2024 MONITORING WELL MAINTENANCE PERFORMANCE REEVALUATION

FOR

MONONA COUNTY SANITARY LANDFILL 67-SDP-1-75C

TURIN, IOWA

by: HLW Engineering Group 204 West Broad Street P.O. Box 314 Story City, Iowa 50248 (515) 733-4144

May, 2024



2024 MONITORING WELL MAINTENANCE PERFORMANCE REEVALUATION

MONONA COUNTY SANITARY LANDFILL 67-SDP-1-75C

by: HLW Engineering Group 204 West Broad Street P.O. Box 314 Story City, Iowa 50248 (515) 733-4144

Prepared by:

odd Whipple, CPG

5/10/24

TABLE OF CONTENTS

Introduction

Assessment of Monitoring Well Condition
Physical Condition
Well Depth and Sedimentation
In-situ Hydraulic Conductivity

Assessment of Hydrologic Conditions
Flow Paths
Water Level Conditions and Well Locations

Conclusions and Recommendations

FIGURES

Figure 1 – October, 2023 Site Plan

2 - October, 2023 Water Table Contour Map

TABLES

Table 1 - Well Depth and Sedimentation

- 2 Hydraulic Conductivity Summary Data
- 3 Water Elevation Versus Top of Screen

APPENDICES

Appendix A – Boring Logs & Well Construction Information

B - Hydraulic Conductivity Calculations

C – Historic Water Contour Maps (1993 & 2011 & 2019)

D - Historic Water Elevations

Monitoring Well Maintenance Performance Reevaluation Plan

INTRODUCTION

The purpose of this study is to ensure that all monitoring wells included in the approved Hydrologic Monitoring System Plan (HMSP) remain reliable monitoring points. A Monitoring Well Maintenance Performance Reevaluation (MWMPRP) is required to be performed every five (5) years at closed landfill sites (114.21(2)"d"). A total of five (5) monitoring wells are included in the approved HMSP for the closed landfill site (Figure 1).

The five (5) monitoring wells are designated MW-1, MW-3R, MW-4, MW-5, and MW-7.

Assessment of the well function and/or well deterioration is made through direct observation and measurement and through indirect testing methods. Assessment of the site hydrologic conditions is also made to determine whether changes in the static water level and/or groundwater flow path has occurred.

ASSESSMENT OF MONITORING WELL CONDITION

Physical Condition - Observation of the physical condition of each well is made during each sampling episode. Observation indicates that all protective casings and locks are in place and operable. All well casings are capped. The PVC well casings appear to be in satisfactory conditions and allow adequate access to the groundwater for water depth measurements and water sampling activities.

Well Depth and Sedimentation - Annual well depth measurements are made. Table 1 summarizes the original well depth and the most recent (April 18, 2024) well depths. The difference in the original bottom elevation and the April 18, 2024 bottom elevation is estimated to represent sedimentation in the well. As summarized in Table 1, sedimentation is minimal in all wells. Sedimentation is recorded to be 1.0 ft or less in all wells, except MW-4. At MW-4 sedimentation is recorded at 3.3 ft. The sediment recorded in the monitoring wells is not considered problematic at this time. Sedimentation does not appear to impact well production and/or sampling at any of the HMSP wells.

In-situ Hydraulic Conductivity Testing - Monitoring wells MW-1, MW-3R, MW-4, MW-5, and MW-7 were installed at this site between 1992 and 2011. MW-3 (1992) was replaced with MW-3R on September 10, 2013. Boring Logs and well construction information is included in Appendix A.

The record was reviewed and results of historic in-situ hydraulic conductivity testing at each of the five (5) monitoring wells is summarized in Table 2. In-situ hydraulic conductivity testing was again performed for the five (5) wells on April 18, 2024. The reported hydraulic conductivities (Table 2) do not demonstrate considerable changes at

Monitoring Well Maintenance Performance Reevaluation Plan

any monitoring point. The historic hydraulic conductivity values and the 2024 hydraulic conductivity values are highly similar and may indicate a slight increase over time. Variability in the calculated hydraulic conductivities is not attributed to well deterioration. It is our interpretation that the variability is not excessive and falls within the anticipated range of deviation. The hydraulic conductivity calculations are included in Appendix B for reference.

ASSESSMENT OF SITE HYDROLOGIC CONDITIONS

Flow Paths - Figure 1 is a recent Site Plan. Figure 2 is a recent Groundwater Contour Map and illustrates the water table surface in October, 2023. A 1993 Groundwater Contour Map, a 2011 Groundwater Contour Map, and a 2019 Groundwater Contour Map are included in Appendix C. Review of the 1993, 2011, 2019, and 2023 Groundwater Contour Maps indicate that the water table surface appears unchanged between 1993 and 2023.

Groundwater flow at the site is inward from the south, converging at the ravine centerline to the north. The wells are positioned such that the flow paths are adequately intersected, and any release will be detected by the monitoring system.

Water Level Condition and Well Location - A summary of historic water elevation data (2013-2023) is included in Appendix D. Water elevation data over the past five (5) years has remained static.

Table 3 is a summary of the recorded April 18, 2024 water level data, along with pertinent well construction information. Column 8 of Table 3 is a direct comparison of the static water elevation (April, 2024) to the top of screen elevation in each respective well. A positive value indicates that the static water level is above the top of the screen, while a negative value indicates a static water level that is below the top of the screen (within the screened interval).

Review of Table 3 indicates that the static water elevation is above the top of screen in all wells except MW-3R and MW-7. Exposure of the well screen to the atmosphere does not appear to be detrimental to the integrity of the MW-3R or MW-7 well screens. Excessive encrustation is not anticipated on the PVC screen.

The static water levels in each of the remaining wells fall above the screened interval of the given well. It appears that all wells function adequately to monitor groundwater. Draw-down in the water table recorded at the site monitoring wells during purging and bail testing (Column 11, Table 3) indicates that the water table surface descends into the screened interval in all the monitoring wells during purging activities. The samples collected over time adequately reflect water quality in the unconsolidated soils.

Monitoring Well Maintenance Performance Reevaluation Plan

Replacement of those wells where the water table is above the screened interval is <u>not</u> recommended.

