GEOLOGIC CONDITIONS

AND WATER QUALITY AT

THE DUNKIRK LANDFILL

PEC NO. 200R

Prepared For:

Department of Public Works
Chautauqua County, New York

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SEPTEMBER, 1980

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LICENSED PROFESSIONAL ENGINEER

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1.0 INTRODUCTION

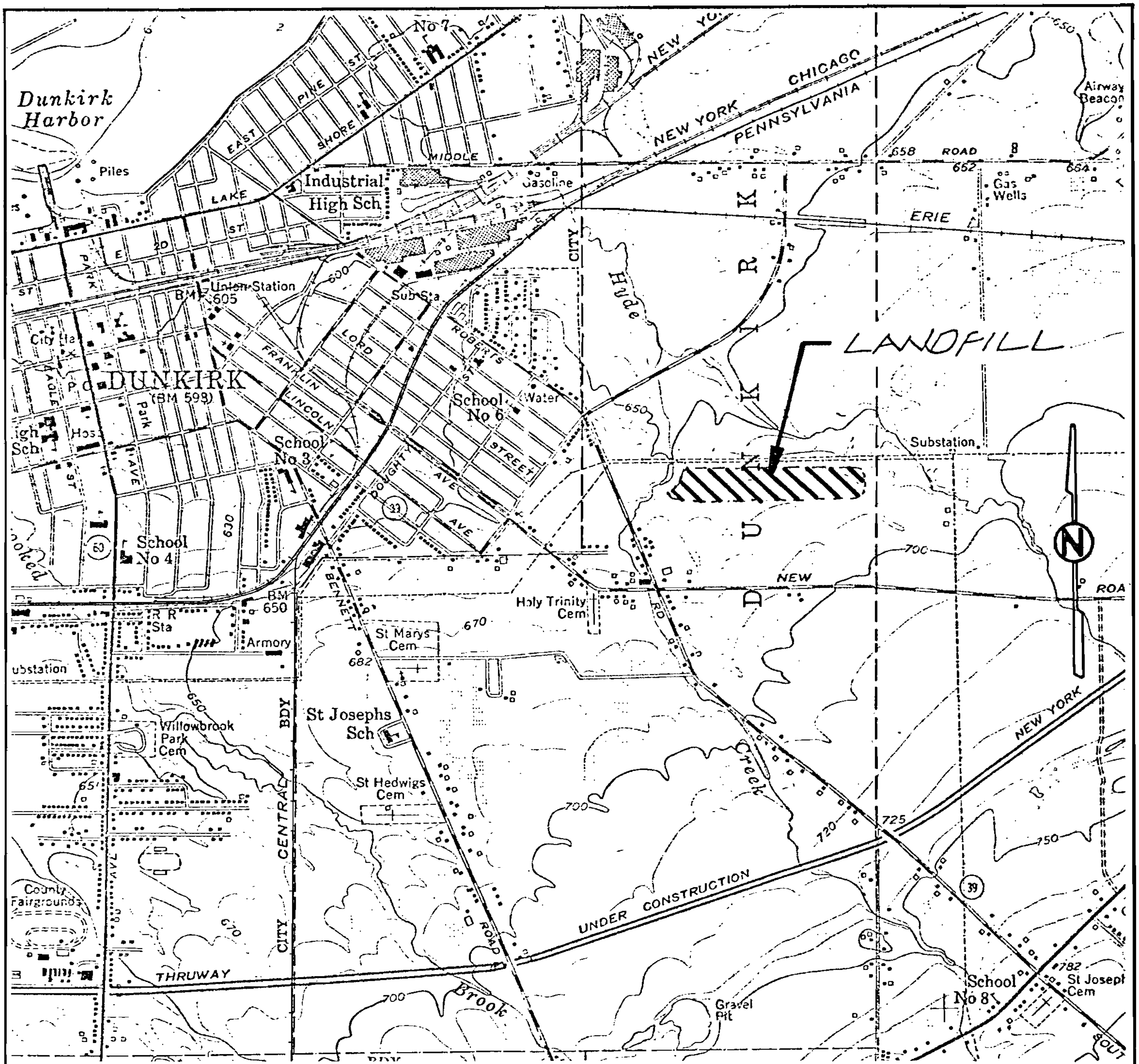
This report and the accompanying drawings were prepared at the request of Mr. William Parment, Director of Chautauqua County Department of Public Works and in response to requirements of the New York State Department of Environmental Conservation.

