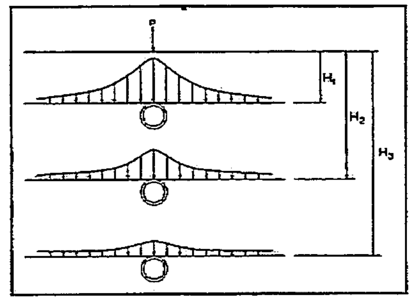
The distributed load method gives more realistic values where the depth equals less than twice the square root of the loaded area, whereas for deeper depths concentrated loads are preferred because the calculations are simpler and typically more conservative.

The pressure distribution under a concentrated load varies with depth as illustrated in Figure 8. When the live load is calculated using the point load methods given in the following sections, the maximum pressure occurring at the crown is assumed to be distributed across the entire pipe, which gives additional conservatism.

A key consideration in the determination of the live load pressure on the pipe is the location of the wheels relative to the pipe. A higher pressure may occur beneath a point between two vehicles passing in adjacent lanes than directly under a single vehicle wheel. This depends on the depth of cover.

When depths are greater than four or five feet, the combined H20 load for two separate wheels straddling the pipe is greater than that for a single wheel directly over the pipe. Deeper than five feet, H20 loads are not usually significant because the load is attenuated significantly compared loads under one or two feet of cover. However, greater live loads may produce design significant effects at depths greater than five feet. Therefore, the designer should check load conditions for a single wheel directly over the pipe, and for two wheels spaced six feet apart and centered over the pipe.

Figure 8 Concentrated Load Pressure Distribution at Various Depths



Single Wheel Load Centered On Pipe

To check a single wheel load centered directly over the pipe, a method based on Holl's integration of Boussinesq's equation assumes the wheel load is a concentrated (point) load. Holl's integration finds the pressure at the pipe crown depth that is distributed over a surface three feet long, and the width of the pipe outside diameter.

 18/21

Holl's Integration

Holl's equation for the average vertical pressure acting on a pipe due to a concentrated surface load is given by:

Holl's Equation (11)

$$P_L = C_H \frac{I_I W_L}{LD}$$

Where

P_L = load, lbs/ft^2
I_I = impact factor
W_L = wheel load, lb
C_H = load coefficient from Table III
L = pipe length, ft
D = pipe OD, ft

* If the pipe is longer than 3 ft, usual practice is to assume a length of 3 ft. C_H is found in the Table III as a function of D/2H and L/2H where H = depth of cover.

****

EXAMPLE 4: Find the single H20 rear wheel live load surcharge pressure on a 30" OD PLEXCO pipe buried 4 feet deep. Assume an impact factor of 1.5.

SOLUTION: Use Equation (11), Table III, and Figure 5. To solve Equation (11), the load coefficient, C_H, from Table III is required. For 4 ft of cover, D/2H = 0.31, and L/2H = 0.38. Interpolating Table III for C_H yields 0.189. From Figure 5, the H20 rear wheel live load is 0.4 x 40,000 = 16,000 lb. Solving equation (11) yields:

$$P_L = (0.187)\frac{(1.5)(16{,}000)}{3\left(\frac{30}{12}\right)}$$

$$P_L = 598\ lb/ft^2$$

Multiple Wheel Loads Along Pipe Length

In many cases, the maximum load on the pipe occurs when a single (or dual) wheel is located directly over the pipe. However, at some depths the combined load due to more than one wheel may be larger than the single wheel load. This usually occurs at a location along the pipe which is not directly under a wheel load. This point (Figure 9, Case I, Point 2) will usually be centered between two wheel loads.

Point Load on Pipe Crown

The Boussinesq point load equation may be used to find the wheel load pressure on the pipe, neglecting any pavement effects. Pavement effects are covered later using a modified form of Boussinesq's equation.

