NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Region 9
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MEMORANDUM

TO: Stanley Radon, P.G., Regional Remediation Geologist

FROM: Steven Moeller, P.G., Professional Geologist 1

Steven Moeller
Digitally signed by Steven Moeller
DN: cn=Steven Moeller, o=NYSDEC, ou=Environmental Remediation, email=steven.moeller@dec.ny.gov, c=US
Date: 2019.09.25 16:12:51 -04'00'

DATE: September 25, 2019

SUBJECT: RCRA COMPREHENSIVE GROUNDWATER MONITORING EVALUATION (CME) & FIELD INSPECTION REPORT

Facility: Vanchlor Company Inc. (formerly VanDeMark) Landfill
600 Mill Street, City of Lockport, Niagara County, NY 14094
DEC Site # 932039
EPA ID - NYD991290529

Background: The Vanchlor Landfill site consists of a 2.5-acre landfill portion of a 5-acre parcel located along the top of the Niagara Escarpment that was used to dispose of process wastes from the nearby VanDeMark Chemical Inc. (VDM) manufacturing facility. The site is bounded by Mill Street to north, a Somerset Railroad Corp rail corridor to the south and east, and Plank Road and the City of Lockport Waste Water Treatment facility to the west (Figure 1). Eighteen Mile Creek is located south and west and ~100 feet vertically below the landfill at the base of the Escarpment. Wooded areas surround the capped, grassy landfill. The VDM Chemical plant facility is approximately located ¼-mile to the east-southeast and the Vanchlor Company plant facility is just to the southeast of the landfill.

From 1957 until 1982, VDM landfilled drums of silicon tetrachloride and chlorodisiloxane at the site in trenches with powdered limestone. The limestone was used to react with the decomposing products from the drums in an effort to neutralize the acidic waste material. VDM installed new monitoring wells in 1983 as part of a closure investigation and submitted a closure plan in the spring of 1984. Groundwater was impacted by chlorinated VOCs and metals. In 1988, the landfill was closed in accordance with a NYSDEC approved Closure Plan that included the installation of a final cover system consisting of two feet of compacted clay overlain by a drainage layer of sand and loam soil and planted with a vegetative cover. In 1999, VDM sold the property to Vanchlor Company, Inc.

Following the expiration of the Post-Closure RCRA Permit #9-2909-00049/0003 in September 2013, the NYSDEC requested that Vanchlor Company, Inc. enter into an Order of Consent, executed July 10, 2014. The Order on Consent required development of a Site Management Plan (SMP; 2015). The SMP requires annual inspection of the landfill, groundwater and surface water quality monitoring, and submittal of a Periodic

Review Report (PRR) with an Institutional and Engineering Control (IC/EC) certification. The PRR must include discussions of site activities, inspections, groundwater and surface water quality monitoring results and trend analyses, recommendations, and IC/EC certification.

The principal overburden material observed during the installation of groundwater monitoring wells at the site was a matrix of red brown clayey silt fill intermixed with red rock fragments ranging from 5 to 15 feet in thickness. The bedrock in the vicinity of the Vanchlor Landfill has been reported to include the lower three formations of the Medina Group: the Grimsby, Power Glen, and Whirlpool in descending order. The primary bedrock formation encountered during the installation of the monitoring wells was the Power Glen Formation. Previous rock quarrying operations in the footprint of the landfill resulted in substantial removal of the near surface Grimsby Formation bedrock unit followed by replacement with a layer of fill.

Overburden and bedrock groundwater are inferred to be connected and are therefore considered to be the same aquifer. Historical groundwater elevation data collected from the monitoring well network indicate that the general groundwater flow is in a south-southwesterly direction toward the escarpment bank leading to Eighteen Mile Creek (Figure 2).

I. Office Evaluation

Prior to the field inspection, relevant documents were compiled, reviewed, and evaluated in accordance with criteria on the CME checklist. These documents included:

- Closure Plan for Solid Waste Management Facility VanDeMark Chemical Co. Inc. Lockport, NY & Somerset Railroad Hydrogeologic Study (1982)
- Former Landfill Investigation and Closure Plan (1984)
- Closure Plan Former Landfill Site (1987)
- Former Landfill Corrective Measures Study and Landfill Cap Evaluation (1995)
- Vanchlor Landfill Property Deed (1999/2013)
- 2013 Annual Report
- Monitoring Well VDM-9 Decommissioning and Replacement Report (2014)
- The Order on Consent and Administrative Settlement, Index # B9-0834-14-07 (2014)
- Site Management Plan (2015)
- Annual Periodic Review Reports and IC/EC Certifications (2014-2018)
- Correspondence File (1994-2015)
- Previous Groundwater Inspection Reports (2005, 2008, and 2013)

The completed CME checklist is attached. Assessment activities for the landfill were performed in the 1980s and 1990s with extensive investigation of hydrogeology and contaminant nature and extent. The landfill was closed (capped) in 1988 in accordance with a NYSDEC (the Department) approved Closure Plan and subsequent post-closure monitoring has been performed under a Part 373 RCRA Permit (until 2013) and Order on Consent (since 2014). Groundwater and surface water samples are currently collected annually and analyzed for a site-specific list of chlorinated volatile organic compounds, metals, chloride, and pH. Tetrachloroethene, trichloroethene, trans-1,2-dichloroethene, vinyl chloride, 1,1,2-trichloroethane, 1,2-dichloroethane, chloroform, methylene chloride, chromium, copper, iron, and chloride are detected at concentrations above groundwater standards, primarily in well VDM-14R which has historically demonstrating the highest groundwater contaminant concentrations. Any landfill leachate or underflow may be directed to a ditch running along the northeast edge of the landfill which flows toward well VDM-14R.

Emerging contaminant sampling performed in 2018 also identified perfluorinated compounds (PFAS) and 1,4-dioxane in site groundwater at concentrations above proposed above groundwater standards. There have also been approved modifications to the post-closure monitoring program since the SMP was issued in 2015. Once groundwater standards are promulgated for PFAS and 1,4-dioxane, the SMP should be updated adding PFAS, 1,4-dioxane, carbon tetrachloride, and & cis-1,2- dichloroethene to the site-specific analyte list and incorporating approved changes to the monitoring program.

II. Field Evaluation

On August 5 and 6, 2019, Steven Moeller, PG, conducted a field Inspection at the Vanchlor Landfill during the Annual Groundwater and Surface Water Sampling and Landfill Inspection Event. This inspection included observation of groundwater and surface water sample collection activities and inspection of monitoring wells, the landfill cap, perimeter fenceline, and surrounding areas.

Onsite Personnel:

- **August 5, 2019** Steven Moeller (NYSDEC – PM/Inspector); Brian Law (Vanchlor Company Inc. – Operations Manager); Jim Wrazen (VanDeMark Chemical Inc. - EHS Engineer); Patrick Martin (Golder Associates - PM); Zach Robison and Eric Swartzmeyer (Alpha Analytical Inc. - Vanchlor's sampling and analytical laboratory contractor)

- **August 6, 2019** Steven Moeller (NYSDEC – PM/Inspector); Zach Robison and Eric Swartzmeyer (Alpha Analytical Inc. - Vanchlor's sampling and analytical laboratory contractor)

Weather: August 5, 2019 - Sunny, mostly clear, 60^o F, calm; **August 6, 2019** - Sunny, mostly clear, 70^o F, breezy

The annual groundwater samples were collected on August 5 (well purging) and 6 (well sampling), 2019 by Vanchlor's sampling contractor personnel from four onsite, downgradient well locations (VDM-9R, VDM-10, VDM-11, and VDM-14R) and one offsite, upgradient location (D-55) in accordance with the Vanchlor Landfill *Groundwater Monitoring Plan* (Appendix E of the SMP); well VDM-12 was dry and could not be sampled (Figure 2). The dry conditions found in well VDM-12 are a good indication that the cap is preventing infiltration, because prior to capping VDM-12 had sufficient water to allow for sample collection. The groundwater monitoring network appeared to be in generally good condition with all wells locked and functional (see attached photos); the protective casing cap on well D-55 needs repair due to a damaged hinge. Depth to water and bottom measurements were recorded with a Solinst Model 101 electronic water level indicator prior to initiating well purging activities; depth to water measurements were also recorded prior to sample collection (Table 1). Wells were purged on August 5 with dedicated HDPE bailers for 3 well volumes (VDM-14R) or until dryness (D-5, VDM-9R, VDM-10, and VDM-11). The purge water was containerized for future characterization and disposal.

The wells were allowed to recover overnight and sampled with the same dedicated HDPE bailers on August 6 for the analytical parameters noted above. A surface water sample was also collected (direct immersion of clean sample bottle in creek) on August 6 from Eighteen Mile Creek at a location downstream from the Site, but upstream of the City of Lockport Wastewater treatment plant SPDES discharge point, for analysis of the same analytical parameters (Figure 1). Volatile organic sample containers were filled first followed by the metals and chloride containers. Field QC samples included trip blanks and a duplicate sample collected at well VDM-14R; no MS/MSD samples were collected during this sampling event. Field parameter measurements included sample pH (wells and surface water) and temperature (surface water only) with an Oakton pH/temperature meter.

Table 1

Monitoring Point	Date	Measured Depth to Water*	Measured Depth to Bottom*	As-built Depth to Bottom*	pH	Temperature (^{o}C)
D-55	8/5/2019	36.55	47.75 (soft)	47.0	-----	-----
	8/6/2019	36.60	-----		7.64	-----
VDM-9R	8/5/2019	33.85	39.19 (hard)	37.35	-----	-----
	8/6/2019	36.78	-----		5.82	-----
VDM-10	8/5/2019	32.96	46.75 (soft)	45.97	-----	-----
	8/6/2019	43.94	-----		6.39	-----
VDM-11	8/5/2019	19.69	22.85 (hard)	22.72	-----	-----
	8/6/2019	20.85	-----		6.29	-----
VDM-12	8/5/2019	Dry	13.28 (muddy)	15.42	-----	-----
VDM-14R	8/5/2019	10.16	11.65 (hard)	12.0	-----	-----
	8/6/2019	10.12	-----		5.46	-----
Eighteen Mile Creek	8/6/2019	-----	-----	-----	8.18	25.2

*Feet below top of riser
----- = Not recorded or measured

A site-wide inspection of the landfill was also performed. Site access is controlled by a road gate at the bottom of the Mill Street access road and a locked gate in the perimeter fence that surrounds the landfill; both gates were locked and the perimeter fence was in good condition with adequate warning signage. The landfill cap appeared to be well grassed and in good condition. No standing water, staining, or distressed vegetation was noted, especially in the ditch running along the northeast edge of the landfill, which potential flows toward well VDM-14R.