Presented here is information on geologic conditions and water quality as determined from investigations conducted at the Dunkirk landfill to determine the interaction between the landfill and surrounding environment. The landfill is no longer in operation and final closure measures are almost completed. Details on closure can be found in Site Closure Plan for the Dunkirk Sanitary Landfill (Penn Environmental Consultants, Inc., February, 1980) which was previously submitted to the New York State Department of Environmental Conservation (NYSDEC).

2.0 SITE DESCRIPTION

The landfill is located on an approximately 27 acre tract of land within the Town of Dunkirk. The land is owned by the City of Dunkirk, and leased on a yearly basis by the county. See Figure 2-1 for the location of the site on the U.S.G.S. topographic map, Dunkirk, New York. The center of the site, as measured from the northeast corner of the Dunkirk quadrangle, is 4 inches to the south and 6.7 inches to the west.

Access to the area is by a haul route intersecting South Roberts Road, 1,800 feet north of the intersection of South Roberts and New Roads.



NOTE: REPRODUCED FROM U.S.G.S. 7.5 MINUTE SERIES MAP. DUNKIRK, NEW YORK QUADRANGLE.

0 1/2 1 MILE

(SCALE 1" = 2000')

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DRAWN	DATE	SCALE
BC	8-78	SHOWN

FIG. 2-1

CLOSURE PLAN
DUNKIRK SANITARY LANDFILL
CHAUTAUQUA COUNTY, N.Y.
SITE LOCATION MAP

562 0-13 :UNI

3.0 PHYSIOGRAPHIC SETTING

The Dunkirk site is part of the Eastern Lake section of the Central Lowland Province which extends across northern Chautauqua County as a narrow, low lying plain which borders the south shore of Lake Erie.

The underlying bedrock structure of Chautauqua County consists of Devonian sedimentary strata which have a gentle south to southeast regional dip. In the Eastern Lake section of the Central Lowland Province, however, glacial excavation of the Erie Basin has resulted in a northwest-dipping erosional bedrock surface.

4.0 SURFACE DRAINAGE

The Dunkirk landfill is drained by Hyde Creek which is located along the western side of the site and flows north into Lake Erie. Runoff, from both the landfill and upland areas to the south, is collected by two (2) ditches which run east to west along and parallel to the sides of the landfill. The southern ditch is located at the toe of the landfill and directs flow westward into Hyde Creek. The northern collection ditch is separated from the landfill by 50 to 100 feet of swamp and marsh. Runoff from the northern slopes accumulate in this low lying swamp area and eventually flow into the collection ditch which channels drainage into Hyde Creek.

5.0 SUBSURFACE INVESTIGATION

A subsurface investigation of the Dunkirk landfill was conducted by PEC personnel, utilizing the services of Empire Soils Investigations, Inc.(ESI), Buffalo, New York, in July, 1979. The purpose of the investigation was to establish bedrock depth and obtain information on soils and groundwater conditions. A total of four (4) test borings, designated as TB1, 2, 3, and 4, were established around the periphery of the landfill (for locations, see Drawing 200R-S-03) using a 6-inch diameter, hollow stem soil auger. All four (4) borings progressed to bedrock. Split-spoon samples were taken at selected intervals. The recovered samples were split for further laboratory analyses (i.e. moisture and calcium carbonate content) and office inspection by PEC and ESI. Groundwater monitoring wells were placed in each of the four (4) borings immediately after drilling. The depth and monitoring interval of each are shown on Drawings 200R-R-04 and 200R-R-05. Monitoring wells, designated DLG, correspond to the test boring in which they were installed. Boring logs, based on the split spoon samples also appear in Drawings 200R-R-04 and 200R-R-05.

6.0 BEDROCK GEOLOGY

The Dunkirk area is underlain by shales and siltstones of the Upper Devonian Chautauquan Series. Strata underlying the site have been mapped (Tesmer, 1963) and assigned to the Canadaway Formation of the Arkwright Group. Glacial erosion, which formed the Erie Basin, removed the upper, coarser-grained members of this formation in the Dunkirk area. The resulting erosional bedrock surface at the site consists of the finer-grained shales and siltstones of the lower Canadaway Formation including, in ascending order, the Dunkirk and South Wales Members.