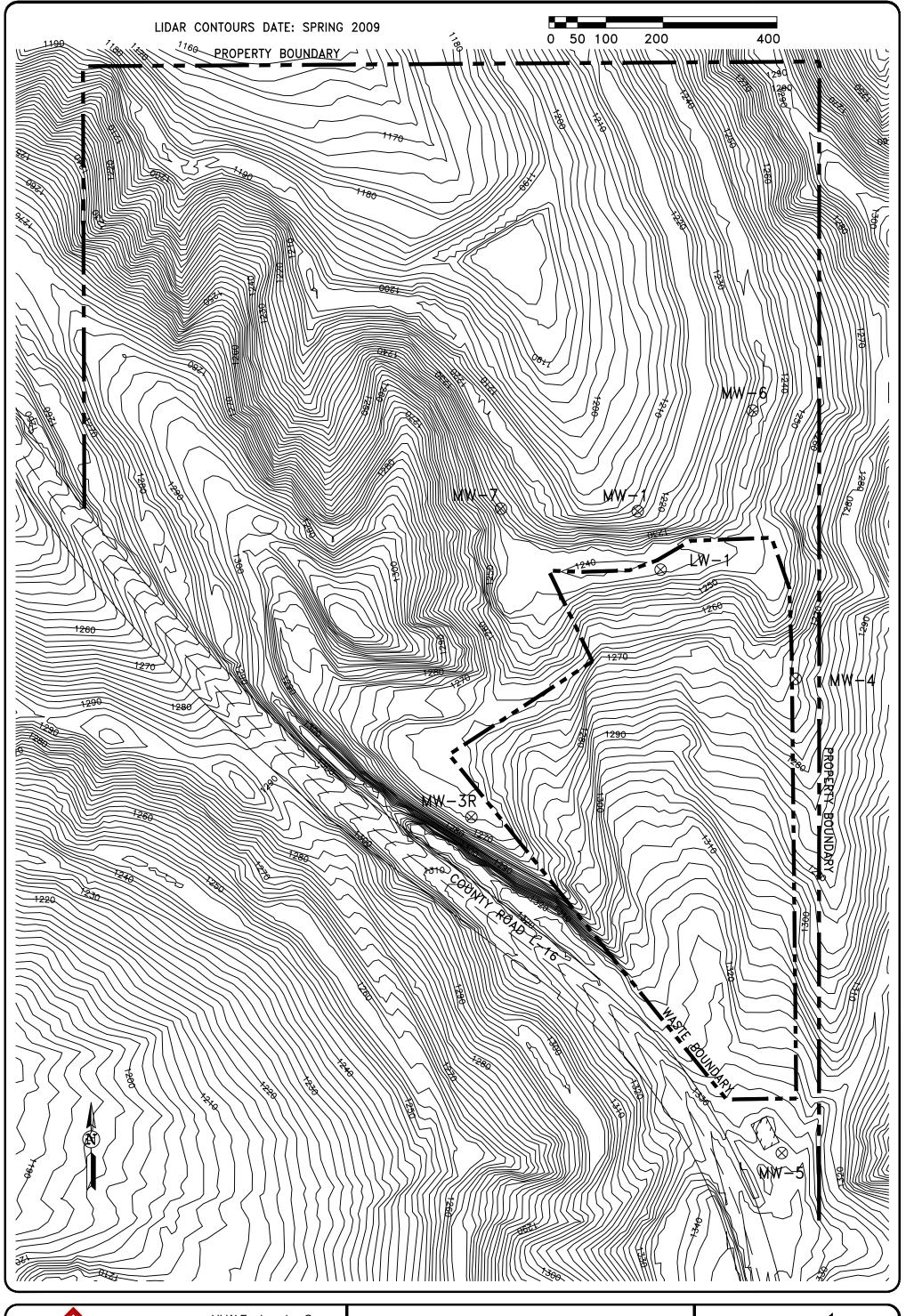
CONCLUSIONS & RECOMMENDATIONS

Assessment of the monitoring well condition indicates that all wells are in satisfactory condition and have not experienced excessive sedimentation. Excessive well deterioration is not apparent based on the comparison of historic in-situ hydraulic conductivity testing and the hydraulic conductivity testing performed in April, 2024.

The water table surface is relatively unchanged between 1993 and 2023, and the well are interpreted to be located appropriately to detect water quality changes.

Water levels in several of the site monitoring wells are consistently above the screened interval. The water samples collected appear to adequately reflect water quality in the subsurface saturated soils.

No changes to the monitoring wells are recommended. Further assessment of the monitoring well conditions should be made in 2029.



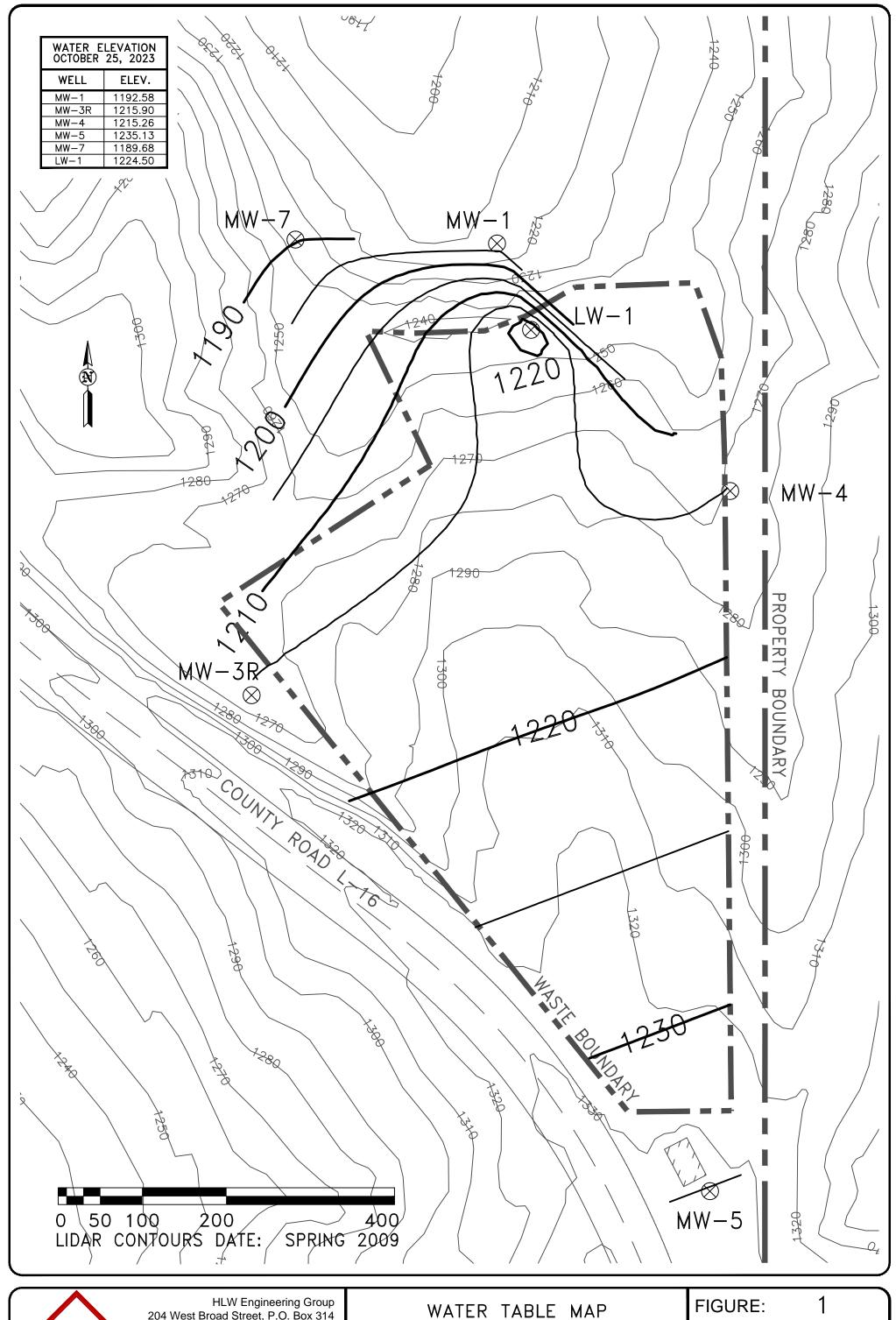


HLW Engineering Group 204 West Broad Street, P.O. Box 314 Story City, Iowa 50248 Phone: (515) 733-4144 FAX: (515) 733-4146

SITE PLAN

MONONA COUNTY SANITARY LANDFILL
TURIN, IOWA

FIGURE	Ē: <i>´</i>	1
REVISION	NO.	DATE
DRAWN	PROJECT NO.	DATE
DRA	6036	10-27-23





HLW Engineering Group 204 West Broad Street, P.O. Box 314 Story City, Iowa 50248 Phone: (515) 733-4144 FAX: (515) 733-4146

MONONA COUNTY SANITARY LANDFILL TURIN, IOWA

FIGURE	Ē: <i>´</i>	1
REVISION	NO.	DATE
DRAWN	PROJECT NO.	DATE
DRA	6036	10-27-23

TABLE 1
Assessment of Well Depth & Sedimentation

Well No.	Top of Casing Elevation	Original Bottom Depth	Original Bottom Elevation	April, 2024 Bottom Depth	April, 2024 Bottom Elevation	April, 2024 Sediment Thickness (ft)
MW-1	1219.49	42.19	1177.3	42.5	1176.99	-0.31
MW-3R	1266.20	66.7	1199.5	66.7	1199.5	0
MW-4	1275.60	82	1193.6	78.7	1196.9	3.3
MW-5	1335.64	121.64	1214	121.5	1214.14	0.14
MW-7	1236.98	54.78	1182.2	54.5	1182.48	0.28

TABLE 2 Hydraulic Conductivity Summary Data Monona County Sanitary Landfill

Well No.	Installation Date	11/24/1992 K cm/sec	1/6/2012 K cm/sec	4/15/2019 K cm/sec	4/18/2024 K cm/sec
MW-1	3/24/1992	8.10E-05	8.10E-05	1.81E-04	2.68E-04
MW-3R	9/10/2013	4.20E-05	4.20E-05	3.71E-05	3.26E-05
MW-4	11/6/1992	3.00E-05	3.00E-05	4.16E-05	4.92E-05
MW-5	11/12/1992	1.60E-05	1.60E-05	4.43E-05	3.03E-05
MW-7	10/6/2011	DNE	2.40E-05	5.15E-05	6.70E-05

DNE = Does not exist

TABLE 3
Water Elevation Versus Top of Screen (April, 2024)

Well No.	Top of Casing Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Screen Length	Static Water Depth	Static Water Elevation	Static Water Level Versus Top of Screen	Purged Water Depth	Purged Water Elevation	Purged Water Level Versus Top of Screen
MW-1	1219.49	1192.3	1177.3	15	27.16	1192.33	0.03	30.2	1189.29	-3.01
MW-3R	1266.20	1215.2	1200.2	15	51.21	1214.99	-0.21	58.8	1207.4	-7.8
MW-4	1275.60	1208.6	1193.6	15	56.92	1218.68	10.08	73.35	1202.25	-6.35
MW-5	1335.64	1229	1214	15	101.35	1234.29	5.29	115.9	1219.74	-9.26
MW-7	1236.98	1197.2	1182.2	15	47.35	1189.63	-7.57	51.4	1185.58	-11.62

[&]quot;-" = feet below top of screen (within the screened interval). All positive values are feet above the screen.