III. Summary

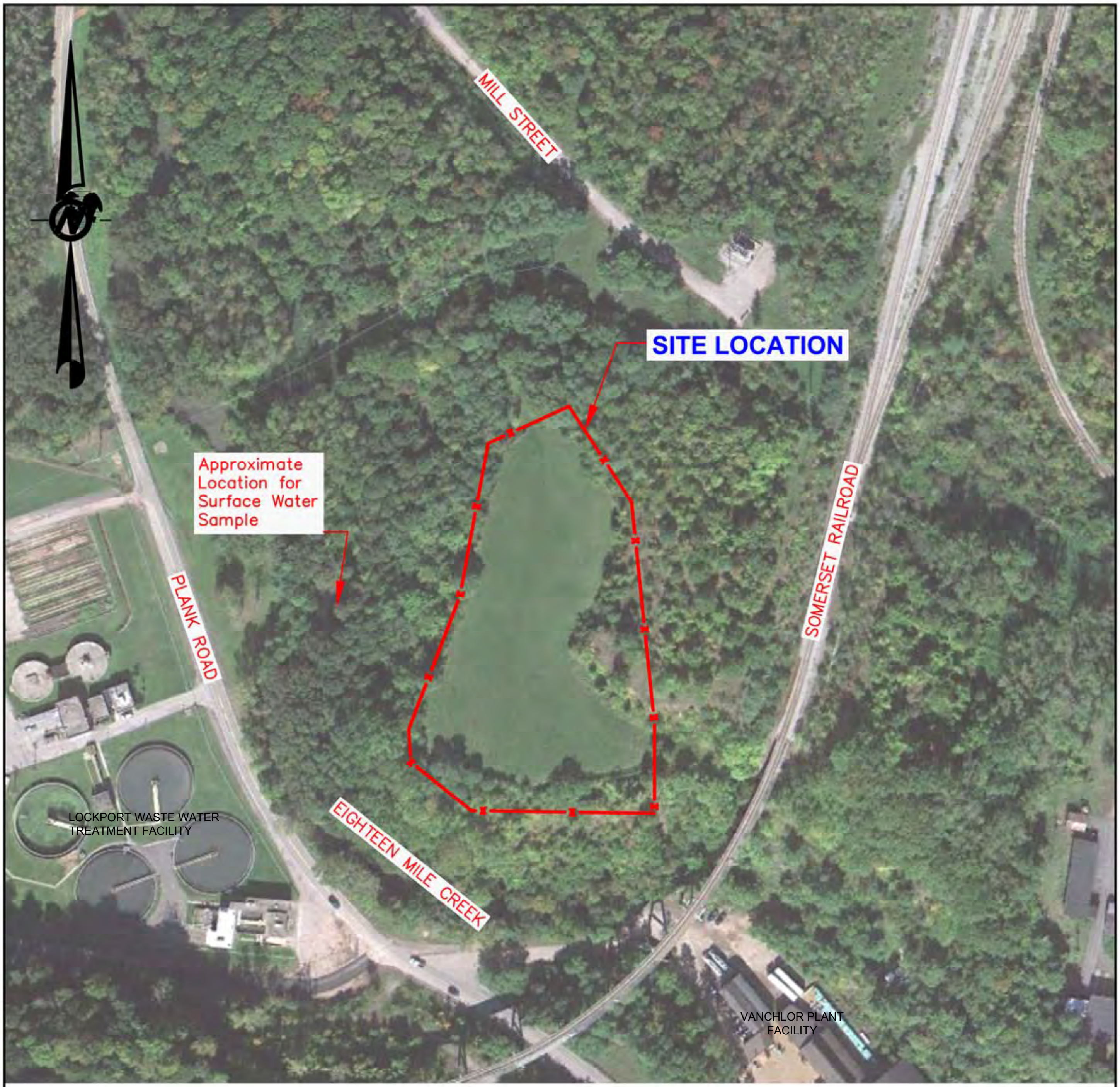
Based upon a review of site-related documents (including the *Groundwater Monitoring Plan*), oversight of groundwater and surface water sample collection, and inspection of the landfill facility, the Department has determined that the facility is in compliance with their post-closure monitoring program as required by the SMP and Order on Consent. The repair on the protective casing cap on well D-55 (recommend replacement with a Royer Cap) should be addressed by the end of December 2019.

ATTACHMENTS

Attachment A - Figures
Attachment B - Photographs
Attachment C - Well Construction Logs
Attachment D - CME Checklist

ATTACHMENT A

FIGURES



LEGEND

FENCE / APPROXIMATE SITE PROPERTY LINE

REFERENCES

1.) BASE MAP TAKEN PER GOOGLE EARTH AERIAL IMAGE (10/5/11)

200 0 200
SCALE FEET

Golder Associates
Buffalo, New York

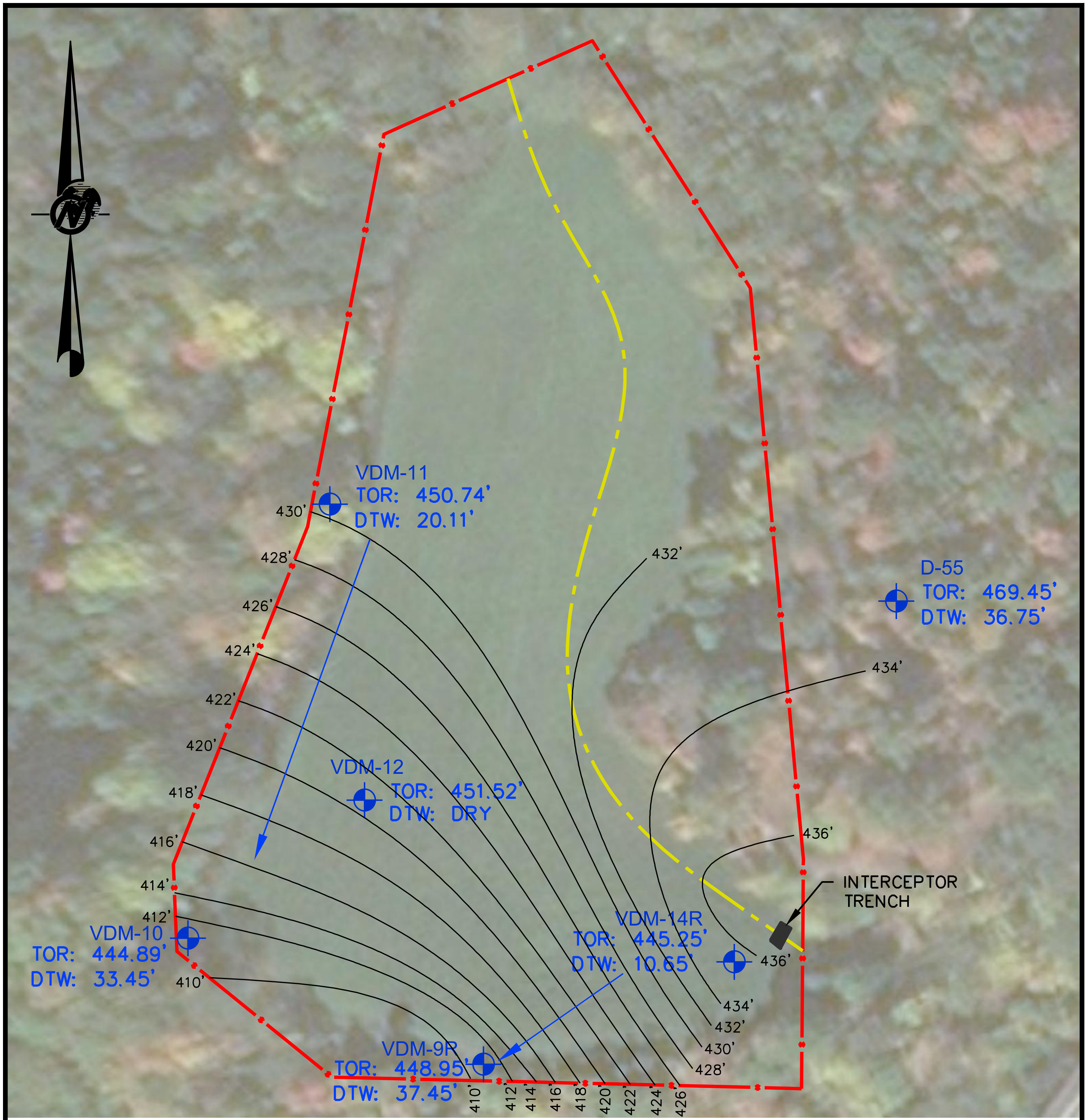
SCALE	AS SHOWN
DATE	9/3/14
DESIGN	JGT
CADD	JGT
CHECK	
REVIEW	

FILE No. 1403185A224
PROJECT No. 1403185 REV. 0

TITLE
SITE LOCATION AND VICINITY MAP

VANCHLOR CO. INC.

FIGURE 1



LEGEND

🟥 FENCE / APPROXIMATE SITE PROPERTY LINE

VDM-9R ⌖ MONITORING WELL APPROXIMATE LOCATION

→ GROUNDWATER FLOW DIRECTION (APPROX.)

75 0 75

SCALE FEET

REFERENCES

1.) BASE MAP GENERATED FROM BING AERIAL IMAGERY.
2.) ELEVATIONS ARE BASED ON SITE DATUM.
3.) WATER ELEVATIONS PER JULY 24, 2018 SAMPLING EVENT.

GOLDER

FILE No.	19116159_001
PROJECT No.	19116159
REV.	0

SCALE	AS SHOWN
DATE	05/06/19
DESIGN	JGT
CADD	RWC
CHECK	JMV
REVIEW	PTM

TITLE

GROUNDWATER MONITORING WELL LOCATIONS & ISOPOTENTIAL MAP

VANCHLOR LANDFILL

VANCHLOR CO. INC.

FIGURE 2

Drawing file: 19116159_001.dwg May 06, 2019 – 10:48am

ATTACHMENT B

PHOTOGRAPHS

(all photos were taken on August 5 & 6, 2019 unless otherwise noted)

Southeastward view of gate to Mill Street access road.

South-southeastward view of landfill access gate in perimeter fenceline (December 2018 photo).

Westward view of perimeter fenceline (near well D-55) showing warning signage.

Wells VDM-9R (left) and VDM-10 (right).

Wells VDM-11 (left) and VDM-12 (right).

Wells VDM-14R (left; December 2018 photo) and D-55 (right).

Taking depth to water and bottom measurements at well VDM-10 (left) and containerizing purge water for future characterization and disposal (right).

Sample collection at well VDM-9R.

Taking sample pH measurement at well VDM-9R.

Collecting Eighteen Mile Creek surface water sample.