The Dunkirk Member consists of 40 feet of medium gray to grayish-black shale. These shales are prominent in the cliffs on the shore of Lake Erie at Point Gratiot, approximately 1 mile to the west of the city of Dunkirk.

The overlying South Wales Member varies between 60 and 80 feet in thickness. The unit consists of medium light gray to medium dark gray shale with some interbedded dark gray shale and light gray siltstone. The Gowanda Shale, which generally overlies the South Wales Member is, based on the test borings at the site, absent in the area of the landfill.

Samples of bedrock recovered from TB1 are thinly bedded, medium dark gray shale as were bedrock fragments recovered from TB2. The dark shale of TB2 is interbedded with light gray shale and claystone. Fragments of similar composition appear in the samples recovered just above bedrock refusal in TB3 and TB4. These lithologies are characteristic of both the South Wales and Dunkirk Shale Members, either of which could underlie the site.

Because bedrock does not outcrop in the immediate vicinity of the landfill, site specific information on jointing could not be obtained. However, based on field observations of the Dunkirk, South Wales, and Gowanda Shales along the lake shore, joints appear vertical or nearly vertical, with an average spacing of 2 to 4 feet. The majority of joints are closed. Those open in outcrop appear to close rapidly with depth.

A determination of the attitude of bedrock surface underlying the unconsolidated deposits was made based on test boring information and extensive use of available literature. Bedrock elevations from test borings 1, 3, and 4 indicate that the erosional bedrock surface probably slopes gently (approximate 1 to 2 degrees) to the northwest (it should be noted that bedrock depths for borings 3 and 4 are based on sampler refusal, samples of bedrock were not recovered). Generally, this data agrees with regional trends for the Lake Erie Plain.

7.0 SOIL CHARACTERISTICS

During July, 1979, four (4) test borings which encircle the Dunkirk landfill were completed. Split-spoon samples were collected and visually examined by a PEC on-site geologist. Descriptive logs appear on Drawings 200R-R-04 and 200R-R-05. Soils encountered consisted of weathered brown till, dense gray till, and associated drift. Soils encountered during the test boring program are described below in descending order.

Light to dark brown, mottled, weathered silt till occurs from the ground surface to a maximum depth of 17.5 feet. This till is a mixture of clay, silt, and rock fragments with traces of organic material. Texturally, the dominant grain size is silt, with little to no trace clay and few to little fragments.

Generally, the weathered brown till increases in density with increasing depth. Based upon the blow counts during the Standard Penetration Test (SPT) performed during sampling, the cohesive soils within this horizon range from medium to hard. The more dense brown till soils are located near the brown till-gray till interface. Iron oxide staining of the till was observed in TB3.

Dense gray silt till underlies the brown till and directly overlies gray siltstone bedrock. The gray till is predominantly silt with clay, sand, and fragments. In the gray till the clay sized particles range from 5 to 20 percent, sand sized material less than 10 percent, and fragments 10 to 30 percent. The percentage of rock fragments increases as the gray till-bedrock interface is approached.

The density of the gray silt till ranges from medium to hard as determined by the SPT. These cohesive soils generally increase in density with increasing depth.

Gray siltstone bedrock was encountered at a depth of 13.2 feet in TB1 and 20 feet in TB2. Split-spoon refusal at depths of 24.6 feet and 14.7 feet in TB4 and TB3 respectively, was utilized to indicate bedrock.

The brown till-gray till interface was encountered at depths of 7 to 8 feet in TB1 and TB3, whereas this horizon in TB4 was observed at 17.5 feet. Soil sampling in TB2 was not initiated until a depth of 13 feet (which occurs below the interface). The first 15 feet of penetrated material in TB4 consists of man-made fill comprised of cinders, brick, sand, glass, and metal.