APPENDIX A

Boring Logs and Well Construction Information

\bigcap	LOG OF WEL	L NO	. M\	N -1						Pa	age 1	of 2
CLI	ENT											- 23
SIT	Monona County Solid Waste Agency E 24997 County Road L16	PROJI	ECT				-					\neg
311	Turin, lowa		Monona County Landfill Lateral Expansion									
						SAN	IPLES		-	TES	STS	_
GRAPHIC LOG	DESCRIPTION BOREHOLE DIA.: 8.25 in WELL DIA.: 2 in CASING AND SCREEN: PVC (sch. 40); 0.01 slotted screen TOP OF CASING: 1219.49 ft GROUND SURFACE ELEV.: 1216.3 ft	П	ОЕРТН, ft.	USCS SYMBOL	NUMBER	турЕ	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	
7////	LEAN CLAY (LOESS)	% %				HS						
rel. 0storoze Lodes.GPJ TERRACOM GDT 1/6/12 名 名 名 会 等 当	Brown		10									
THE TERM	Continued Next Page e stratification lines represent the approximate boundaries	<u> </u>	L	ND	indical	es a	readir	ng of les	s than I	he field	i detec	ion limit
De pe	ween soil and rock types: in-situ, the transition may be gradual.			of	one (1) par	t per r	nillion (p	pm) is	obutyle	ne equ	valents.
W	ATER LEVEL OBSERVATIONS, ft							TARTE				-24-92
07026 W		7			B		_	OMPLI		ם ווורף		-24-92 JE
W W	ă ă IIII	UL	.U		1	IG		DME 8	_	RILLER		17092
₫ W					LLC	افافار	ש א.	Baum	an J	JD#	UO	17082

	LOG OF WEL	L NO	. M\	N -1						Pa	age 2	of 2
CLI	ENT Monona County Solid Waste Agency											
SIT		PROJ										
	Turin, lowa		Мо	nona	a Co	unty	Land	dfill La	Ifili Lateral Expansion TESTS			
		WELL			-	SAIN	/IF LES	,				\neg
GRAPHIC LOG	DESCRIPTION	DETAIL	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	
CONTACT TIGHT	BOTTOM OF BORING NOTE: Soil classifications were based on visual observations made by the field crew at nearby boring PZ-1A.		30—									
E S	stratification lines represent the approximate boundaries			ND i	ndicat	es a	readin	g of less	than t	he field	detecti	on limit
bet	e stratification lines represent the approximate boundaries ween soil and rock types: in-situ, the transition may be gradual.			of	one (1) par	t per n	nillion (p	pm) isc	butyler	ne equiv	alents.
	ATER LEVEL OBSERVATIONS, ft					_	_	TARTE OMPLE		_		24-92 24-92
WL		ar		n	RI			OMPLE OME 85		RILLER		24-92 JB
WL WL	Ā Ā IIGII	UL	لان			_	_	Bauma				17092

WL

\bigcap	LOG OF	WELI	L NO.	MV	/ -31	₹					Pa	age 1	of 2
CLI	ENT												
SIT	Monona County Solid Waste Agency E 24997 County Road L16		PROJI	ECT		_							
311	Turin, lowa			Monona County Landfill									
							SAN	IPLES	3		TES	STS	115
RAPHIC	DESCRIPTION BOREHOLE DIA.: WELL DIA.: CASING AND SCREEN: TOP OF CASING: GROUND SURFACE ELEV.:	8.25 in 2 in C (sch. 40) 1270.56 ft 1268.6 ft		DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	
The W W Locs and Terracon on 2017/16 What was a supervised by the control of the	LEAN CLAY (LOESS) Light brown			5 — 10 — 15 — 20 — 35 — 35 — 40 — 40 —			HS						
The	Continued Next Page			*	ND in	ndicate	es a r	eadin	g of less	than th	ne field	detecti	on limit
betv	stratification lines represent the approximate boundaries veen soil and rock types: in-situ, the transition may be gra	dual.			of o	one (1) part	per n	nillion (p	pm) iso	butylen	e equiv	/alents.
WA	TER LEVEL OBSERVATIONS, ft					_			ARTE				10-13
WL WL	∑ ¥	211	7			BC			OMPLE			9-	10-13
WL	Ā	21 I	CIL	J.		RI	G	С	ME 85	50 DR	ILLER		

Tlerracon

WL

DRILLER JOB#

LOGGED

05137078

\cap	LOG OF WEL	L NO.	MV	/-3	R					Pa	age 2	of 2
CLI	ENT Court Sellel Wests A server											
SIT	Monona County Solid Waste Agency E 24997 County Road L16	PROJ	ECT									
L.,	Turin, lowa				Mo		a Co	unty L	andfi	II TES	STS	_
-00 -	DESCRIPTION	WELL		/BOL		JAN.			%			
GRAPHIC LOG	ē		DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	
	43 1225. LEAN CLAY (LOESS)	5										
	Brown		45-									
			50-									
			55— = = = =									
			60-									
			Ē									
	65 1203. BOTTOM OF BORING	5 🗏	65	-		-						
	NOTE: Soil classifications were based on visual observations made by the field crew at nearby well PZ-3. Log for monitoring well MW-3R not prepared. Monitoring well MW-3R adapted from nearby PZ-3 and MW-3 boring and monitoring well logs.											
The betw									at.			
The betw	stratification lines represent the approximate boundaries reen soil and rock types: in-situ, the transition may be gradual.		*	ND i	one (1) part	per m	g of less nillion (pp	om) iso	ne tield butylen	aetectic e equiv	on limit alents.
WA	TER LEVEL OBSERVATIONS, ft						_	TARTE				10-13
WL	ă ă Jeu	7			BC		_	OMPLE			9-	10-13
WL	T IIEII	UL	U.		RI	G GGEI		ME 85	_	ILLER B #	0512	7078

\bigcap	LOG OF WEL	L NO	. M\	N -4						Pa	age 1	of 3
CLI	ENT											
	Monona County Solid Waste Agency	PROJE	CT	-			_					-
SIT	E 24997 County Road L16 Turin, Iowa	FIXOSE		nona	Col	unty	Land	dfill La	teral l	Expan	sion	
	Turni, Iowa						PLES			TES	STS	
SAPHIC	DESCRIPTION BOREHOLE DIA.: 8.25 in WELL DIA.: 2 in CASING AND SCREEN: PVC (sch. 40); 0.01 slotted screen TOP OF CASING: 1275.60 ft GROUND SURFACE ELEV.: 1258.6 ft	П	БЕРТН, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, In.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	*
71111	ON CONTROL OF THE CON	W W		-	_	HS	ш	O) EI	30		0,1	
The bet William Willia	Brown		10									
The	e stratification lines represent the approximate boundaries		-	NDi	ndica	tes a	readir	ig of les	s than	the field	detec	tion lim
bet	ween soil and rock types: in-situ, the transition may be gradual.			of	-	_	_	nillion (p	-	obutyle		1-5-92
W	ATER LEVEL OBSERVATIONS, ft						_			_		1-6-92
WL		Dr	m			_	NG C	OMPL				
WL	ž 11611	CL			l K	IG	<u> </u>	CME	_	RILLER	_	J700
WL					L	JGGE	υK.	Baum	an J	UB.#	U5	17092

	LOG OF WELL NO. MW-4 Page 2 of 3											
CLIE												
SITE	Monona County Solid Waste Agency 24997 County Road L16	PRO									N-2-11.5.	
	Turin, lowa		Mo	non	a Co	SAN	Land IPLES	dfill La	teral i	Expan TES	STS	
GRAPHIC LOG	DESCRIPTION	WELL	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %		SAMPLE SENT TO LAB	
9	Continued Next Page		30									
The stratification lines represent the approximate boundaries				ND i	ndicat	es a	readin	g of less nillion (p	than to	he field butyler	detect ne equi	ion limi valents
betw	the stratification lines represent the approximate boundaries of one (1) part per million (ppm) isobutylene equivalents.											