ATTACHMENT C

WELL CONSTRUCTION LOGS

GROUND WATER OBSERVATION WELL REPORT

PROJECT Somerset Railroad - Van De Mark

LOCATION N1,160,756 E468,241

Date Completed 10/19/81 Original Depth 46.7 (cored)

Inspected By J. C. Isham Date 10/19/81

Checked By ______ Date ______

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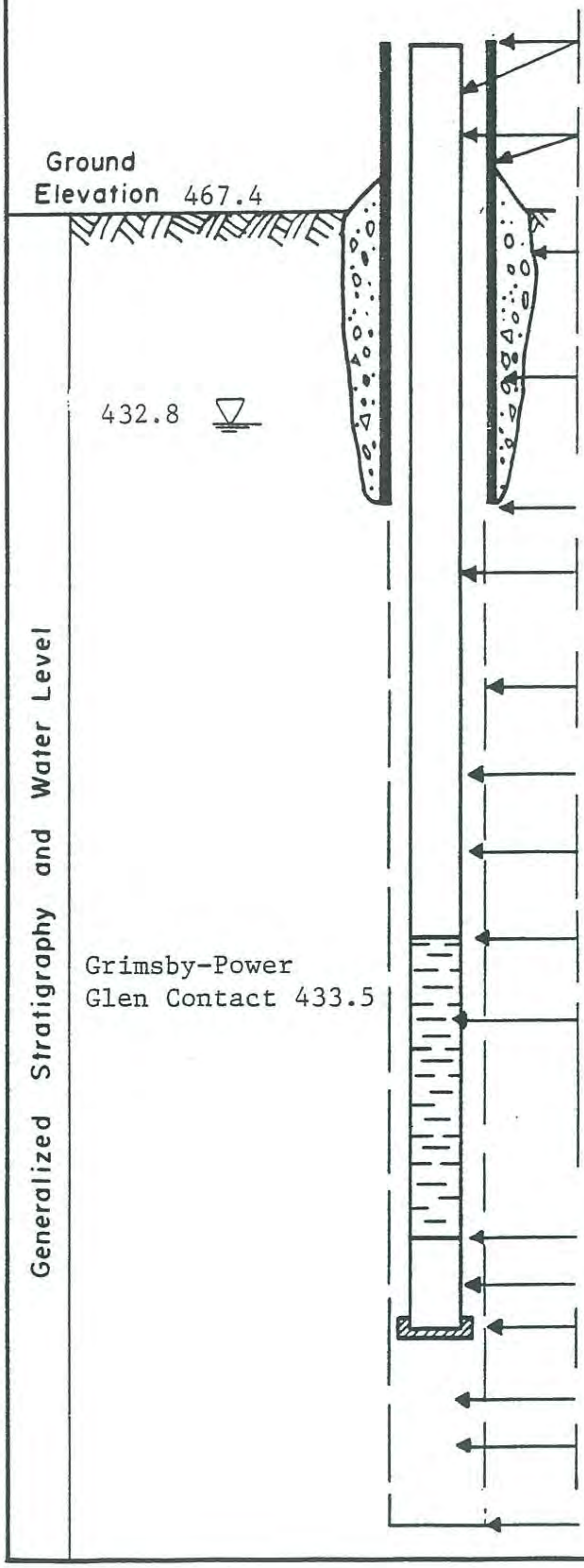
Well No. D-55

Aquifer Grimsby-Power Glen Contact

Elev. Interval 420.7-439.4'



Elevation of top of surface casing / riser pipe.	469.36/469.36'
Heigth of top of surface casing / riser pipe above ground surface.	2.0/2.0'
Depth of surface seal below ground surface	3.0'
Type of surface seal: Cement	
I. D. of surface casing.	4"
Type of surface casing: Cast iron with lock cap	
Depth of surface casing below ground	3.0'
I. D. of riser pipe.	2"
Type of riser pipe: Sch 80 PVC	
Diameter of borehole	0.5'
Depth of borehole (reamed)	45.0'
Type of backfill: Cement	
Elev./depth top of seal.	442.3/25.1'
Type of seal: Bentonite	
Elev./depth bottom of seal.	439.4/28.0'
Type of sand pack. Q-02 (fine to med. sand)	
Depth of top of sand pack.	439.4/28.0'
Elev./depth top of screened section.	432.9/34.5'
Type of screened section: Sch 80 PVC	
Describe openings 0.010" machine slot - horizontal slot	
I. D. of screened section.	2.0"
Elev./depth bottom of screened section.	423.3/44.1'
Length of blank section.	0.9'
Elev./depth bottom of plugged blank section.	422.4/45.0'
Elev./depth bottom of sand column.	422.4/45.0'
Type of backfill below observation pipe. Cuttings	
Elev./depth of hole.	420.7/46.7'

MONITORING WELL INSTALLATION LOG

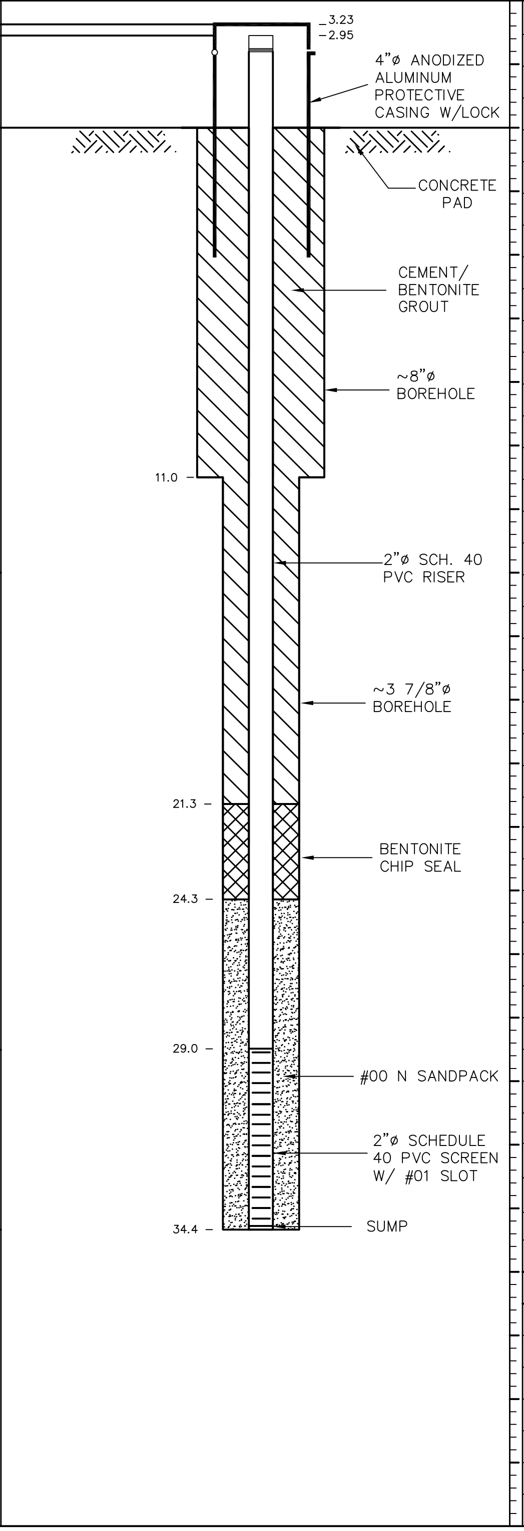
JOB NO. 14-03185 PROJECT VANDEMARK/LANDFILL WELL REPLACEMENT/NY WELL NO. VDM-9R SHEET 1 of 1
GA INSP. RJM DRILLING METHOD 4 1/4" I.D. HOLLOW STEM AUGERS CONC.PAD ELEV. ~444.0 Ft. WATER DEPTH ~29.0 Ft. BGS
WEATHER P. CLOUDY DRILLING COMPANY NOTHNAGLE DRILLING, INC. COLLAR ELEV. ~447.0 Ft. DATE/TIME 1245/05-29-14
TEMP. 65° F DRILL RIG CME-55 ATV DRILLER T. MANGEFRIDA STARTED 1250/05-29-14 (TIME / DATE) COMPLETED 1330/05-29-14 (TIME / DATE)
LOCATION / COORDINATES N , E (APPROXIMATELY 10-FT EAST OF VDM-9 LOCATION)

MATERIALS INVENTORY

WELL CASING 2.0 in. dia. 28.5 l.f. WELL SCREEN 2.0 in. dia. 5 l.f. BENTONITE SEAL MEDIUM BENTONITE CHIPS
CASING TYPE SCH. 40 PVC SCREEN TYPE MACHINE SLOTTED PVC INSTALLATION METHOD POUR THROUGH AUGERS
JOINT TYPE FLUSH THREADED SLOT SIZE 0.01"-SLOT FILTER PACK QTY. 1.0-BAG
GROUT QUANTITY 12-GALLONS CENTRALIZERS NOT USED FILTER PACK TYPE #00-N SIZE SAND
GROUT TYPE CEMENT/BENTONITE DRILLING MUD TYPE NOT USED INSTALLATION METHOD POUR THROUGH AUGERS

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
449.23	TOP OF CASING
448.95	TOP OF RISER
446.0	EXISTING GROUND SURFACE*
0.0	(CL), SILTY CLAY to (ML) CLAYEY SILT, some f-c gravel red to red-brown; dry, as interpreted from drill cuttings and original VDM-9 well log.
432.0 14.0	Grey-brown siltstone and grey weathered shale, over dark green-grey sandstone, as interpreted from drill cuttings and original VDM-9 well log.
▼	29.0' PRE-INSTALLATION
411.6 34.4	EOB @ 34.4 FT. BGS

WELL SKETCH



INSTALLATION NOTES

BORING LOCATION AUGERED WITH 4 1/4" I.D. HOLLOW STEM AUGERS (HSAs) WITH NO SAMPLING PERFORMED TO APPROX. 11.0-FT BELOW GROUND SURFACE (bgs). DRILLER SWITCHED TO 3 7/8" TRI-CONE ROTARY AIR DRILLING DUE TO HARD DRILLING. DRILLED TO 34.4-FT. bgs USING AIR DRILLING. DRILL RODS REMOVED AND WELL MATERIALS PLACED IN BOREHOLE USING 5.0 FT. WELL SCREEN, THREADED FLAT-END CAP, 29.0 FT. OF WELL RISER AND SLIP TOP CAP FOR OVERALL LENGTH OF 34.4-FT. WELL MATERIALS PLACED TO 34.4-FT WITH APPROX. 2.5 FT. STICKUP. #00-N SAND POURED THROUGH AUGERS 34.3-24.3 FT. bgs. 3/8" BENTONITE CHIP SEAL PLACED BY HAND 24.3-21.3 FT. bgs. CHIPS ALLOWED TO HYDRATE 30 MINUTES. CEMENT/BENTONITE GROUT ADDED 21.3-0.0 FT. bgs. FOLLOWING REMOVAL OF STONE DRILLING BENCH, 4" DIAMETER ANODIZED ALUMINUM SQUARE PROTECTIVE CASING PLACED OVER RISER AND CEMENTED INTO CONCRETE PAD WITH 2.5 FT. STICKUP ON 06/02/14. NO SAND PLACED IN ANNULUS OF PROTECTIVE CASING BY DRILLERS.