Testing for moisture and clacium carbonate content was performed on collected samples from TB1, TB3, and TB4. In all three (3) test borings, both calcium carbonate content and relative soil density (i.e. as determined by SPT) increased with depth. Moisture content, in TB1 and TB3 decreases with depth (see Drawings 200R-R-04 and 200R-R-05). In TB4, moisture content increases with depth to the brown till-gray till interface where a noticeable decrease appears. The higher moisture content is believed to result from water that percolated downward through the highly porous fill material above the brown till. The increased density and impermeable nature of the gray till accounts for the sharp moisture content decrease at the brown till-gray interface. Higher moisture contents in the brown till indicate that infiltrating surface water may accumulate in the soil above the brown till-gray interface.

Split-spoon samples were subjected to acid testing for calcium carbonate content in order to clarify minimum and maximum depths of natural leaching activity. Since the degree of weathering decreases with depth, the degree of leaching of soluble minerals would also be expected to decrease with depth. Calcium carbonate content data, depicted on the test boring logs, reveals the upper portions of the brown till to be devoid of calcium carbonate (see TB1, TB3, and TB4). This zone ranges from ground level to a depth of approximately 5 feet. With increasing depth, the calcium carbonate content increases to maximum values in the upper portions of the gray silt till. These maximum values occur at a minimum depth of 8 feet to a maximum of 22 feet. Calcium carbonate may be undergoing precipitation in this horizon due to the dense, impermeable nature of the gray till which restricts the downward migration of infiltrating groundwater.

Little or no groundwater percolates into the bedrock due to its fine-grained texture, lack of secondary porosity, and the relatively impermeable nature of the overlying gray silt till.

8.0 GROUNDWATER CONDITIONS

The till that mantles bedrock at the Dunkirk site are typically poor sources of groundwater. Groundwater occurs chiefly in two modes: (1) at the contact between weathered brown till and unweathered gray till and (2) in a zone of rock fragments at the gray till-bedrock interface. Bedrock apparently consists of gray siltstone and should be relatively impermeable with regard to groundwater flow and recharge from the overlying till.

Four (4) monitoring wells were installed in TB1, TB2, TB3, and TB4 during July, 1979 (see Drawings 200R-R-04 and 200R-R-05). The monitoring wells were installed by inserting 4-inch inside diameter schedule 40 (PVC) plastic pipe into the borehole. The monitoring intervals consist of 5 foot sections of schedule 40 slotted PVC pipe. The slotted well screens have an effective opening of 0.01 inch. A sand pack was placed in each boring surrounding the screened interval. An impermeable bentonite seal 2 feet thick was placed above the sand pack. The wells were then grouted with a cement slurry to the surface. Vandal resistant steel casing sleeves with locking well caps were installed on all four wells.

No indications of coarse sediment or fragment horizons were recovered from the test borings. Water occurred in TB4 at the artificial fill-brown till interface and rapidly percolated into the borehole.

Groundwater flow direction is controlled by topography and the geology of the unconsolidated sediments. Shallow groundwater probably flows to the northwest toward Hyde Creek. Groundwater at the gray till-bedrock interface probably flows to the northwest along the bedrock surface gradient.

In TB1 and TB4 well screens were placed to allow acquisition of water quality data from water at the brown till-gray till interface. The well screen intervals in TB2 and TB3 monitor the gray till-bedrock interface.

8.1 Monitoring Well Hydraulics

Table 8-1 presents well data collected from the Dunkirk Landfill monitoring wells since their installation in July, 1979. The table expresses static water level and recovery rate data for the four (4) monitoring wells.

Well DLG-01, which monitors the brown till-gray till interface, reveals a highly fluctuating static water level since development. The static level has ranged from a maximum of 7.42 feet to a minimum of 1.34 feet.

TABLE 8-1

Dunkirk Landfill, Chautauqua County, New York

Monitoring Wells -- Recharge Rates

and Water Level Data

Date	Well Number	Static Water Level (ft)*	Recovery Period (hrs)	Percent Recovery
July 9, 1979**	DLG-01	5.5	24	--
	DLG-02	6.5	24	--
	DLG-03	dry	24	--
	DLG-04	13.0	24	--
July 20, 1979	DLG-01	5.9	24	113
	DLG-02	1.83	24	100
	DLG-03	7.6	24	107
	DLG-04	13.3	24	100
August 31, 1979	DLG-01	2.5	--	--
	DLG-02	1.0	--	--
	DLG-03	2.4	--	--
	DLG-04	obstructed	--	--
December 26, 1979	DLG-01	7.42	42	96.6
	DLG-02	0.42	42	98.7
	DLG-03	0.42	42	30.5
	DLG-04	obstructed	--	--
March 7, 1980	DLG-01	1.34	24	85.9
	DLG-02	1.17	24	100.4
	DLG-03	1.59	24	21.9
	DLG-04	obstructed	--	--
June 4, 1980	DLG-01	3.33	24	86.9
	DLG-02	1.67	24	100.4
	DLG-03	2.08	24	15.1
	DLG-04	obstructed	--	--

* Depths recorded in feet below ground level.