WATER LEVEL OBSERVATIONS, ft

WL

Ø 65.0 WD

Ø 55.0 24 HRS. AB

WL

Ø

WL

WL

Terracon

BORING	11-5-92		
BORING	COMPLETE	D	11-6-92
RIG	JB		
LOGGED	R. Bauman	JOB#	05117092

	LOG OF WEL	WELL NO. MW-4		Page 3 of 3								
CLII	ENT Monona County Solid Waste Agency											
SITI		PROJ								2		
L_	Turin, Iowa		Mo	non	a Co	unty	Land APLES	dfill La	Lateral Expansion TESTS			
GRAPHIC LOG	DESCRIPTION	WELL DETAIL	ОЕРТН, ft.	USCS SYMBOL	NUMBER	ТҮРЕ	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	
ELL OSIOTOGO LOGS, GPJ TERRACON GDT 12/12/11 AND MAN TERRACON	59 1199. LEAN CLAY (LOESS) Gray 50 BOTTOM OF BORING NOTE: Soil classifications were based on visual observations made by the field crew at nearby well PZ-4.		55 —									
The bet	e stratification lines represent the approximate boundaries ween soil and rock types: in-situ, the transition may be gradual.			ND of	indica one (ites a 1) pa	readir t per i	ng of les million (s than opm) is	the field obutyle	d detect ne equi	ion limit valents.
W OGS	ATER LEVEL OBSERVATIONS, ft				В			TARTI				1-5-92
WL	□				В	ORII	VG C	OMPL	ETED		1	1-6-92
WL		36			R	IG		CME	75 D	RILLER	1	JB
₩L				ih T	Lo	OGGE	DR.	Baum	an J	OB#	051	17092

	LOG OF WEL	L NO	. M\	N-5	5					P	age 1	of 5
CLI												
SIT	Monona County Solid Waste Agency 24997 County Road L16	PROJ	ECT	_	_							\neg
311	Turin, lowa			non	a Co	unty	Land	dfill La	teral	Expar	sion	
					200	SAN	IPLES			TES	STS	-
GRAPHIC LOG	DESCRIPTION BOREHOLE DIA.: WELL DIA.: CASING AND SCREEN: TOP OF CASING: GROUND SURFACE ELEV.: DESCRIPTION 8.25 in 2 in 2 in 12 in 1	П	ОЕРТН, А.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	
7////	LEAN CLAY (LOESS)	%	=			HS						
HACOMADI I ELEM	Light brown Continued Next Page		10-									
Th	estratification lines represent the approximate boundaries		,	ND	indica	tes a	readir	ng of les	s than	the field	d detec	tion limit ivalents.
be'	ween soil and rock types: in-situ, the transition may be gradual. ATER LEVEL OBSERVATIONS, ft		_	of				TARTE	-	Journe		-10-92
WI	TI1.0 24 HRS. AB							OMPL		-		-12-92
W		a (-0		R	IG		CME		RILLEF	₹	JB
W					LO	OGGE	DR.	Baum	an J	OB#	051	17092

ſ	LOG OF WEL	L NO	. M\	N-5	5					P	age 2	of 5
CLI	ENT											
SIT	Monona County Solid Waste Agency E 24997 County Road L16	PROJ	ECT									
l on	Turin, lowa		Мо	non	a Co	unty	Land	dfill La	teral l	Expar	sion	
		WELL				SAN	IPLES	5		TES	SIS	
	DESCRIPTION	DETAIL		ᆲ			ć			~	╘	- 1
ğ	DEGONIF HON			MBC			RY.	نے	Ť,	NPO!	SE	- 1
일			Ę	SSY	BER	ا ا	OVE	Z S	EN N	> E	BE	
GRAPHIC LOG			DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, In.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	1
7////				Ē	~			4, E				
			-	1						8		
				1								
	.83			1								
			-	-								
			30-	}								
			_	1								
			_									
			_	1								
	•		=]								
			35—	1								
			-									
			-									
			=	}							i	
				1						1.		
	•			1								
		* 3	40-	-								
			-	-					1			
			15	1							1	
			-	1								
			-	1		1						
			-	-						1		
			45—	1								
	•		; .	1								
= ////			-							1	1	
			,									
			-									
			50 —]				
EX S	Continued Next Page	<u></u>							ahen i	ho fiold	detect	ion limit
The bet	stratification lines represent the approximate boundaries ween soil and rock types: in-situ, the transition may be gradual.			ND i	one (1) par	t per n	nillion (p	pm) iso	butyle	ne equi	
W/	ATER LEVEL OBSERVATIONS, ft				_	_		FARTE				10-92
WL		7			BC	_		OMPLE				12-92
WL	ă ă IGII	UL	.U		RI			CME.	_	_		JB
WL				1800	LO	GGE	DR.	Bauma	an J	OB#	051	17092

. 1

	LOG OF WEL	L N	0.	. MV	V- 5						Pa	age 3	of 5
CLI	ENT Monona County Solid Waste Agency												
SIT		PR	OJE	ECT Mo	nona	Co	unty	Land	ifill La	teral i	Expan	sion	
	Turni, IOVa		1	===			SAN	IPLES	5		TES	STS	
GRAPHIC LOG	DESCRIPTION	WEL DETA	L dL	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	
	LEAN CLAY (LOESS) Dark brown S8 LEAN CLAY (LOESS), with oxidized iron Brown Continued Next Page			55 — 60 — 70 — 75 — 75 —									
Th	e stratification lines represent the approximate boundaries		-	8	· ND	indica	tes a	readir	ng of les	s than	the field	detec	ion limit
be be	tween soil and rock types: In-situ, the transition may be gradual.		_		of	one (1) par	t per i	million (opm) is	obutyle	ne equ	valents.
g w	ATER LEVEL OBSERVATIONS, ft					B	ORI	NG S	TARTE	=D		11	-10-92

¥ 111.0 24 HRS. AB

Vertacon

Mr A

BORING	STARTED		11-10-92
BORING	COMPLETE	ED	11-12-92
RIG	CME 75	DRILLER	JB
LOGGED	R. Bauman	JOB#	05117092

\bigcap	LOG OF WEI	L N	O. M	W-(5					P	age 4	of 5
CL	ENT Monona County Solid Waste Agency											
SIT		PRC	JECT				19				19	
<u>_</u>	Turin, lowa		Mo	non	a Co	unty	Land IPLES	dfill La	teral	Expan	STS	
GRAPHIC LOG	DESCRIPTION	WELL	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, In.	SPT - N BLOWS / ft.	WATER CONTENT, %		SAMPLE SENT TO LAB	
MELL 05/07/026 LOGS GPJ TERRACON GGT 12/12/11 MELL 05/07/026 LOGS GPJ TERRACON GGT 12/12/11 MIT	LEAN CLAY (LOESS), with oxidized iron Brown and gray (mottled) 1249 1249 1240	3. 3.	80-									
The	e stratification lines represent the approximate boundaries			• ND	indical	tes a	readin	g of less nillion (p	than to	he field	detect	ion limi
bet	ween soil and rock types: in-situ, the transition may be gradual. ATER LEVEL OBSERVATIONS, ft			01				FARTE		22.7.0		10-92
WL WL								OMPLE				12-92
WL		3			RI			CME	~	RILLER		JE
WL					LC	GGE	DR.	Bauma	an JO	DB#	051	17092

	LOG OF WEL	L NC). M\	N-5	5					Pa	age 5	of 5
CLII	ENT Monona County Solid Waste Agency											l
SITI		PROJ										\neg
	Turin, Iowa		Mo	non	a Co			dfill La	teral l	Expan TES	sion	
		WELL				SAN	APLES			TES	15	
ا ی	DESCRIPTION	DETAIL		٦ 0			Ė.		9	<u>د</u> .	Þ	
용			نے	YMB	ac		ERY	/#	Ę.	APC PM)	SE	i
GRAPHIC LOG			ОЕРТН, А.	USCS SYMBOL	NUMBER	<u>س</u>	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	- 1
8			DEF	Š	Ž	TYPE	RE	SP.	§8	## ##	28 2	
												1
												- {
		58 B	_	1								l
			<u> </u> =									-
			=									1
		目	105									- 1
			7=	1		1						
			-	}								
			_		1							
			110	}								
	¥		110-	}								
	+		-	1								
			-	1								
				1								
		目:	-	1							1	
			115—	7								
			-	1								
] =								-	
	118 121:		-	1			ŀ					
	LEAN CLAY (LOESS) Gray		-	1	ļ				1			
	120 121	3	120-	1								
	BOTTOM OF BORING		120									
	NOTE: Soil classifications were based on	1								1		
	visual observations made by the field crew at nearby well PZ-5.											
	at realby won't 2 o.		1	1		1	1			T.		
The	stratification lines represent the approximate boundaries		-	ND i	indical	es a	readin	g of less	than t	he field	detect	on limit
bet	veen soil and rock types: in-situ, the transition may be gradual.			of	one (1) par	t per n	nillion (p	pm) iso	butyler	ne equi	/alents.
WL	TER LEVEL OBSERVATIONS, ft ▼ 111.0 24 HRS. AB							TARTE OMPLE				12-92
WL		ar	m'	n	RI			CME		RILLER		JB
WL					1			Bauma				17092
VVL			-	_	LC	,000	J 11.	Judin				