Boussinesq's Equation (12)

$$P_L = \frac{3 I W_L H^3}{2\pi r^5}$$

Where

P_L = vertical surcharge pressure at pipe crown, lb/ft^2
W_L = wheel load, lb
H = vertical depth to pipe crown, ft
r = distance from the point of load application to pipe crown, ft

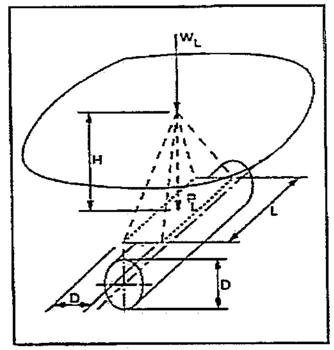
$$r = \sqrt{X^2 + H^2} \qquad (13)$$

Using the Boussinesq point load equation in this way is conservative, as the pressure applied to the point on the pipe crown is taken as the pressure applied accross the pipe's diameter.

Source: Plexo/Spirolite Engineering Manual, 1992

 19/21

Table III Load Coefficient, C_H, for Holl's Integration of Boussinesq's Equation



D/2H	L/2H 0.1	0.2	0.3	0.4	0.5	0.6	0.7
0.1	0.019	0.037	0.053	0.067	0.079	0.089	0.097
0.2	0.037	0.072	0.103	0.131	0.155	0.174	0.189
0.3	0.053	0.103	0.149	0.190	0.224	0.252	0.274
0.4	0.067	0.131	0.190	0.241	0.284	0.320	0.349
0.5	0.079	0.155	0.224	0.284	0.336	0.379	0.414
0.6	0.089	0.174	0.252	0.320	0.379	0.428	0.467
0.7	0.097	0.189	0.274	0.349	0.414	0.467	0.511
0.8	0.103	0.202	0.292	0.373	0.441	0.499	0.546
0.9	0.108	0.211	0.306	0.391	0.463	0.524	0.574
1.0	0.112	0.219	0.318	0.405	0.481	0.544	0.597
1.2	0.117	0.229	0.333	0.425	0.505	0.572	0.628
1.5	0.121	0.238	0.346	0.442	0.525	0.596	0.655
2.0	0.124	0.244	0.355	0.454	0.540	0.613	0.674
20.0	0.127	0.248	0.361	0.462	0.550	0.625	0.688