** Water levels after installation of monitoring wells.

The gray till-bedrock boundary is monitored by well DLG-02. Static water levels in this well increased initially but have decreased since December, 1979. A minimum static water level of 0.42 feet to a maximum of 6.5 feet have been recorded.

Well DLG-03, with the slotted interval slightly above the gray till-bedrock interface, reveals water levels that eventually and initially increased. Since December, 1979, levels have steadily decreased. The static water levels have ranged from a maximum of 7.6 feet to a minimum of 0.42 feet.

Monitoring well DLG-04 monitors the brown till-gray till contact. The water level (approximately 13 feet) in this well was in a state of stabilization when the well became obstructed between July and August, 1979. The obstruction may be vandal related. The well is no longer functional.

Highly erratic water levels from DLG-01 are probably directly related to the amount of precipitation occurring between sampling periods. Periods of greater precipitation will allow greater quantities of water to percolate into the soils and become available as recharge.

Wells DLG-02 and DLG-03 reveal similar water level patterns. The water levels in these wells increased to

December, 1979, and have steadily declined since. These wells monitor the deep groundwater flow zone. Recharge will not affect these wells penetrating this deeper system as rapdily as DLG-01. The declining water levels since December, 1979, may be attributed to a recharge deficiency resulting from the relatively mild winter of 1979 to 1980 in terms of accumulated snow-pack and subsequent spring thaw.

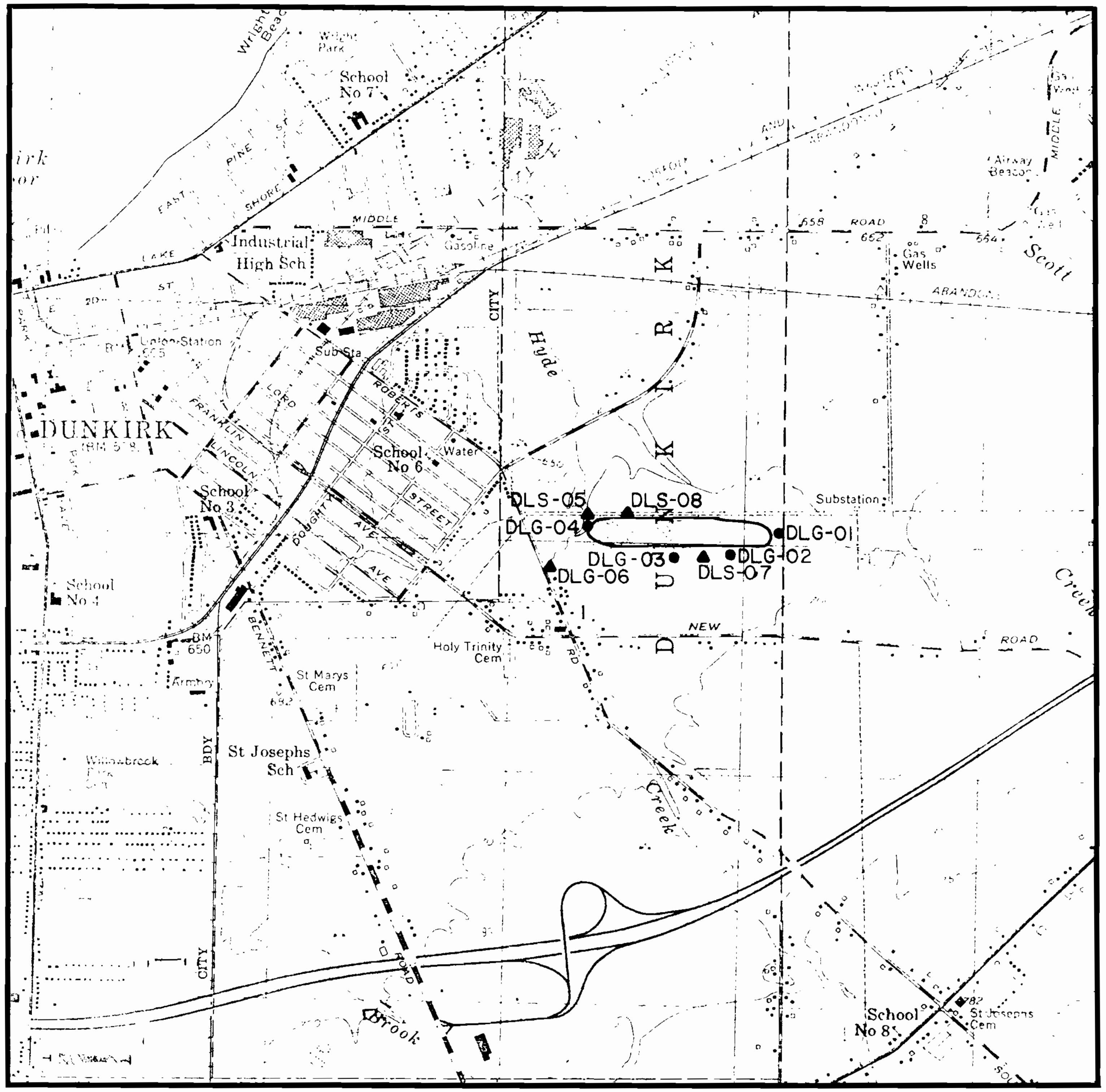
Generally, the Dunkirk monitoring wells reveal static water levels that reflect changes in the quantities of precipitation and recharge for the local area. Depending on the location of the slotted interval, the wells reveal declining or increasing water levels apparently in response to the amount of recharge which is seasonally controlled.