	LOG OF WEL	L	NO	. MV	N-7	'					P	age 1	of 2
CLI	ENT Monona County Solid Waste Agency												
SIT		F	PROJE										
	Turin, Iowa			Mo	non	a Co			ifili La	teral l	Expar	sion	_
							SAN	IPLES			TES	STS	
		DE N	VELL ETAIL									.	Œ.
၅	DESCRIPTION	٦	- 17.1.		BOL			Ë		%	유		E
S C	BOREHOLE DIA.: 8.25 in WELL DIA: 2 in			نے	ΥM	œ		ER	/ H	, Ę	AP V	ш В	PNT. TEST (TSF)
Ē	WELL DIA.: 2 in CASING AND SCREEN: PVC (sch. 40); 0.01 slotted screen			Ŧ	SS	1BE	ш	8	NS N	띪		[필종]	Ę.
GRAPHIC LOG	TOP OF CASING: 1236.98 ft			ОЕРТН, Æ.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	<u>ا</u> ۾
27777	GROUND SURFACE ELEV.: 1234.2 ft LEAN CLAY (LOESS), trace oxidized iron	V			f	-	HS	_					
	and calcium carbonate bearing sediments	7		_									- 1
	Brown and gray (mottled)			-									- 1
	Dry											1	
												1	980
				5—									1
				-		1			V-			1	- 1
	5	3				1							
				5—	}	l							- 1
		111		_									ı
					}								
				10-									
				_	1	1							
				=	1	ł	1		1	1	1		1
	*					1							
		w.			1	l				1			
		١.		15-	7	1					1		
				-	1	İ		1					
					1								
	₩	#		15		ł	1						
		۲.		::	1	1	1	1		1	1		1
		×		20-	}	1				1			
		Е		- "	1								
				2=	7	1	1	Į.		1	1	}	
		-		_	7					1			
		2		3 =	1								
		å		1	1	1	1			l			
		į,		25-	1	1	1	1	1	Ĭ	1		
				-	1								
					-						1		
					7	1	1	1	}			1	
		2			7								
				30-	7								
	Continued Next Page				_	_	1_				2 200	1 10020 00	
The bet	e stratification lines represent the approximate boundaries ween soil and rock types: in-situ, the transition may be gradual.			•	ND of	indica one (tes a 1) par	readin t per r	g of les nillion (p	s than to pm) is:	he field obutyle	detect ne equi	ion limit valents.
W	ATER LEVEL OBSERVATIONS, ft					В	ORIN	IG S	TARTE	D		10	0-5-11
WL		_				В	ORIN	IG C	OMPLI	ETED		10	0-6-11
WL		ē			П	R	IG D	iedric	h D-1	20 DI	RILLER		. Pfouts
WL	10/0/11					• -	_		. Woz	_	OB#		17092
		_										and the same	

ı

	LOG OF WE	LL NO	. M\	N-7	7					P	age 2	of 2
CLI	ENT Monona County Solid Waste Agency											
SIT		PROJE										
	Turin, Iowa		Мо	non	a Co	unty	Land	dfill La	teral	Expar	sion	
						SAN	(PLES	3		TES	STS	
GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DЕРТН, ft.	USCS SYMBOL	NUMBER	туре	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*	SAMPLE SENT TO LAB	PNT. TEST (TSF)
	The soils were moist at 38 feet below grade during drilling. 43 LEAN CLAY (LOESS), trace oxidized iron Gray Moist The soils were wet at 48 feet below grade during drilling. 53 BOTTOM OF BORING NOTE: Soil classifications were based on visual observations made by the field crew at nearby boring PZ-7.		35— 40— 45— 50—	-31								
The	stratification lines represent the approximate boundaries veen soil and rock types: in-situ, the transition may be gradual.		*	ND in	ndicati one (1	es a i	eading per n	of less illion (p	than thom) iso	ne field butyler	detecti e equiv	on limit valents.
	TER LEVEL OBSERVATIONS, ft						_	ARTE		- 11)-5-11
WL			0 22					MPLE			10)-6-11
WL		ar			DI			h D-12		ILLFR		. Pfouts
VVL	¥ 47.94 10/18/11 ¥				I	الاق	GUIIC	11 0-12	JUN ON			

05117092

LOGGED S. Wozab JOB#

WELL 05107026 LOGS.GPJ TERRACON.GDT 12/12/11

WL

APPENDIX B

Hydraulic Conductivity Calculations

SITE

Monona County Sanitary Landfill

CLIENT

Monona County Sanitary Landfill Job/Account: 6036 2024

CONSULTANT

HLW Engineering Group

SLUG TEST

Hydraulic Conductivity: 2.68e-04 cm/sec

Monitoring Well: MW-1 Test Date: 04/18/2024 Field Testing by: TDW Test Analysis by: TDW

WELL GEOMETRY

H: 25.34 ft Lw: 15.34 ft Le: 15.0 ft

dw: 0.66667 ft, rw: 0.333 ft dc: 0.16667 ft, rc: 0.0833 ft

Drained Filter Pack Porosity (%): 20 Effective Radius (re): 0.167 ft

Slug Volume(L):

BOUWER-RICE COEFFICIENTS

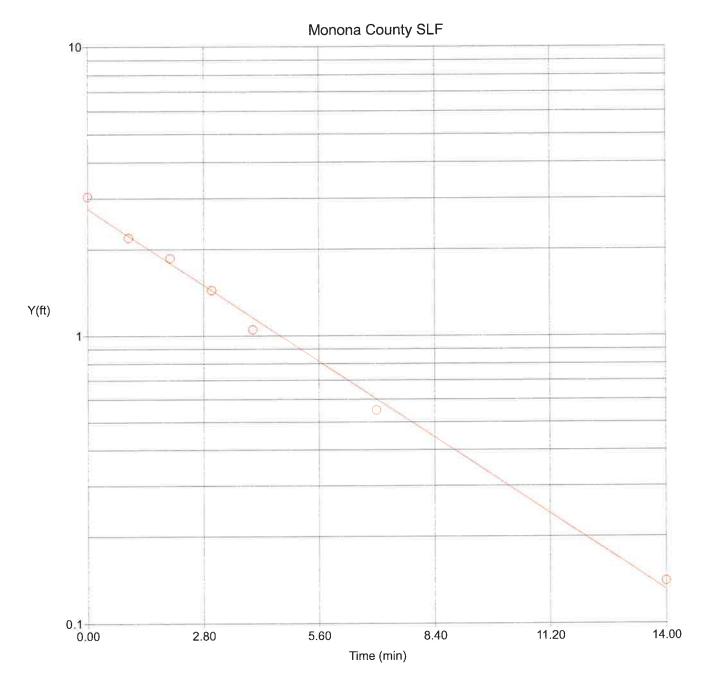
Le/rw: 45.0 A: 2.82 B: 0.425 C: 2.47

Ln(Re/rw): 2.62

LEAST SQUARES BEST FIT

Ln(Y)-cm versus Time-sec Slope: -3.63e-03

Intercept: 4.43



LUST No.:	Site Nam	e: Monona County S	Sanitary Landfill
Hydraulic Conductivity: 2.68e-04 cm.	sec :	Well: <mark>MW-1</mark>	Slug Test Date: 04/18/2024
HLW Engineering Group		CGWP:	

SITE

Monona County Sanitary Landfill

CLIENT

Monona County Sanitary Landfill Job/Account: 6036 2024

CONSULTANT

HLW Engineering Group

SLUG TEST

Hydraulic Conductivity: 3.26e-05 cm/sec

Monitoring Well: MW-3R Test Date: 04/18/2024 Field Testing by: TDW Test Analysis by: TDW

WELL GEOMETRY

H: 25.49 ft Lw: 15.49 ft Le: 15.0 ft

dw: 0.66667 ft, rw: 0.333 ft dc: 0.16667 ft, rc: 0.0833 ft Drained Filter Pack Porosity (%): 20 Effective Radius (re): 0.167 ft