* MEASUREMENTS REFERENCED FROM GROUND SURFACE AS OF DATE OF INSTALLATION (05/29/14).

WELL DEVELOPMENT NOTES

DATE DEVELOPED: N/A
DEVELOPMENT METHOD: N/A

VOLUME PURGED: N/A
FOR FURTHER DETAILS SEE ACCOMPANYING WELL DEVELOPMENT FIELD RECORD.

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME: VAN DE MARK LANDFILL SITE JOB NO.: 1277 HOLE NO.: VDM-10 Pg 1 of 2

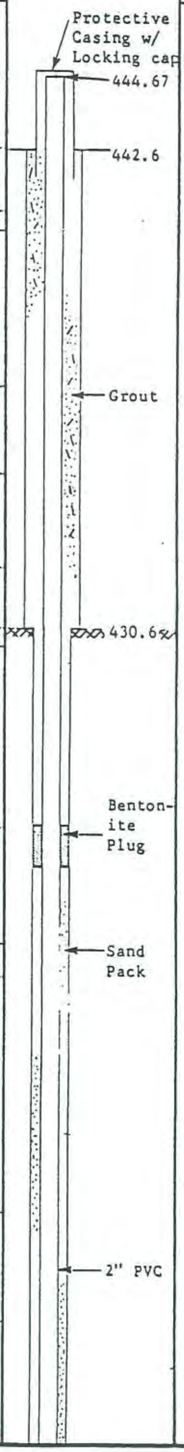
CLIENT: VAN DE MARK CHEMICAL COMPANY DATE COMPLETED: DECEMBER 7, 1983

HOLE TYPE: 8" Ø HOLLOW STEM AUGER LOCATION: SOUTHWEST CORNER LANDFILL

GEOLOGIST / ENGINEER: DAVE BLACK GROUND ELEVATION: 442.6 TOP OF PIPE ELEVATION: 444.67

PROFILE		SAMPLE		
DEPTH (ELEVATION)	STRATIGRAPHY DESCRIPTION & REMARKS	NUMBER	TYPE	BLOWS / FOOT
445				
	Red clayey silt, some rock fragments, fine gravel, and root fibers	1	SS	25
	Rock fragments			91
440	Soft rock fragments, some red clayey silt, pebbles, trace root fibers	2	SS	100+
				77
		3	SS	28
				28
	No recovery	4	SS	36
435				38
	Rock fragments, some red clayey silty sand	5	SS	44
				97
	Dense grey siltstone, layered, greenish	6	SS	28
	<u>Auger refusal</u> Light grey sandstone, medium grained			100+
430	Grey interbedded shale and dolomite/limestone - fissile to thin bedded - highly fractured (vertical and horizontal) - hematitic staining on fractured faces			
425	Increasing dolomite beds			
	Grey dolomite/limestone, aphanitic - thin bedded, highly fractured - hematitic and MnO staining on fractures			
420	Greenish grey to buff interbedded siltstone and sandstone, aphanitic to fine grained - thin to medium beds - frequent fractures along horizontal parting planes and some vertical fractures - some MnO staining - allochthonous sandstone fragments			
415	Grey shale, moderately soft interbedded with moderately hard buff sandstone			
	Buff sandstone moderately hard interbedded with grey moderately soft shale (thin beds)			

MONITOR INSTALLATION



PENETRATION TEST BLOWS / FOOT

(37) GRAIN SIZE ANALYSIS ▼ WATER FOUND ▽ STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

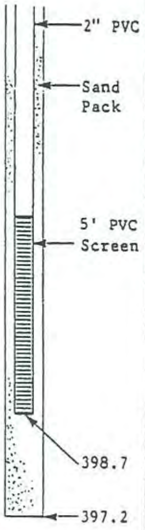
PROJECT NAME: VAN DE MARK LANDFILL SITE JOB NO.: 1277 HOLE NO.: VDM-10 Pg 2 of 2

CLIENT: VAN DE MARK CHEMICAL COMPANY DATE COMPLETED: DECEMBER 7, 1983

HOLE TYPE: 8" Ø HOLLOW STEM AUGER LOCATION: SOUTHWEST CORNER OF LANDFILL

GEOLOGIST / ENGINEER: DAVE BLACK GROUND ELEVATION: 442.6 TOP OF PIPE ELEVATION: 444.67

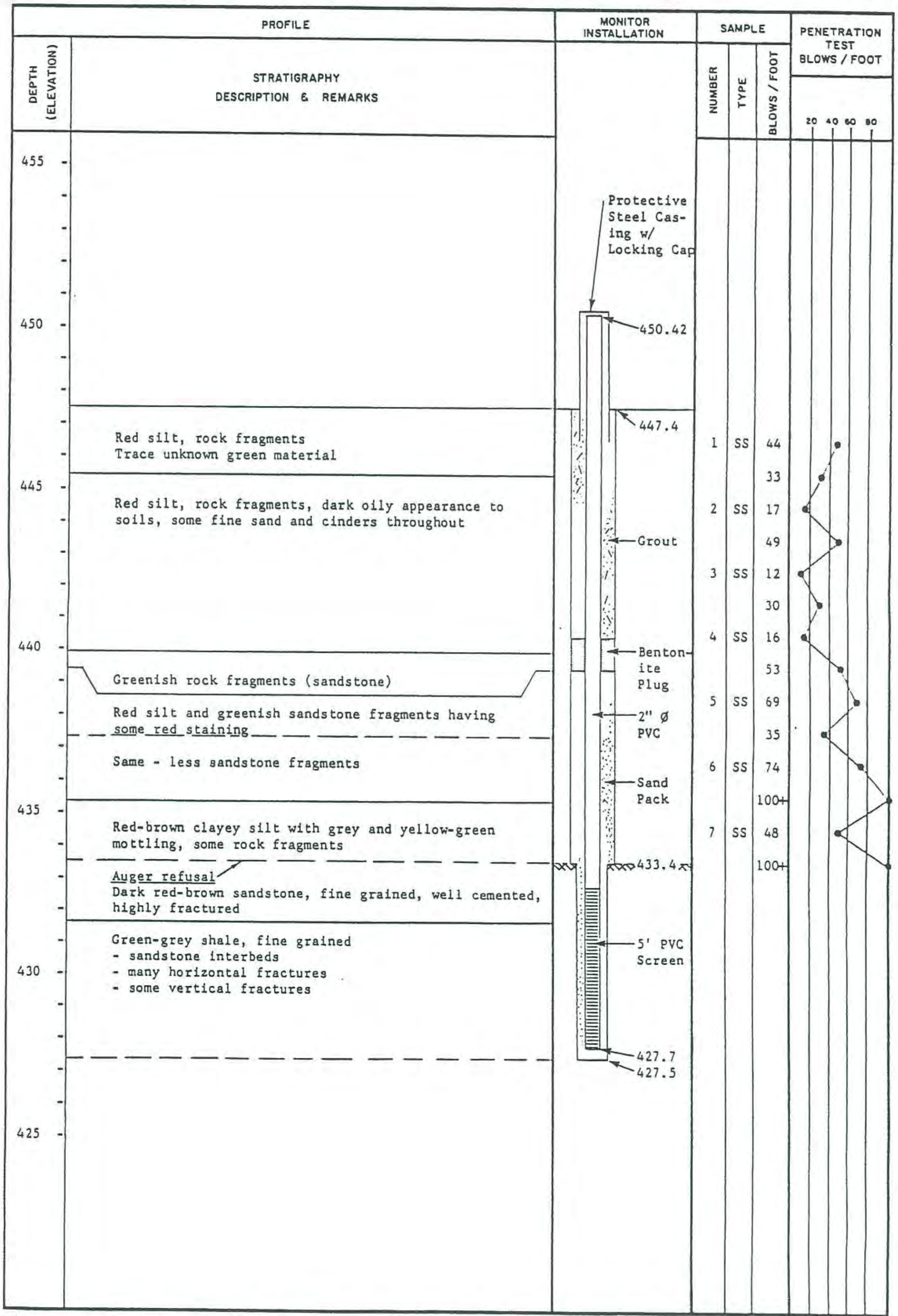
PROFILE		MONITOR INSTALLATION	SAMPLE			PENETRATION TEST BLOWS / FOOT
DEPTH (ELEVATION)	STRATIGRAPHY DESCRIPTION & REMARKS		NUMBER	TYPE	BLOWS / FOOT	20 40 60 80
410	Buff sandstone moderately hard interbedded with grey moderately soft shale (thin beds)					
405						
	Buff sandstone moderately hard, massive					
	WHIRLPOOL-QUEENSTON interface (olive green) Red shale moderately soft - thin bedded - green shale interbed					
400						
395						



㊲ GRAIN SIZE ANALYSIS ▼ WATER FOUND ▽ STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME: VAN DE MARK LANDFILL SITE   JOB NO.: 1277   HOLE NO.: VDM-11
CLIENT: VAN DE MARK CHEMICAL COMPANY   DATE COMPLETED: DECEMBER 9, 1983
HOLE TYPE: 8" Ø HOLLOW STEM AUGER   LOCATION: MID-WESTERN LIMIT OF LANDFILL
GEOLOGIST / ENGINEER: DAVE BLACK   GROUND ELEVATION: 447.4   TOP OF PIPE ELEVATION: 450.42



STRATIGRAPHY DESCRIPTION & REMARKS

Red silt, rock fragments
Trace unknown green material

Red silt, rock fragments, dark oily appearance to soils, some fine sand and cinders throughout

Greenish rock fragments (sandstone)

Red silt and greenish sandstone fragments having some red staining

Same - less sandstone fragments

Red-brown clayey silt with grey and yellow-green mottling, some rock fragments

Auger refusal
Dark red-brown sandstone, fine grained, well cemented, highly fractured

Green-grey shale, fine grained
- sandstone interbeds
- many horizontal fractures
- some vertical fractures

SAMPLE		
NUMBER	TYPE	BLOWS / FOOT
1	SS	44
		33
2	SS	17
		49
3	SS	12
		30
4	SS	16
		53
5	SS	69
		35
6	SS	74
		100+
7	SS	48
		100+