Recovery rates for the monitoring wells are shown on Table 7-1. Wells DLG-01 and DLG-02 have revealed rapid recovery rates throughout the monitoring period. Whereas, the recovery rate for DLG-03 has declined since December of 1979. Apparently, two separate groundwater horizons are penetrated; the first by DLG-01 and the second by DLG-02 and DLG-03.

9.0 SURFACE AND GROUNDWATER QUALITY

Samples of three (3) of the four (4) test borings (DLG-01 through DLG-03), upstream (DLS-05) and downstream (DLS-06) samples of Hyde Creek, an adjacent farm pond (DLS-07), and the northern diversion ditch (DLS-08) have been monitored during the last quarter of 1979 and the first three quarters of 1980. Monitoring well DLG-04 was vandalized prior to the last quarter 1979 sampling and cannot be salvaged for future monitoring. Another well is scheduled for installation at this location during the week of October 1, 1980. Sampling locations are depicted on Drawing 200R-R-3 and on Figure 9-1.

Monitoring wells were bailed 24 hours prior to sampling. When the samples were collected, they were filtered in the field prior to placement in sample bottles. Surface and groundwater samples were placed in appropriate containers with preservatives according to U.S. Environmental Protection Agency "Methods for Chemical Analysis of Water and Waste," 1979, or "Standard Methods for the Examination of Water and Wastewater," 14th edition, 1975. Sample containers were refrigerated immediately after collection and arrived at PEC laboratories within 12 hours of collection.



MONITORING POINTS

LEGEND

- —— APPROXIMATE BOUNDARY OF LANDFILL SITE
- ▲ SURFACE WATER SAMPLE (DLS)
- • MONITORING WELL (DLG)

SAMPLING POINT DESCRIPTION

DLG-01	Groundwater Monitoring point, east of landfill
DLG-02	Groundwater monitoring point, south of landfill
DLG-03	Groundwater monitoring point, south of landfill
DLG-04	Groundwater monitoring point, north of landfill, unusable due to vandalism
DLS-05	Downstream sample of Hyde Creek
DLS-06	Upstream sample of Hyde Creek
DLS-07	Farm pond, south of landfill
DLS-08	Leachate stream north of landfill

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DRAWN	DATE	SCALE
KG	10-80	1"=2000'

FIG. 9-1

DUNKIRK SANITARY LANDFILL
CHAUTAUQUA COUNTY, NEW YORK
QUARTERLY MONITORING PROGRAM

The samples were analyzed for typical indicators of sanitary landfill leachate and include chloride, nitrogen compounds, total dissolved solids, BOD (5-day), COD, TOC, and several metals. The results are tabulated in the Appendix.