Slug Volume(L):

BOUWER-RICE COEFFICIENTS

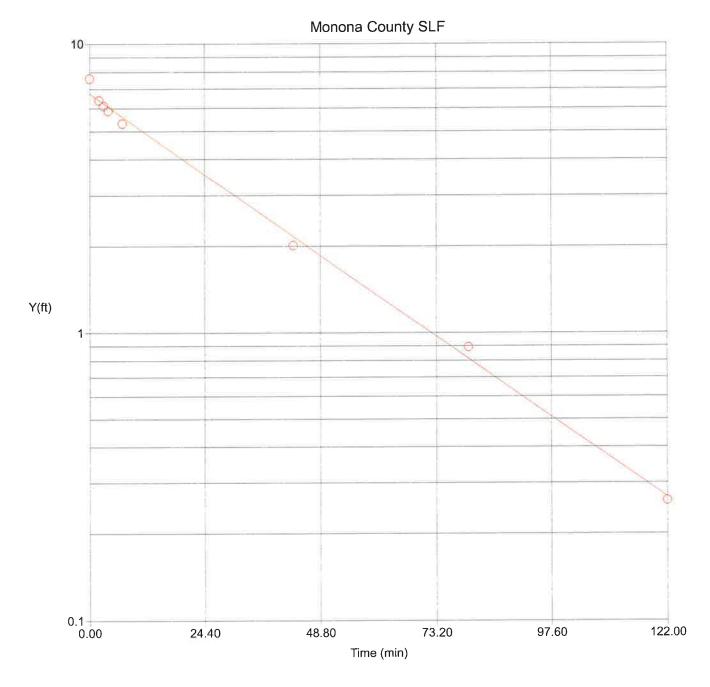
Le/rw: 45.0 A: 2.82 B: 0.425 C: 2.47

Ln(Re/rw): 2.62

LEAST SQUARES BEST FIT

Ln(Y)-cm versus Time-sec Slope: -4.41e-04

Intercept: 5.33



LUST No.:	Site Na	ame: Monona County Sa	anitary Landfill
Hydraulic Conductivity: 3.2	26e-05 cm/sec	Well: MW-3R	Slug Test Date: 04/18/2024
HLW Engineering Group		CGWP:	

SITE

Monona County Sanitary Landfill

CLIENT

Monona County Sanitary Landfill Job/Account: 6036 2024

CONSULTANT

HLW Engineering Group

SLUG TEST

Hydraulic Conductivity: 4.92e-05 cm/sec

Monitoring Well: MW-4 Test Date: 04/18/2024 Field Testing by: TDW Test Analysis by: TDW

WELL GEOMETRY

H: 31.78 ft Lw: 21.78 ft Le: 15.0 ft

dw: 0.66667 ft, rw: 0.333 ft dc: 0.16667 ft, rc: 0.0833 ft

Drained Filter Pack Porosity (%): 20 Effective Radius (re): 0.167 ft

Slug Volume(L):

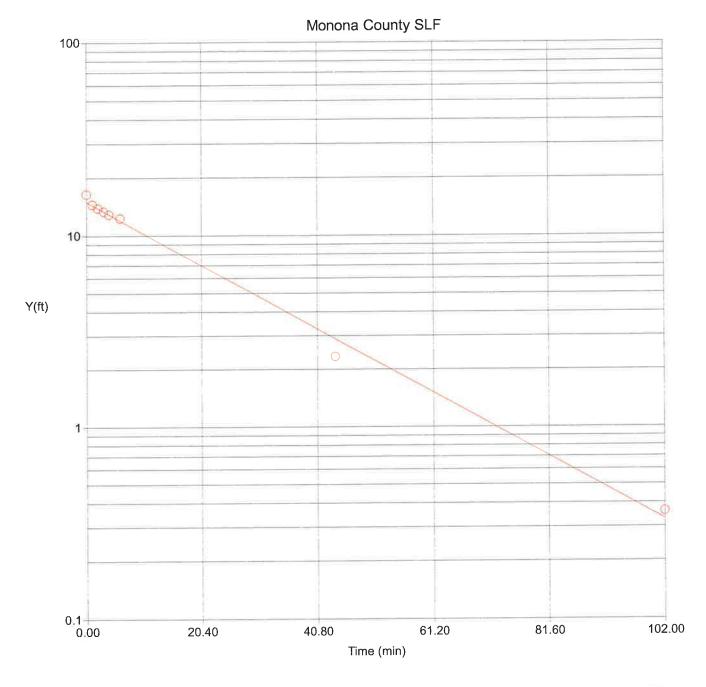
BOUWER-RICE COEFFICIENTS

Le/rw: 45.0 A: 2.82 B: 0.425 C: 2.47

Ln(Re/rw): 2.79

LEAST SQUARES BEST FIT

Ln(Y)-cm versus Time-sec Slope: -6.24e-04 Intercept: 6.12



LUST No.:	Site Name:	Monona County S	Sanitary Landfill
Hydraulic Conductivity: 4.92e-05 cm	/sec We	ell: MW-4	Slug Test Date: 04/18/2024
HLW Engineering Group		CGWP:	

SITE

Monona County Sanitary Landfill

CLIENT

Monona County Sanitary Landfill Job/Account: 6036 2024

CONSULTANT

HLW Engineering Group

SLUG TEST

Hydraulic Conductivity: 3.03e-05 cm/sec

Monitoring Well: MW-5 Test Date: 04/18/2024 Field Testing by: TDW Test Analysis by: TDW

WELL GEOMETRY

H: 30.15 ft Lw: 20.15 ft Le: 15.0 ft

dw: 0.66667 ft, rw: 0.333 ft dc: 0.16667 ft, rc: 0.0833 ft

Drained Filter Pack Porosity (%): 20 Effective Radius (re): 0.167 ft

Slug Volume(L):

BOUWER-RICE COEFFICIENTS

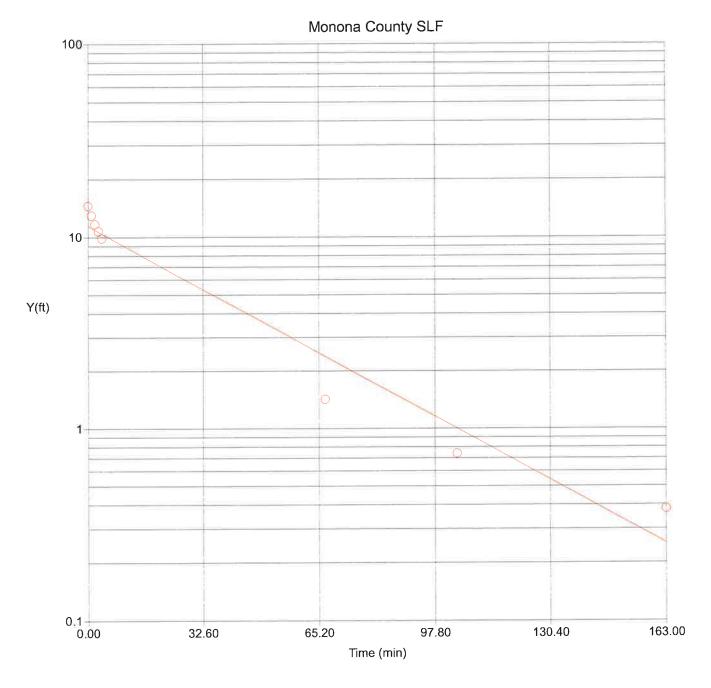
Le/rw: 45.0 A: 2.82 B: 0.425 C: 2.47

Ln(Re/rw): 2.76

LEAST SQUARES BEST FIT

Ln(Y)-cm versus Time-sec Slope: -3.90e-04

Intercept: 5.85



LUST No.:	Site Na	ame: Monona Cour	nty Sanitary Landfill
Hydraulic Conductivity: 3.03	3e-05 cm/sec	Well: MW-5	Slug Test Date: 04/18/2024
HLW Engineering Group		CGWF	P:

SITE

Monona County Sanitary Landfill

CLIENT

Monona County Sanitary Landfill Job/Account: 6036 2024

CONSULTANT

HLW Engineering Group

SLUG TEST

Hydraulic Conductivity: 6.70e-05 cm/sec

Monitoring Well: MW-7 Test Date: 04/18/2024 Field Testing by: TDW Test Analysis by: TDW

WELL GEOMETRY

H: 17.15 ft Lw: 7.15 ft Le: 7.15 ft

dw: 0.66667 ft, rw: 0.333 ft dc: 0.16667 ft, rc: 0.0833 ft Drained Filter Pack Porosity (%): 20 Effective Radius (re): 0.167 ft