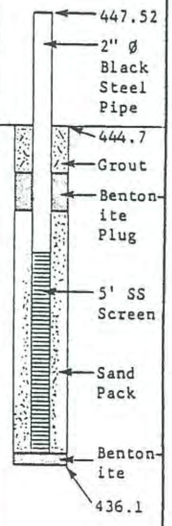
(37) GRAIN SIZE ANALYSIS   ▼ WATER FOUND   ▽ STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

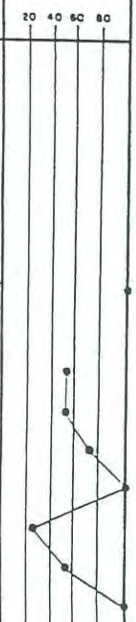
PROJECT NAME: VAN DE MARK LANDFILL SITE JOB NO.: 1277 HOLE NO.: VDM-12
CLIENT: VAN DE MARK CHEMICAL COMPANY DATE COMPLETED: DECEMBER 2, 1983
HOLE TYPE: 8" Ø HOLLOW STEM AUGER LOCATION: CENTER OF EARLY LANDFILL AREA
GEOLOGIST / ENGINEER: DAVE BLACK GROUND ELEVATION: 444.7 TOP OF PIPE ELEVATION: 447.52

PROFILE		SAMPLE		
DEPTH (ELEVATION)	STRATIGRAPHY DESCRIPTION & REMARKS	NUMBER	TYPE	BLOWS / FOOT
450				
445				
	Red silty clayey sand, medium grained, some angular rock fragments, some green slag, trace black deposits	1	SS	100^+
				--
	Red sandy silt, some angular rock fragments, lime green slag at 4.0 feet	2	SS	55
				55
440	Brown sandy silt, trace of angular rock fragments and green slag	3	SS	75
	Red sandy silt, some angular rock fragments, dark oily deposits and trace of wood fragments			100
		4	SS	24
				58
	Rock fragments	5	SS	100^+
435				

MONITOR INSTALLATION



PENETRATION TEST BLOWS / FOOT



㊲ GRAIN SIZE ANALYSIS ▼ WATER FOUND ▽ STATIC WATER LEVEL

McINTOSH & McINTOSH
PROFESSIONAL CORPORATION

McINTOSH & McINTOSH, P.C.
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Principal Office. 429 Pine Street. P.O Box 490 Lockport, New York 14095
716 - 433-2535 BUFFALO, N Y
716 - 434-9138 625-8360
FAX # 716-433-2627

After capping

December 9, 1992

Van De Mark Chemical Co., Inc.
One North Transit Road
Lockport, NY 14094

Attention: Mr. Joe Venturo

Re: Measured Elevations on Landfill
Wells VDM 9, 10 and 11

1983 as-built elevations (before capping).

Well No.	Top of PVC Pipe	(Published)	Ground Elev.	(Published)
9	447.37	(447.22)	445.0	(444.3)
10	444.89	(444.67)	443.1	(442.6)
11	450.74	(450.42)	448.55	(447.4)
Check Wells:				
12	451.52	4' higher (447.52)	450.4	(444.7)
D-55	469.45	(469.36)	467.45	(467.4)

NOTE:

Elevations based on BM1 - top conc. wall s.w. corner ruins elev. 454.02 as shown on map of Van De Mark Chemical Co., Inc., Dwg. No. VDM 1966 by William W. Whitmore, P.E. P.C., datum unknown.

Measured By: L. Zimpfer

Niagara Frontier Land Surveyors Association • American Congress on Surveying and Mapping • New York State Association of Professional Land Surveyors
Genesee Valley Land Surveyors Association • American Society of Photogrammetry • New York Society of Professional Engineers Inc • Canadian Institute of Surveying

Project No: 0155-002-100

Borehole Number: VDM-14R

Project: Vandamark Replacement well

Client: Vandamark Chemical, Inc.

Logged By: TAB

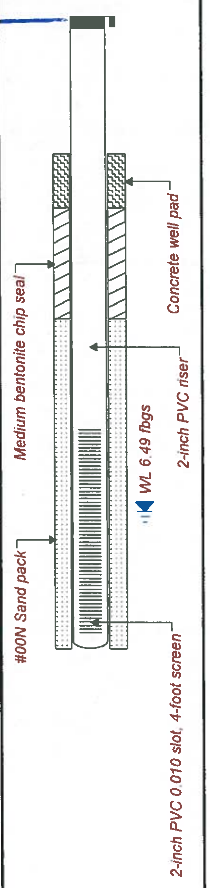
Site Location: Vandamark Landfill

Checked By: BCH

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

Benchmark Environmental Engineering & Science, PLLC
726 Exchange Street, Suite 624
Buffalo, NY
(716) 856-0599

SUBSURFACE PROFILE			SAMPLE						
Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Sample No.	SPT N-Value	Recovery (ft)	Symbol	PID VOCs ppm 0 12.5 25	Lab Sample	Well Completion Details or Remarks
-3.0									
							440.47		
	0.0	Ground Surface							
	0.0 -0.5 0.5	***Topsoil*** Dark brown, moist, silt with some clay and fine sand, soft							
		Crushed Limstone Brown and grey, moist to wet, crushed lime stone with some silt and fine sand, medium dense, loose when disturbed							
2.0									
7.0									
	-9.0 9.0	End of Borehole							
12.0									
17.0									



Drilled By: Earth Dimensions, Inc.
Drill Rig Type: CME 550 ATV Rig
Drill Method: Overdrill and replace

Drill Date(s): 09/16/08

Hole Size:
Stick-up: 3.0 feet
Datum: NA

Sheet: 1 of 1

ATTACHMENT D

CME CHECKLIST

Comprehensive Groundwater Monitoring Evaluation	Y/N
I. Office Evaluation Technical Evaluation of the Design of the Groundwater Monitoring System **A. Review of Relevant Documents** 1. What documents were obtained prior to conducting the inspection: ☐RCRA Part A permit application ☐RCRA Part B permit application ☒Correspondence between the owner/operator and appropriate agencies or citizen's groups ☒Previously conducted facility inspection/investigation reports ☒Facility's contractor reports (Annual Periodic Review Reports) ☒Regional hydrogeologic, geologic, or soil reports ☒The facility's Sampling and Analysis Plan ☐Groundwater Assessment Program Outline (or Plan, if the facility is in assessment monitoring) ☒Other (specify): Site Management Plan (2015)	Yes
B. Evaluation of the Owner/Operator's Hydrogeologic Assessment 1. Did the owner/operator use the following direct techniques in the hydrogeologic assessment: ☒Logs of the soil borings/rock corings (documented by a professional geologist, scientist, or geotechnical engineer) ☒Materials tests (e.g., grain size analyses, standard penetration tests, etc.) ☒Piezometer installation for water level measurements at different depths ☒Slug tests ☒Pressure tests ☒Geochemical analyses of soil samples ☐Other (specify) (e.g., hydrochemical diagrams, wash analysis):	Yes

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
2. Did the owner/operator use the following indirect technique to supplement direct techniques data: ☐Geophysical well logs ☐Tracer studies ☐Resistivity and/or electromagnetic conductance ☐Seismic survey ☐Hydraulic conductivity measurements of cores ☐Aerial photography ☐Ground penetrating radar ☐Other (specify):	No
3. Did the owner/operator document and present the raw data from the site hydrogeologic assessment? Some	Some
4. Did the owner/operator document methods (criteria) used to correlate and analyze the information? Some	Some
5. Did the owner/operator prepare the following: ☒Narrative description of geology ☒Geologic cross sections ☒Geologic and soil maps ☒Boring/coring logs ☐Structure contour maps of the differing water bearing zones and confining layer ☒Narrative description and calculation of groundwater flows ☒Water table/potentiometric map ☒Hydrologic cross sections	Yes
6. Did the owner/operator obtain a regional map of the area and delineate the facility? On regional topographic map If yes, does the site map show: ☐Surficial geology features ☒Streams, rivers, lakes, or wetlands near the facility ☐Discharging or recharging wells near the facility	Yes
7. Did the owner/operator obtain a regional hydrogeologic map? No If yes, does this hydrogeologic map indicate: ☐Major areas of recharge/discharge ☐Regional groundwater flow direction ☐Potentiometric contours which are consistent with observed water level elevations	No

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
8. Did the owner/operator prepare a facility site map? Yes If yes, does the site map show: ☒Regulated units of the facility (e.g., landfill areas, impoundments) ☒Any seeps, springs, streams, ponds, or wetlands ☒Location of monitoring wells, soil borings, or test pits	Yes
9. How many regulated units does the facility have? 1 If more than one regulated unit then, ☐Does the waste management area encompass all regulated units? ☐Is a waste management area delineated for each regulated unit?	Yes
C. Characterization of Subsurface Geology of Site 1. Soil boring/test pit program:	
a. Were the soil borings/test pits performed under the supervision of a qualified professional? Yes	Yes
b. Did the owner/operator provide documentation for selecting the spacing for borings? Some	Yes
c. Were the borings drilled to the depth of the first confining unit below the uppermost zone of saturation or ten feet into bedrock?	Yes
d. Indicate the method(s) of drilling: ☒Auger (hollow or solid stem) ☒Air rotary ☐Reverse rotary ☐Cable tool ☐Jetting ☐Other (specify):	Yes
e. Were continuous sample cores taken? Some	Yes
f. How were the samples obtained (checked method(s)) ☒Split spoon ☒Shelby tube, or similar ☒Rock coring ☒Ditch sampling ☐Other (explain):	Yes
g. Were the continuous sample cores logged by a qualified professional in geology? Yes	Yes

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
h. Does the field boring log include the following information: ☒Hole name/number ☒Date started and finished ☒Driller's name ☒Hole location (i.e., map and elevation) ☒Drill rig type and bit/auger size ☒Gross petrography (e.g., rock type) of each geologic unit ☐Gross mineralogy of each geologic unit ☐Gross structural interpretation of each geologic unit and structural features (e.g., fractures, gouge material, solution channels, buried streams or valleys, identification of depositional material) ☒Development of soil zones and vertical extent and description of soil type ☒Depth of water bearing unit(s) and vertical extent of each ☒Depth and reason for termination of borehole ☐Depth and location of any contaminant encountered in borehole ☒Sample location/number ☒Percent sample recovery Narrative descriptions of: ☒Geologic observations ☒Drilling observations	Variously
i. Were the following analytical tests performed on the core samples: ☐Mineralogy (e.g., microscopic tests and x-ray diffraction) Petrographic analysis: ☐Degree of crystallinity and cementation of matrix ☐Degree of sorting, size fraction (i.e., sieving), textural variations ☐Rock type(s) ☐Soil type ☐Approximate bulk geochemistry ☐Existence of microstructures that may affect or indicate fluid flow ☐Falling head tests ☐Static head tests ☐Settling measurements ☐Centrifuge tests ☐Column drawings	No