Monitoring well DLG-01 does not appear to be affected by significant leachate contamination, however, there are a few pecularities.

The manganese concentration averages about 2 mg/l. This is more than 10 times the amount in the other wells. In addition, this is about 40 times the drinking water standard. Another anomally is the high total dissolved solids (TDS) concentration. This has averaged approximately 1,250 mg/l for the monitoring periods. This is over twice the limit for the NYSDEC Class "A" Standard.

This number does not correlate well with the parameters analyzed since the summation of the ions present does not approach the TDS concentration indicating that significant parameters have not been analyzed. The typical sanitary landfill indicators are low. Hardness is probably high and will be analyzed in the next sampling period. Sulfate, sulfide and potassium will also be added during the next sampling period.

It is possible that leaching of the cement used for grouting has added to the high TDS. This will be determined in the next sampling when hardness is included in the analyses.

The test boring program indicates that the brown till/gray till interface and the till/bedrock interface dip to the northwest. This would indicate that monitoring wells DLG-02 and DLG-03 would be upgradient wells. The majority of the analyzed parameters for DLG-02 are within drinking water limits. The TDS concentration is near the upper limit, probably due to the alkalinity and hardness. The ammonia concentration is also near the Class "A" limit. The source of this is not certain at present, however, the absence of other typical sanitary landfill leachate indicators would imply that the landfill is not the source.

Analyses of DLG-03 are very similar to DLG-02. The TDS values are higher than drinking water limits. This again is probably the result of alkalinity and hardness and will be checked in future analyses. Iron values are slightly less than 1 mg/l. All of the surface and groundwater samples exhibit similar ranges. Although values approach and sometimes exceed the USPHS drinking water limit of 0.3 mg/l, it is probably inherent to the area.

Due to vandalism DLG-04 could not be sampled.

Based on water samples of the upstream and downstream samples of Hyde Creek, the landfill activity has caused no degradation in water quality. The variation between these two sampling points is minimal. The farm pond (DLS-07) also does not appear to be affected by landfill leachate.

The northern drainage ditch DLS-08 does indicate contamination from the landfill. This is expected because the pre-landfill topography slopes northward. Flow on the base of the landfill would probably break out to the north. Analyses of DLS-08 indicates high COD and TOC values. The sodium (approximately 375 mg/l) and TDS (approximately 2,500 mg/l) concentrations are similar to those of DLG-01 and may indicate that DLG-01 has some sanitary landfill influence.

Although DLS-08 has the poorest quality of any sampling point, it is a mild leachate. This weak leachate coupled with the low flow has a small total loading and cannot be detected in the downstream sample of Hyde Creek.

The combination of small direct recharge area, thickness of the landfill and steep side slopes which promote runoff do not aid in the rapid production of large amounts of leachate. This is supported by the water quality data presented in this report. It will probably be many years, if at all, before the landfill reaches field capacity (saturation) and produces large quantities of leachate (especially if a low permeability cover is placed on the landfill).

10.0 CONCLUSIONS

Results of this investigation indicate the following conclusions can be made. In addition, further action to obtain additional data which is necessary for a complete evaluation of the Dunkirk landfill is described.

1. Bedrock consists of gray siltstone and should be relatively impermeable with regard to groundwater flow and recharge from the overlying soils.
2. Soils consist of brown silt and gray silt till. Coarse sediment zones that could serve as perched groundwater flow systems were not detected.
3. The gray silt till is very dense and relatively impermeable.
4. Two (2) major groundwater flow systems were found. These are at the brown till-gray till interface and gray till-bedrock interface.
5. Static water level and well recovery data shows a relation to a seasonal variation in precipitation which percolates into the soils and recharges the subsurface flow system.