Slug Volume(L):

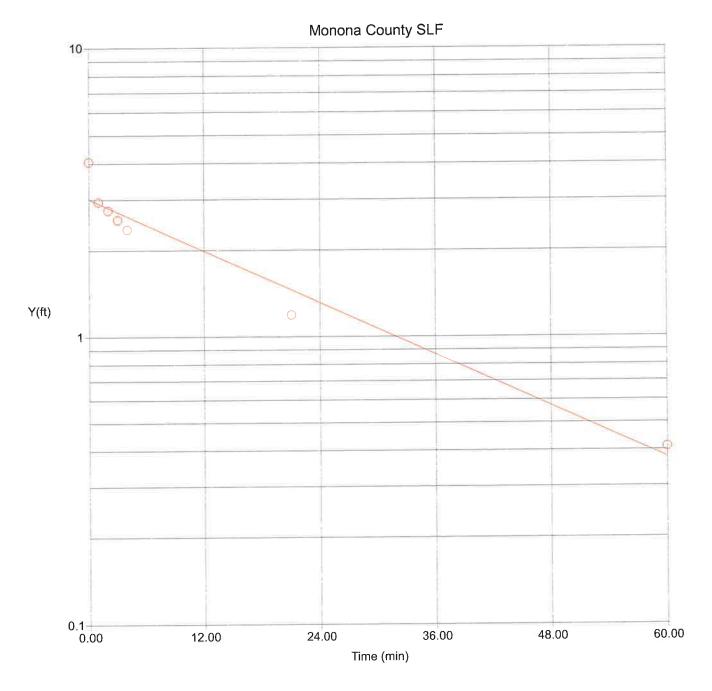
BOUWER-RICE COEFFICIENTS

Le/rw: 21.4 A: 2.18 B: 0.307 C: 1.58

Ln(Re/rw): 1.96

LEAST SQUARES BEST FIT

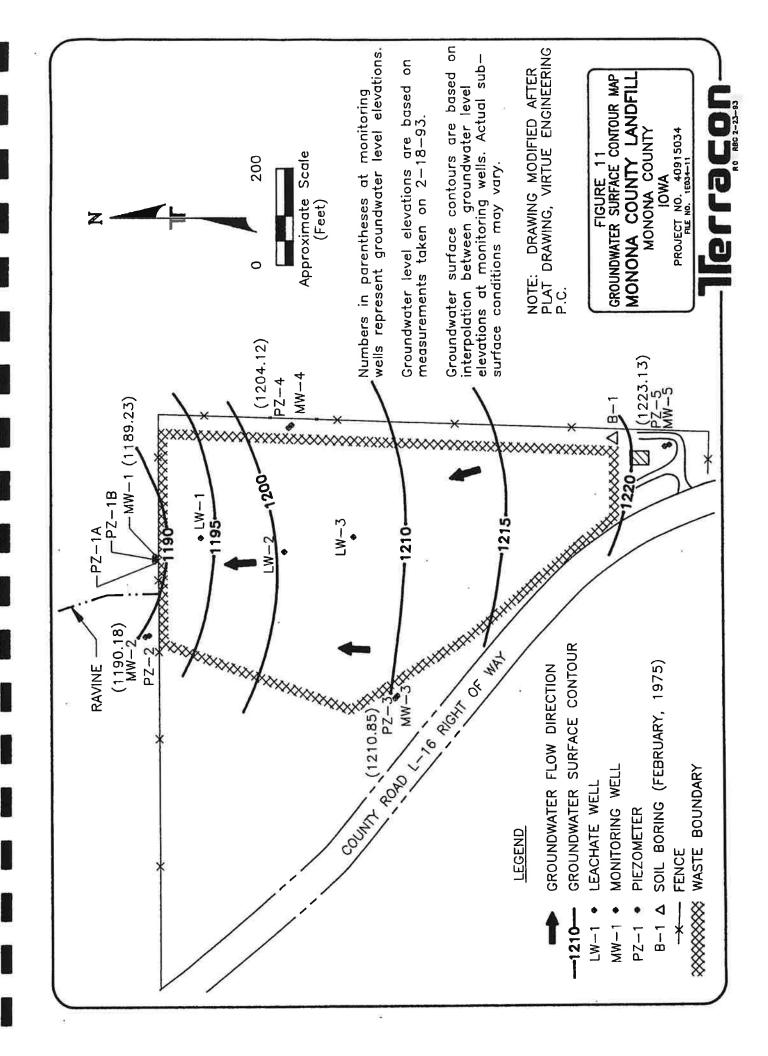
Ln(Y)-cm versus Time-sec Slope: -5.76e-04 Intercept: 4.52

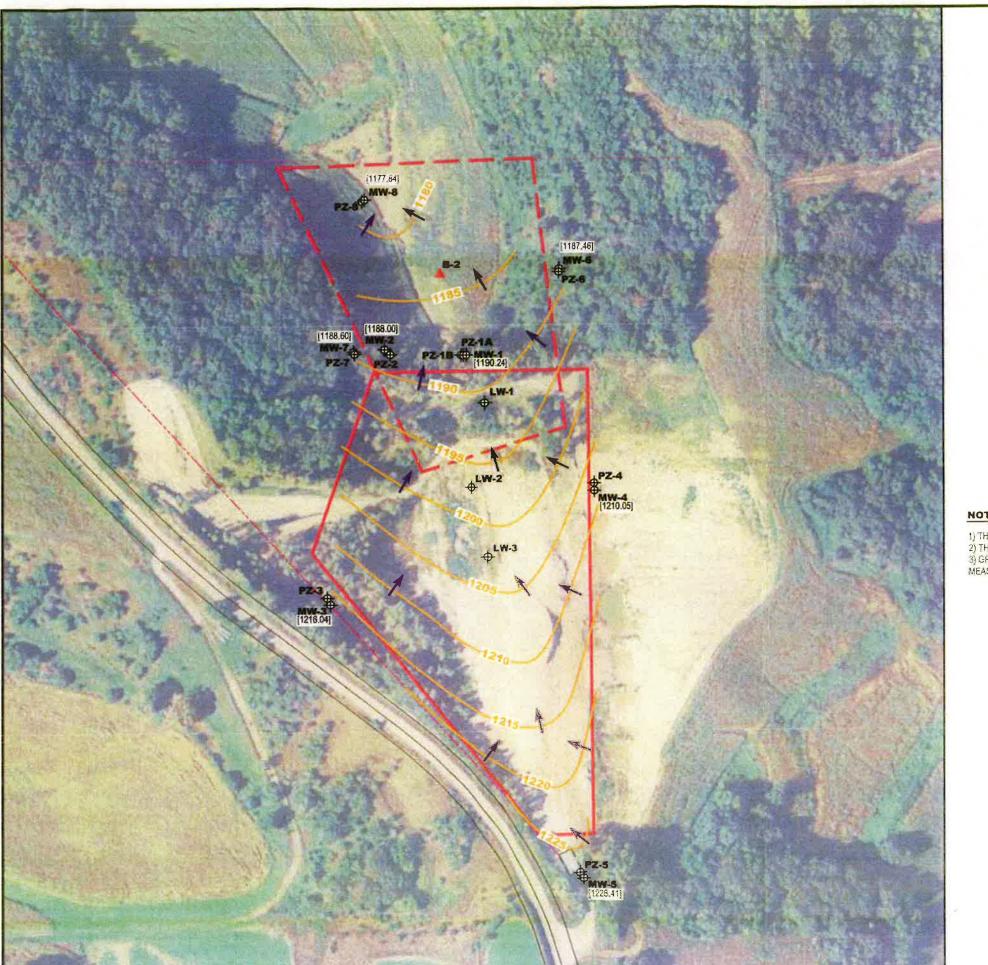


LUST No.:	Site Na	ame: Monona Coun	ty Sanitary Landfill
Hydraulic Conductivity: 6.	70e-05 cm/sec	Well: MW-7	Slug Test Date: 04/18/2024
HLW Engineering Group		CGWP	•

APPENDIX C

Historic Groundwater Contour Maps (1993 & 2011 & 2019)







LIMIT OF FILL FOR EXISTING CELL LIMIT OF FILL FOR PROPOSED NEW CELL EXISTING MONITORING POINT EXISTING BORING GROUNDWATER ELEVATION CONTOUR LINE GROUNDWATER ELEVATION (FEET) INFERRED GROUNDWATER FLOW DIRECTION

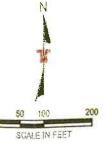
1) THE AERIAL IMAGE WAS OBTAINED FROM A 2010 IOWA GEOLOGIC MAP SERVER.
2) THE TOPOGRAPHIC IMAGE WAS GENERATED FROM IDNR LIDAR DATA COLLECTED IN 2008.
3) GROUNDWATER ELEVATION CONTOURS ARE BASED ON INTERPOLATION BETWEEN WATER LEVELS MEASURED IN MONITORING WELLS ON OCTOBER 18, 2011.