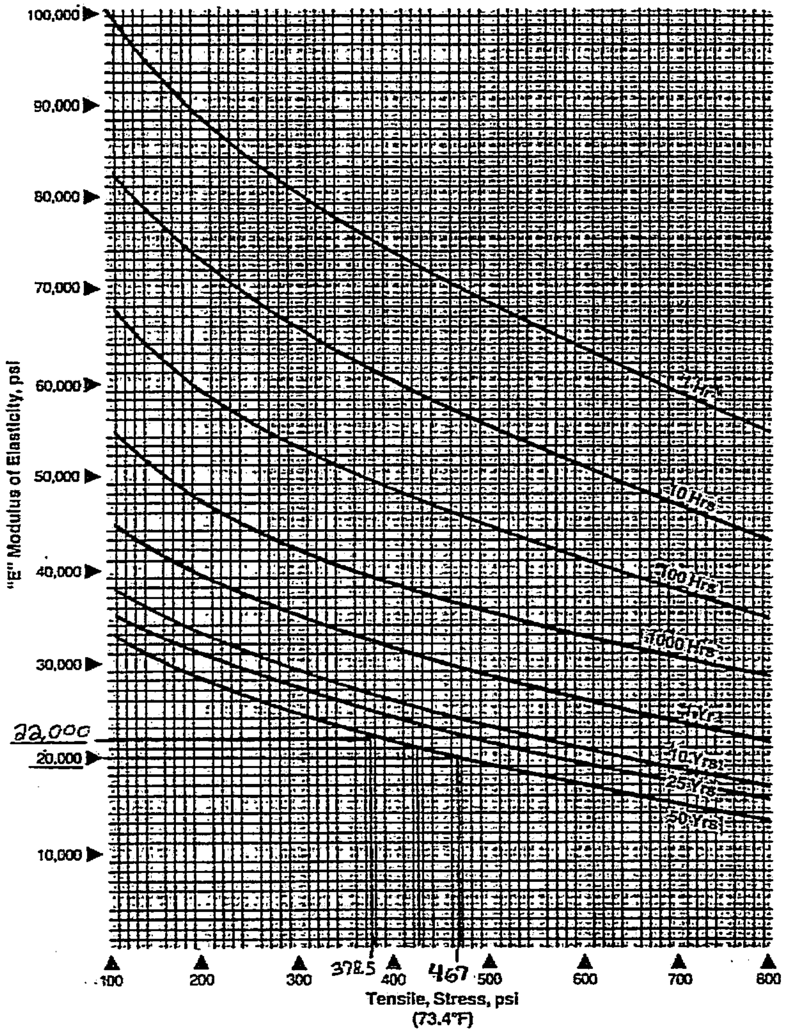
D/2H	L/2H 0.8	0.9	1.0	1.2	1.5	2.0	20.0
0.1	0.103	0.108	0.112	0.117	0.121	0.124	0.127
0.2	0.202	0.211	0.219	0.229	0.238	0.244	0.248
0.3	0.292	0.306	0.318	0.333	0.346	0.355	0.361
0.4	0.373	0.391	0.405	0.425	0.442	0.454	0.462
0.5	0.441	0.463	0.481	0.505	0.525	0.540	0.550
0.6	0.499	0.524	0.544	0.572	0.596	0.613	0.625
0.7	0.546	0.574	0.597	0.628	0.655	0.674	0.688
0.8	0.584	0.615	0.639	0.674	0.703	0.725	0.740
0.9	0.615	0.647	0.673	0.711	0.743	0.766	0.783
1.0	0.639	0.673	0.701	0.740	0.775	0.800	0.818
1.2	0.674	0.711	0.740	0.783	0.821	0.849	0.871
1.5	0.703	0.743	0.775	0.821	0.863	0.895	0.920
2.0	0.725	0.766	0.800	0.849	0.895	0.930	0.960
20.0	0.740	0.783	0.818	0.871	0.920	0.960	1.000

Source: Plexo/Spirolite Engineering Manual, 1992

ATTACHMENT 4

Chart 25

Time Dependent Modulus of Elasticity for Polyethylene Pipe vs. Stress Intensity (73.4°F)

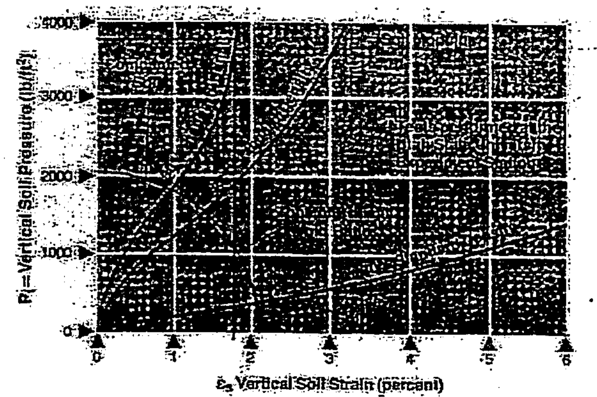


NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

Source: Driscopipe Systems Design Manual

DRISCOPIPE ATTACHEMNT 5

FIGURE 7: PLOT OF VERTICAL STRESS-STRAIN DATA FOR TYPCIAL TRENCH BACKFILL (EXCEPT CLAY) FROM ACTUAL TESTS



Example:
Find: E' @ 2000 psf and 80% density
Formula: E' = Pr/εs
Calculations: E' = 2000 psf / (0.018 * 144) = 771 psi

Note: The curves shown on this chart are sample curves for a granular soil. If other types of soil are used for backfill such as clay or clay loam, curves should be developed from laboratory test data for the material used. Soil pressures greater than 4000 psf may be extrapolated with the slope of the curve or curves can be generated by testing at higher soil pressures. Probable error of curves is about half the distance between adjacent lines.

Source: Driscopipe Polyethylene Piping Systems Manual