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
D. Verification of Subsurface Geological Data 1. Has the owner/operator used indirect geophysical methods to supplement geological conditions between borehole locations? No	No
2. Do the number of borings and analytical data indicate that the confining layer displays a low enough permeability to impede the migration of contaminants to any stratigraphically lower water-bearing units? Yes	Yes
3. Is the confining layer laterally continuous across the entire site? Yes	Yes
4. Did the owner/operator consider the chemical compatibility of the site-specific waste types and the geologic materials of the confining layer? No	No
5. Did the geologic assessment address or provide means for resolution of any information gaps of geologic data? Yes	Yes
6. Do the laboratory data corroborate the field data for petrography?	NA
7. Do the laboratory data corroborate the field data for mineralogy and subsurface geochemistry?	NA
E. Presentation of Geologic Data 1. Did the owner/operator present geologic cross sections of the site?	Yes
2. Do cross sections: ☒Identify the types and characteristics of the geologic materials present ☒Define the contact zones between different geologic materials ☐Note the zones of high permeability or fracture ☒Give detailed borehole information including: ☒Location of borehole ☒Depth of termination ☒Location of screen (if applicable) ☐Depth of zone(s) of saturation ☐Backfill procedure	Yes
3. Did the owner/operator provide a topographic map which was constructed by a licensed surveyor? Yes	Yes

Comprehensive Groundwater Monitoring Evaluation			Y/N
4.	Does the topographic map provide: ☒Contours at a maximum interval of two feet ☒Locations and illustrations of man-made features (e.g., parking lots, factory buildings, drainage ditches, storm drain, pipelines, etc.) ☒Descriptions of nearby water bodies ☐Descriptions of off-site wells ☒Site boundaries ☐Individual RCRA units ☐Delineation of the waste management area(s) ☐Well and boring locations		Yes (unchecked information provided on separate figures)
5.	Did the owner/operator provide an aerial photograph depicting the site and adjacent off-site features? Yes		Yes
6.	Does the photograph clearly show surface water bodies, adjacent municipalities, and residences and are these clearly labeled? Yes		Yes
F. 1.	**Identification of Groundwater Flow Paths** Groundwater flow direction		
	a.	Was the well casing height measured by a licensed surveyor to the nearest 0.01 feet? Yes	Yes
	b.	Were the well water level measurements taken within a 24 hour period? Yes	Yes
	c.	Were the well water level measurements taken to the nearest 0.01 feet? Yes	Yes
	d.	Were the well water levels allowed to stabilize after construction and development for a minimum of 24 hours prior to measurements? Yes	Yes
	e.	Was the water level information obtained from (check appropriate one): ☐Multiple piezometers placed in single borehole ☒Vertically nested piezometers in closely spaced separate boreholes (only for Somerset Railroad wells) ☒Monitoring wells	Yes
	f.	Did the owner/operator provide construction details for the piezometers?	Yes

Comprehensive Groundwater Monitoring Evaluation		**Y/N**
g.	How were the static water levels measured (check method(s)). ☒Electric water sounder ☐Wetted tape ☐Air line ☐Other (explain):	Yes
h.	Was the well water level measured in wells with equivalent screened intervals at an equivalent depth below the saturated zone? Yes	Yes
i.	Has the owner/operator provided a site water table (potentiometric) contour map? Yes	Yes
	• Do the potentiometric contours appear logical and accurate based on topography and presented data? Yes	Yes
	• Are groundwater flow lines indicated? Yes	Yes
	• Are static water levels shown? Yes	Yes
	• Can hydraulic gradients be estimated? Yes	Yes
j.	Did the owner/operator develop hydrologic cross sections of the vertical flow component across the site using measurements from all wells? No	No
k.	Do the owner/operator's flow nets include: ☐Piezometer locations ☐Depth of screening ☐Width of screening ☐Measurements of water levels from all wells and piezometers	NA

Comprehensive Groundwater Monitoring Evaluation			**Y/N**
2.	Seasonal and temporal fluctuations in groundwater:		
	a.	Do fluctuations in static water levels occur? If yes, are the fluctuations caused by any of the following: ☐Off-site well pumping ☐Tidal processes or other intermittent natural variations (e.g., river stage, etc.) ☐On-site well pumping ☐Off-site, on-site construction or changing land use patterns ☐Deep well injection ☐Seasonal variations ☐Other (specify):	Not significantly
	b.	Has the owner/operator documented sources and patterns that contribute to or affect the groundwater patterns below the waste management? No	No
	c.	Do water level fluctuations alter the general groundwater gradients and flow directions? NO	No
	d.	Based on water level data, do any head differentials occur that may indicate a vertical flow component in the saturated zone? Not evaluated extensively on site	Unknown
	e.	Did the owner/operator implement means for gauging long-term effects on water movement that may result from on-site or off-site construction or changes in land-use patterns? No	No
3.	Hydraulic conductivity:		
	a.	How were hydraulic conductivities of the subsurface materials determined? ☒Single-well tests (packer & slug tests) ☐Multiple-well tests (pump tests) ☐Other (specify):	Yes
	b.	If single-well tests were conducted, was it done by: ☒Adding or removing a known volume of water ☒Pressurizing well casing	Both
	c.	If single well tests were conducted in a highly permeable formation, were pressure transducers and high-speed recording equipment used to record the rapidly changing water levels? No	No

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
d. Since single well tests only measure hydraulic conductivity in a limited area, were enough tests run to ensure a representative measure of conductivity in each hydrogeologic unit? Yes	Yes
e. Is the owner/operator's slug test data (if applicable) consistent with existing geologic information (e.g., boring logs)? Yes	Yes
f. Were other hydraulic conductivity properties determined? If yes, provide any of the following data, if available: ☐ Transmissivity ☐ Storage coefficient ☐ Leakage ☒ Permeability ☐ Porosity ☐ Specific capacity ☒ Other (specify): Groundwater flux calculations	Yes
4. Identification of the uppermost aquifer: Overburden/Grimsby/Power Glen	
a. Has the extent of the uppermost saturated zone (aquifer) in the facility area been defined? If yes,	Yes
• Are soil boring/test pit logs included? Yes	Yes
• Are geologic cross-sections included? Yes	Yes
b. Is there evidence of confining (competent, unfractured, continuous, and low permeability) layers beneath the site? Yes, Queenston Fm. If yes, • How was continuity demonstrated? Borings/literature	Yes
c. What is hydraulic conductivity of the confining unit (if present)? Variable - 10^{-4} to < 10^{-7} cm/sec How was it determined? Packer testing/literature	Variable
d. Does potential for other hydraulic communication exist (e.g., lateral discontinuity between geologic units, facies changes, fracture zones, cross cutting structures, or chemical corrosion/alteration of geologic units by leachage? If yes or no, what is the rationale? Well sandpacks	Possible

Comprehensive Groundwater Monitoring Evaluation	Y/N
G. Office Evaluation of the Facility's Groundwater Monitoring System Monitoring Well Design and Construction: These questions should be answered for each different well design present at the facility. 1. Drilling Methods:	
a. What drilling methods were used for the wells? ☒Hollow-stem auger ☐Solid-stem auger ☐Mud rotary ☒Air rotary ☐Reverse rotary ☐Cable tool ☐Jetting ☐Air drill w/ casing hammer ☐Other (specify):	Yes
b. Were any cutting fluids (including water) or additives used during drilling? If yes, specify: • Type of drilling fluid: water • Source of water used: unknown • Foam • Polymers • Other	Yes
c. Was the cutting fluid, or additive, identified? Water	Yes
d. Was the drilling equipment steam-cleaned prior to drilling the well? • Other methods	Unknown
e. Was compressed air used during drilling? If yes, • Was the air filtered to remove oil? unknown	Yes
f. Did the owner/operator document procedure for establishing the potentiometric surface? If yes, • How was the location established?	No

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
g. Formation samples	
• Were formation samples collected initially during drilling?	Yes
• Were any cores taken continuous?	Yes
• If not, at what interval were samples taken? Variable	Also variable
• How were the samples obtained? ☒ Split spoon ☒ Shelby tube ☒ Core drill ☐ Other (specify):	Various methods
• Identify if any physical and/or chemical tests were performed on the formation samples (specify): various, data provided in numerous historical reports	Yes
2. Monitoring Well Construction Materials (see attached logs)	
a. Identify construction materials (by number) and diameters (ID/OD) Material / Diameter • Primary Casing: PVC 2″ • Secondary or outside casing (double construction) • Screen: PVC 2″	See logs
b. How are the sections of casing and screen connected? ☐ Pipe sections threaded ☐ Couplings (friction) with adhesive or solvent ☐ Couplings (friction) with retainer screws ☐ Other (specify):	Threaded
c. Were the materials steam-cleaned prior to installation? • If no, how were the materials cleaned? Unknown	?
3. Well Intake Design and Well Development	
a. Were well intake screens installed?	Yes
• What are the length of the screens for the wells? 5′ & 10′	5′ & 10′

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
• Is the screen manufactured? Yes, machine slotted	Yes
b. Was a filter pack installed?	Yes
• What kind of filter pack was employed? Silica sand	Yes
• Is the filter pack compatible with formation materials?	Yes
• How was the filter pack installed? Poured in HSA	Yes
• What are the dimensions of the filter pack? Variable	See logs
• Has a turbidity measurement of the well water ever been made? Yes, during development and sampling	Yes
• Have the filter pack and screen been designed for the in situ materials? Yes	Yes
c. Well development	
• Were the wells developed? Yes	Yes
• What technique was used for well development? ☐Surge block ☒Bailer (in 1983, 3 well volumes for 3 days) ☐Air surging ☐Water pumping ☐Other (specify):	Bailer well development
4. Annular Space Seals	
a. What is the annular space in the saturated zone directly above the filter pack filled with: ☒Sodium bentonite (generally granular; chips used for VDM-9R) ☐Cement (specify neat or concrete) ☐Other (specify):	Yes