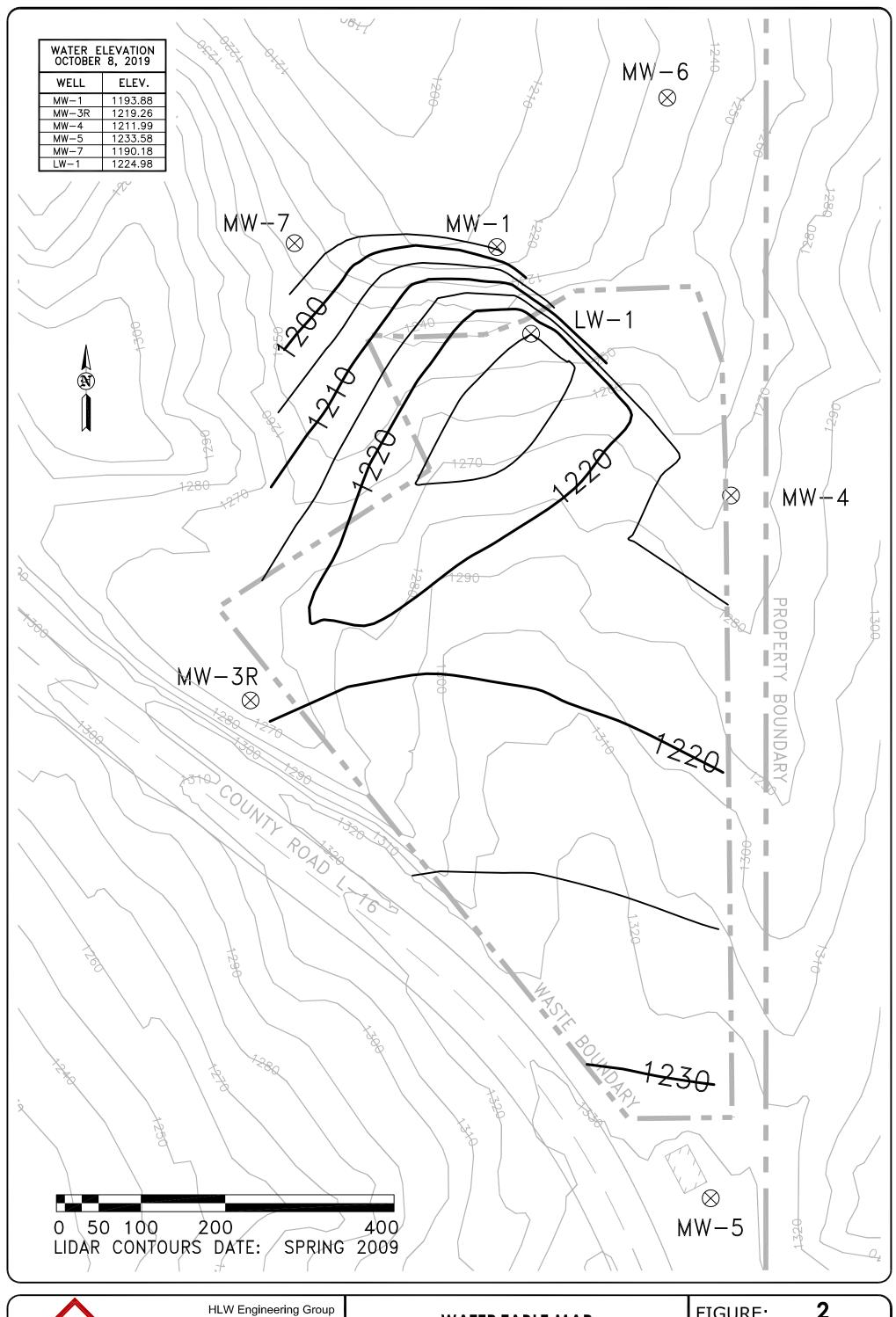


GROUNDWATER CONTOUR MAP

MONONA COUNTY LANDFILL LATERAL EXPANSION MONONA COUNTY SOILD WASTE AGENCY

				Ī







HLW Engineering Group 204 West Broad Street, P.O. Box 314 Story City, Iowa 50248 Phone: (515) 733-4144 FAX: (515) 733-4146

WATER TABLE MAP MONONA COUNTY SANITARY LANDFILL MONONA COUNTY, IOWA

FIGURE	≣: 2	2
REVISION	NO.	DATE
DRAWN DRA	PROJECT NO. 6036-14A	DATE 10-13-19

APPENDIX D

Historic Water Table Elevations

Water Elevation Data Monona County Landfill 67-SDP-1-75P

Well/TOC	MW-1	1219.73	MW-3R	1266.2	MW-4	1271.62	WW-5	1335.73	WW-7	1236.98
	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
		רופיאמוסי		T A STATE OF THE S		7				רומי
04/01/13	Ę	Z	Z	K	65.70	1205.92	104.45	1231.28	Ä	Ł
05/01/13	15.00	1204.73	L	Ā	64.50	1207.12	104.80	1230.93	Ł	Ä
06/01/13	15.00	1204.73	LN.	F	64.45	1207.17	104.65	1231.08	¥	LN
07/01/13	15.10	1204.63	LN.	Þ	64.45	1207.17	104.66	1231.07	Ā	۲N
08/01/13	18.30	1201.43	Ľ	Ā	64.40	1207.22	104.65	1231.08	ħ	ħ
09/01/13	18.85	1200.88	50.90	1215.30	64.55	1207.07	104.80	1230.93	ħ	Ä
10/01/13	19.94	1199.79	51.11	1215.09	64.61	1207.01	104.78	1230.95	¥	LN
04/16/14	30.35	1189.38	52.20	1214.00	64.40	1207.22	105.00	1230.73	49.80	1187.18
10/21/14	29.15	1190.58	46.35	1219.85	64.70	1206.92	105.20	1230.53	49.30	1187.68
04/15/15	29.10	1190.63	48.50	1217.70	64.70	1206.92	105.25	1230.48	49.30	1187.68
10/07/15	28.45	1191.28	49.00	1217.20	65.45	1206.17	105.00	1230.73	49.00	1187.98
04/12/16	27.67	1192.06	50.07	1216.13	64.55	1207.07	105.00	1230.73	48.27	1188.71
10/11/16	27.40	1192.33	50.10	1216.10	63.51	1208.11	104.33	1231.40	47.82	1189.16
04/10/17	28.25	1191.48	50.80	1215.40	63.92	1207.70	104.04	1231.69	47.32	1189.66
10/12/17	28.00	1191.73	51.03	1215.17	62.20	1209.42	103.47	1232.26	48.20	1188.78
04/10/18	28.25	1191.48	50.10	1216.10	61.70	1209.92	103.10	1232.63	48.30	1188.68
10/04/18	27.68	1192.05	48.81	1217.39	61.20	1210.42	103.03	1232.70	48.15	1188.83
04/15/19	28.25	1191.48	50.10	1216.10	60.33	1211.29	102.32	1233.41	47.32	1189.66
10/08/19	25.85	1193.88	46.94	1219.26	59.63	1211.99	102.15	1233.58	46.80	1190.18
04/08/20	25.07	1194.66	46.22	1219.98	58.47	1213.15	101.66	1234.07	46.41	1190.57
10/02/20	25.53	1194.20	46.27	1219.93	57.91	1213.71	101.65	1234.08	46.26	1190.72
04/12/21	25.90	1193.83	46.90	1219.30	26.87	1214.75	101.05	1234.68	46.38	1190.60
10/26/21	26.25	1193.48	47.41	1218.79	55.89	1215.73	100.44	1235.29	46.56	1190.42
04/12/22	26.43	1193.30	47.65	1218.55	55.50	1216.12	99.81	1235.92	46.36	1190.62
10/07/22	26.89	1192.84	49.09	1217.11	56.25	1215.37	100.50	1235.23	47.17	1189.81
04/19/23	26.67	1193.06	48.62	1217.58	57.45	1214.17	99.80	1235.93	46.70	1190.28
10/25/23	27.15	1192.58	50.30	1215.90	56.36	1215.26	100.60	1235.13	47.30	1189.68