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
b. Was the seal installed by: ☐Dropping material down the hole and tamping ☒Dropping material down the inside of hollow-stem auger ☐Tremie pipe method ☐Other (specify):	Poured down HSA
c. Was a different seal used in the unsaturated zone? If yes,	Yes
• Was this seal made with ☐Sodium bentonite ☒Cement-bentonite grout (above bentonite seal to surface) ☐Other (specify):	Yes
• Was this seal installed by ☐Dropping material down the hole and tamping ☒Dropping material down the inside of hollow stem auger ☐Other (specify):	Poured down HSA
d. Is the upper portion of the borehole sealed with a concrete cap to prevent infiltration from the surface? Yes	Yes
e. Is the well fitted with an above-ground protective device and bumper guards? Steel stick-up protective casings, but no bumper guards	Yes
f. Has the protective cover been installed with locks to prevent tampering? Yes	Yes
H. Evaluation of the Facility's Detection Monitoring Program 1. Placement of Downgradient Detection Monitoring Wells:	
a. Are the groundwater monitoring wells or clusters located immediately adjacent to the waste management area? Yes	Yes
b. How far apart are the detection monitoring wells? ~150′	~150′

Comprehensive Groundwater Monitoring Evaluation			Y/N
	c.	Does the owner/operator provide a rationale for the location of each monitoring well or cluster? Yes	Yes
	d.	Does the owner/operator identify the well screen lengths of each monitoring well or clusters? Yes	Yes
	e.	Does the owner/operator provide an explanation for the well screen lengths of each monitoring well or cluster? Yes	Yes
	f.	Do the actual locations of monitoring wells or clusters correspond to those identified by the owner/operator? Yes	Yes
2.	Placement of Upgradient Monitoring Wells:		
	a.	Has the owner/operator documented the location of each upgradient monitoring well or cluster? Yes	Yes
	b.	Does the owner/operator provide an explanation for the location(s) of the upgradient monitoring well(s)? Yes	Yes
	c.	What length screen has the owner/operator employed in the background monitoring well(s)? 10′	10′
	d.	Does the owner/operator provide an explanation for the screen length(s) chosen? Installed by others	No
	e.	Does the actual location of each background monitoring well or cluster correspond to that identified by the owner/operator? Yes	Yes
I.	**Office Evaluation of the Facility's Assessment Monitoring Program**		
1.	Does the assessment plan specify: Assessment activities for the site were performed in the 1980s and 1990s; Landfill closure in 1988; Post-closure monitoring under Part 373 RCRA Permit (until 2013) and Order on Consent (since 2014) to present		
	a.	The number, location, and depth of wells? Yes	Yes
	b.	The rationale for their placement and identify the basis that will be used to select subsequent sampling locations and depths in later assessment phases? Yes	Yes

Comprehensive Groundwater Monitoring Evaluation		**Y/N**
2.	Does the list of monitoring parameters include all hazardous waste constituents from the facility? No; carbon tetrachloride, cis-1,2-DCE, PFAS compounds, and 1,4-dioxane need to be added to SMP analyte list	No
	a. Does the water quality parameter list include other important indicators not classified as hazardous waste constituents? Some	Yes
	b. Does the owner/operator provide documentation for the listed wastes which are not included? NA	NA
3.	Does the owner/operator's assessment plan specify the procedures to be used to determine the rate of constituent migration in the groundwater?	NA
4.	Did the owner/operator specified a schedule of implementation in the assessment plan? Yes	Yes
5.	Were the assessment monitoring objectives been clearly defined in the assessment plan? Yes	Yes
	a. Did the plan include analysis and/or re-evaluation to determine if significant contamination has occurred in any of the detection monitoring wells? Yes	Yes
	b. Did the plan provide for a comprehensive program of investigation to fully characterize the rate and extent of contaminant migration from the facility? Yes	Yes
	c. Did the plan call for determining the concentrations of hazardous wastes and hazardous waste constituents in the ground water? Yes	Yes
	d. Did the plan employ a quarterly monitoring program? Yes; over time, the sampling frequency was reduced to semiannual monitoring, and then to annual monitoring since 2015	Yes (initially)
6.	Did the assessment plan identify the investigatory methods that were used in the assessment phase? Yes	Yes
	a. Is the role of each method in the evaluation fully described? Yes	Yes
	b. Does the plan provide sufficient descriptions of the direct methods to be used? Yes	Yes

Comprehensive Groundwater Monitoring Evaluation			Y/N
	c.	Did the plan provide sufficient descriptions of the indirect methods to be used? None used	NA
	d.	Will the method contribute to the further characterization of the contaminant movement?	NA
7.	Were the investigatory techniques utilized in the assessment program based on direct methods? Yes		Yes
	a.	Does the assessment approach incorporate indirect methods to further support direct methods? No	No
	b.	Did the planned methods called for in the assessment approach ultimately meet performance standards for assessment monitoring? Yes	Yes
	c.	Were the procedures well defined? Yes	Yes
	d.	Did the approach provide for monitoring wells similar in design and construction as the detection monitoring wells? Yes	Yes
	e.	Did the approach employ taking samples during drilling or collecting core samples for further analysis? Yes	Yes
8.	Are the indirect methods to be used based on reliable and accepted geophysical techniques?		NA
	a.	Are they capable of detecting subsurface changes resulting from contaminant migration at the site?	NA
	b.	Is the measurement at an appropriate level of sensitivity to detect groundwater quality changes at the site?	NA
	c.	Is the method appropriate considering the nature of the subsurface materials?	NA
	d.	Does the approach consider the limitations of these methods?	NA
	e.	Will the extent of contamination and constituent concentration be based on direct methods and sound engineering judgment? (Using indirect methods to further substantiate the findings.) Sampling	Yes

Comprehensive Groundwater Monitoring Evaluation			**Y/N**
9.	Did the assessment approach incorporate any mathematical modeling to predict contaminant movement? Post-closure modeling performed		No
	a.	Were site specific measurements utilized to accurately portray the subsurface?	Some
	b.	Was the derived data reliable?	Yes
	c.	Were the assumptions identified?	Yes
	d.	Have the physical and chemical properties of the site-specific wastes and hazardous waste constituents been identified? Yes	Yes
J.	**Conclusions** Subsurface geology		
1.	Subsurface geology		
	a.	Has sufficient data been collected to adequately define petrography and petrographic variation? Yes	Yes
	b.	Has the subsurface geochemistry been adequately defined? Yes	Yes
	c.	Was the boring/coring program adequate to define subsurface geologic variation? Yes	Yes
	d.	Was the owner/operator's narrative description complete and accurate in its interpretation of the data? Yes	Yes
	e.	Does the geologic assessment address or provide means to resolve any information gaps? Yes	Yes
2.	Groundwater flow paths		
	a.	Did the owner/operator adequately establish the horizontal and vertical components of groundwater flow? Yes	Yes
	b.	Were appropriate methods used to establish groundwater flow paths? Yes	Yes
	c.	Did the owner/operator provide accurate documentation? Yes	Yes
	d.	Are the potentiometric surface measurements valid? Yes	Yes

Comprehensive Groundwater Monitoring Evaluation			**Y/N**
	e.	Did the owner/operator adequately consider the seasonal and temporal effects on the groundwater? During initial quarterly sampling	Yes
	f.	Were sufficient hydraulic conductivity tests performed to document lateral and vertical variation in hydraulic conductivity in the entire hydrogeologic subsurface below the site? Yes	Yes
3.	Uppermost Aquifer		
	a.	Did the owner/operator adequately define the uppermost aquifer?	Yes
4.	Monitoring Well Construction and Design		
	a.	Do the design and construction of the owner/operator's groundwater monitoring wells permit depth discrete groundwater samples to be taken? Yes	Yes
	b.	Are the samples representative of groundwater quality? Yes	Yes
	c.	Are the groundwater monitoring wells structurally stable? Yes	Yes
	d.	Does the groundwater monitoring well's design and construction permit an accurate assessment of aquifer characteristics? Yes	Yes
5.	Detection Monitoring		
	a.	Downgradient Wells • Do the location, and screen lengths of the groundwater monitoring wells or clusters in the detection monitoring system allow the immediate detection of a release of hazardous waste or constituents from the hazardous waste management area to the uppermost aquifer? Yes	Yes
	b.	Upgradient Wells • Do the locations and screen lengths of the upgradient (background) groundwater monitoring wells ensure the capability of collecting groundwater samples representative of upgradient (background) groundwater quality including any ambient heterogenous chemical characteristics? Yes	Yes

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
6. Assessment Monitoring	
a. Has the owner/operator adequately characterized site hydrogeology to determine contaminant migration? Yes	Yes
b. Is the detection monitoring system adequately designed and constructed to immediately detect any contaminant release? Yes	Yes
c. Are the procedures used to make a first determination of contamination adequate? NA	NA
d. Is the assessment plan adequate to detect, characterize, and track contaminant migration? Yes	Yes
e. Will the assessment monitoring wells, given site hydrogeologic conditions, define the extent and concentration of contamination in the horizontal and vertical planes? Yes	Yes
f. Are the assessment monitoring wells adequately designed and constructed? Yes	Yes
g. Are the sampling and analysis procedures adequate to provide true measures of contamination? Yes	Yes
h. Do the procedures used for evaluation of assessment monitoring data result in determinations of the rate of migration, extent of migration, and hazardous constituent composition of the contaminant plume? Yes	Yes
i. Are the data collected at sufficient frequency and duration to adequately determine the rate of migration? Yes	Yes
j. Is the schedule of implementation adequate? Yes	Yes
k. Is the owner/operator's assessment monitoring plan adequate? The SMP should be updated once groundwater standards are promulgated for PFAS and 1,4-dioxane; also add carbon tetrachloride & cis-1,2-DCE to analyte list	Needs updating
l. If the owner/operator had to implement his assessment monitoring plan, was it implemented satisfactorily? NA	NA

Comprehensive Groundwater Monitoring Evaluation	Y/N
II. Field Evaluation (inspection performed on August 5 and 6, 2019 during annual groundwater/surface water sampling event) **A. Groundwater Monitoring System** 1. Are the numbers, depths, and locations of monitoring wells in agreement with those reported in the facility's monitoring plan (SMP, 2015)?	Yes
B. Monitoring Well Construction 1. Identify construction material and diameter a. Primary casing: 2" PVC b. Secondary or outside casing: see attached well construction logs	See Logs & Photos
2. Are the upper portions of the boreholes sealed with concrete to prevent infiltration from the surface?	Yes
3. Are the wells fitted with above-ground protective device?	Yes
4. Are the protective covers fitted with locks to prevent tampering? If a facility utilizes more than a single well design, answer the above questions for each well design? The hinge on the top cap of the protective casing at well D-55 (rusted away) needs repair or replacement.	Yes
III. Review of Sample Collection Procedures **A. Measurement of Well Depths /Elevation** 1. Are measurements of both depth to standing water and depth to the bottom of the well made?	Yes
2. Are measurements taken to the 0.01 feet?	Yes
3. What device is used? Solinst Model 101 electronic water level indicator	Yes
4. Is there a reference point established by a licensed surveyor? Notches on well riser	Yes

	Comprehensive Groundwater Monitoring Evaluation	**Y/N**
5.	Is the measuring equipment properly cleaned between well locations to prevent cross contamination?	Yes
B.	**Detection of Immiscible Layers**	
1.	Are procedures used which will detect light phase immiscible layers? No NAPLs have ever been detected at the site historically nor was disposal of NAPLS suspected or documented at the site	No
2.	Are procedures used which will detect heavy phase immiscible layers?	NA
C.	**Sampling of Immiscible Layers**	
1.	Are the immiscible layers sampled separately prior to well evacuation?	NA
2.	Do the procedures used minimize mixing with water soluble phases?	NA
D.	**Well Evacuation**	
1.	Are low yielding wells evacuated to dryness?	Yes
2.	Are high-yielding wells evacuated so that at least three casing volumes are removed?	Yes
3.	What device is used to evacuate the wells? Dedicated HDPE bailers	Bailers
4.	If any problems are encountered (e.g., equipment malfunction) are they noted in a field logbook? On field forms	Yes
E.	**Sample Withdrawal**	
1.	For low yielding wells, are samples for volatiles, pH, ~~and oxidation/reduction potential~~ drawn first after the well recovers? ORP is not on the parameter list	Yes
2.	Are samples withdrawn with either fluorocarbon/resin or stainless steel (316, 304 or 2205) sampling devices? Dedicated HDPE bailers (fluorocarbon/resin bailers are no longer acceptable)	No
3.	Are sampling devices either bottom-valve bailers or positive gas displacement bladder pumps?	Yes

	Comprehensive Groundwater Monitoring Evaluation	Y/N
4.	If bailers are used, is fluorocarbon/resin coated wire, single strand stainless steel wire, or monofilament used to raise and lower the bailer? Masons twine is used (fluorocarbon/resin coated wire is no longer acceptable)	No
5.	If bladder pumps are used, are they operated in continuous manner to prevent aeration of the sample?	NA
6.	If bailers are used, are they lowered slowly to prevent degassing of the water?	Yes
7.	If bailers are used, are the contents transferred to the sample container in a way that minimizes agitation and aeration?	Yes
8.	Is care taken to avoid placing clean sampling equipment on the ground or other contaminated surfaces prior to insertion into the well?	Yes
9.	If dedicated sampling equipment is not used, is equipment disassembled and thoroughly cleaned between samples? Dedicated sampling equipment	NA
10.	If samples are for inorganic analysis, does the cleaning procedure include the following sequential steps: Dedicated sampling equipment ☐Dilute acid rinse (HNO_3 or HC1)	NA
11.	If samples are for organic analysis, does the cleaning procedure include the following sequential steps: Dedicated sampling equipment ☐Nonphosphate detergent wash ☐Tap water rinse ☐Distilled/deionized water rinse ☐Acetone rinse ☐Pesticide-grade hexane rinse	NA
12.	Is sampling equipment thoroughly dry before use?	NA
13.	Are equipment blanks taken to ensure that sample cross-contamination has not occurred?	No
14.	If volatile samples are taken with a positive gas displacement bladder pump, are pumping rates below 100 ml/min?	NA

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
F. In-situ or Field Analyses 1. Are the following labile (chemically unstable) parameters determined in the field: pH is the only required field parameter ☒pH ☐Temperature ☐Specific conductivity ☐Redox potential ☐Chlorine ☐Dissolved oxygen ☐Turbidity ☐Other (specify):	Yes
2. For in-situ determinations, are they made after well evacuation and sample removal?	Yes
3. If sample is withdrawn from the well, is parameter measured from a split portion?	Yes
4. Is monitoring equipment calibrated according to manufacturers' specifications and consistent with SW-846?	Yes
5. Are the date, procedure, and maintenance for equipment calibration documented in the field logbook? On field data sheets	Yes
IV. Review of Sample Preservation and Handling Procedures **A. Sample Containers** 1. Are samples transferred from the sampling device directly to their compatible containers?	Yes
2. Are sample containers for metals (inorganics) analyses polyethylene with polypropylene caps?	Yes
3. Are sample containers for organics analysis glass bottles with fluorocarbon resin lined caps? For VOCs (not for PFAS analyses)	Yes
4. If glass bottles are used for metals samples are the caps fluorocarbon resin-lined?	NA

Comprehensive Groundwater Monitoring Evaluation		**Y/N**
5.	Are the sample containers for metal analyses cleaned using these sequential steps: Sample containers provided by the laboratory are pre-cleaned and pre-preserved ☐Nonphosphate detergent wash ☐1:1 nitric acid rinse ☐Tap water rinse ☐1:1 hydrochloric acid rinse ☐Tap water rinse ☐Distilled/deionized water rinse	NA
6.	Are the sample containers for organic analyses cleaned using these sequential steps: Sample containers provided by the laboratory are pre-cleaned and pre-preserved ☐Nonphosphate detergent/hot water wash ☐Tap water rinse ☐Distilled/deionized water rinse ☐Acetone rinse ☐Pesticide-grade hexane rinse	NA
7.	Are trip blanks used for each sample container type to verify cleanliness? Trip Blanks in cooler (VOC analysis)	Yes
B.	**Sample Preservation Procedures**	
1.	Are samples for the following analyses cooled to 4°C: Yes ☒VOCs (site-specific list) ☐TOX ☒Chloride ☐Phenols ☐Sulfate ☐Nitrate ☐Coliform bacteria ☐Cyanide ☐Oil and grease ☐Hazardous constituents (261, Appendix VIII)	Yes

Comprehensive Groundwater Monitoring Evaluation		Y/N
2.	Are samples for the following analyses field acidified to pH<2 with HNO_3: ☒Iron ☒Chromium ☒Copper ☒Zinc ☐Dissolved metals ☐Fluoride ☐Endrin ☐Lindane ☐Methoxychlor ☐Toxaphene ☐2,4-D ☐2,4,5-TP Silvex ☐Radium ☐Gross alpha ☐Gross beta	Yes
3.	Are samples for the following analyses field acidified to pH<2 with H_2S0_4: ☐Phenols ☐Oil and grease	NA
4.	Is the sample for VOC analyses field acidified to pH <2 with HCl? Yes	Yes
5.	Is the sample for TOX analysis preserved with 1 ml of 1.1 M sodium sulfite?	NA
6.	Is the sample for cyanide analysis preserved with NaOH to pH >12?	NA
C. 1.	**Special Handling Considerations** Are organic samples handled without filtering?	Yes
2.	Are samples for volatile organics transferred to the appropriate vials to eliminate headspace over the sample?	Yes
3.	Are samples for metal analysis split into two portions? No, only unfiltered metals analyses are performed	No
4.	Is the sample for dissolved metals filtered through a 0.45 micron filter? No filtered samples	NA
5.	Is the second portion not filtered and analyzed for total metals?	NA

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
6. Is one equipment blank prepared each day of groundwater sampling? Not required by SMP	No
V. Review of Chain-of-Custody Procedures **A. Sample Labels** 1. Are sample labels used?	Yes
2. Do they provide the following information: ☒Sample identification number ☒Name of collector ☒Date and time of collection ☒Place of collection ☒Parameter(s) requested and preservatives used	Yes
3. Do they remain legible even if wet?	Yes
B. Sample Seals 1. Are sample seals placed on those containers to ensure samples are not altered? Samples are transported directly to the lab (Alpha Analytical) by the sampling crew (from Alpha Analytical)	No
C. Field Logbook 1. Is a field logbook maintained? Field forms are used	Yes

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
2. Does it document the following: ☐Purpose of sampling (e.g., detection or assessment) - NA ☒Location of well(s) ☒Total depth of each well ☒Static water level depth and measurement technique ☐Presence of immiscible layers and detection method - NA ☐Collection method for immiscible layers and sample identification numbers - NA ☐Well evacuation procedures ☐Sample withdrawal procedure ☒Date and time of collection ☐Well sampling sequence ☐Types of sample containers and sample identification number(s) ☐Preservative(s) used ☒Parameters requested ☒Field analysis data and method(s) ☐Sample distribution and transporter Field observations ☒Unusual well recharge rates ☐Equipment malfunction(s) ☐Possible sample contamination ☒Sampling rate	Some
D. Chain-of-Custody Record 1. Is a chain-of-custody record included with samples? Yes	Yes
2. Does it document the following: ☒Sample number ☒Signature of collector ☒Date and time of collection ☒Sample type ☒Station location ☒Number of containers ☒Parameters requested ☒Signatures of persons involved in chain-of-custody ☒Inclusive dates of custody	Yes

Comprehensive Groundwater Monitoring Evaluation	**Y/N**
E. Sample Analysis Request Sheet 1. Does a sample analysis request sheet accompany samples? No, info is on COC	No
2. Does the request sheet document the following: No, info is on COC ☐Name of person receiving the sample ☐Date of sample receipt ☐Duplicates ☐Analysis to be performed	NA
VI. Review of Quality Assurance/Quality Control A. Is the validity and reliability of the laboratory and field generated data ensured by a QA/QC program? Yes, Appendix F in SMP (QA/QC Plan)	Yes
B. Does the QA/QC program include: 1. Documentation of any deviation from approved procedures? Yes	Yes
2. Documentation of analytical results for: ☒Blanks ☒Standards ☒Duplicates ☒Spiked samples ☒Detectable limits for each parameter being analyzed	Yes
C. Are approved statistical methods used? Yes	Yes
D. Are QC samples used to correct data? Yes	Yes
E. Are all data critically examined to ensure it has been properly calculated and reported? Yes (mainly by lab)	Yes
VII. Surficial Well Inspection and Field Observation A. Are the wells adequately maintained?	Yes
B. Are the monitoring wells protected and secure?	Yes
C. Do the wells have surveyed casing elevations?	Yes

	Comprehensive Groundwater Monitoring Evaluation	Y/N
D.	Are the groundwater samples turbid?	Some
E.	Have all physical characteristics of the site been noted in the inspector's field notes (i.e., surface waters, topography, surface features)?	Yes
F.	Has a site sketch been prepared by the field inspector with scale, north arrow, locations of buildings, locations) of regulated units, locations of monitoring wells, and a rough depiction of the site drainage pattern? No, this information is already available on site maps, figures, and aerial photos	No
VIII.	**Conclusions**	
A.	Is the facility currently operating under the correct monitoring program according to the statistical analyses performed by the current operator? Yes	Yes
B.	Does the groundwater monitoring system, as designed and operated, allow for detection or assessment of any possible groundwater contamination caused by the facility? Yes	Yes
C.	Do the sampling and analysis procedures permit the owner/operator to detect and, where possible, assess the nature and extent of a release of hazardous constituents to ground water from the monitored hazardous waste management facility? Yes, but some modifications needed to SMP (as noted in previous comments above)	Yes