6. Quarterly sampling of the monitoring wells will continue. Potassium, sulfate, sulfide, and hardness will be added to the list of parameters analyzed.
7. Monitoring well locations will be surveyed to enable the elevation of water levels to be determined with reference to sea level.
8. Additional monitoring wells will be installed north of the landfill during the week of October 1, 1980. Results of drilling and analyses will be provided in addendum to this report during October, 1980.

REFERENCES

Tesmer, Irving H., 1963, Geology of Chautauqua County, New York: Part I Stratigraphy and Paleontology (Upper Devonian), New York State Museum and Science Service, Bulletin No. 391.

APPENDIX

QUARTERLY MONITORING RESULTS

DUNKIRK SANITARY LANDFILL

Sample DLG-01

Parameter	12/28/79	3/7/80	6/3/80	7/2/80
pH	7.0	7.5	7.0	6.6
Total Alkalinity	261	191	204	211
Hot Acidity	-277	-185	13	27
Chloride	31	24	25	24
Nitrite-N	--	0.005	0.006	<0.001
Nitrate-N	0.51	2.1	0.05	0.04
Ammonia-N	0.27	0.43	0.15	0.32
Iron (total)	0.30	0.22	0.30	0.48
Manganese	1.08	1.24	1.47	2.29
Sodium	22	18	18	17
BOD (5-day)	<1	<1	<1	1.5
COD	23	24	7.7	23
TOC		12	28	15
Total Dissolved Solids		894	1,252	1,646
Total Suspended Solids	29	2	27	44
Specific Conductance	1,009	740	--	--
Copper	--	--	--	<0.01
Chromium	--	<0.01	<0.01	<0.01
Nickel	--	0.06	0.08	0.10

All values expressed as mg/l with the exception of pH (Standard Units) and Specific Conductance (umhos/cm).

QUARTERLY MONITORING RESULTS

DUNKIRK SANITARY LANDFILL

Sample DLG-02

Parameter	12/28/79	3/7/80	6/3/80	7/2/80
pH	7.6	8.0	7.4	7.1
Total Alkalinity	404	399	384	391
Hot Acidity	-462	-425	-434	-319
Chloride	2.0	16	3.1	1.6
Nitrite-N	--	0.002	0.006	0.004
Nitrate-N	0.32	1.0	0.03	0.03
Ammonia-N	1.8	2.4	1.1	1.6
Iron (total)	0.30	0.24	0.28	0.29
Manganese	0.10	0.11	0.13	0.06
Sodium	64	71	69	69
BOD (5-day)	7.5	2.7	6.0	6.9
COD	<1	20	7.7	29
TOC	--	15	42	17
Total Dissolved Solids	--	436	457	420
Total Suspended Solids	108	5	51	30
Specific Conductance	629	480	--	--
Copper	--	--	--	<0.01
Chromium	--	<0.01	<0.01	<0.01
Nickel	--	<0.03	<0.03	<0.03

All values expressed as mg/l with the exception of pH (Standard Units) and Specific Conductance (umhos/cm).

QUARTERLY MONITORING RESULTS

DUNKIRK SANITARY LANDFILL

Sample DLG-03

Parameter	12/28/79	3/7/80	6/3/80	7/2/80
pH	7.5	7.5	7.3	7.9
Total Alkalinity	392	323	366	393
Hot Acidity	-476	-347	-405	-315
Chloride	4.0	2.1	2.6	1.0
Nitrite-N	--	0.010	0.012	0.001
Nitrate-N	0.47	0.66	0.03	0.05
Ammonia-N	0.16	0.35	0.15	1.7
Iron (total)	1.03	1.33	0.10	0.38
Manganese	0.18	0.14	0.13	0.13
Sodium	14	14	13	12
BOD (5-day)	<1	<1	3.2	<1
COD	12	36	7.7	39
TOC	--	11	40	27
Total Dissolved Solids	--	689	784	805
Total Suspended Solids	554	3	16	59
Specific Conductance	905	575	--	--
Copper	--	--	--	<0.01
Chromium	--	<0.01	<0.01	<0.01
Nickel	--	<0.03	<0.03	0.06

All values expressed as mg/l with the exception of pH (Standard Units) and Specific Conductance (umhos/cm).

QUARTERLY MONITORING RESULTS

DUNKIRK SANITARY LANDFILL

Sample DLG-04

<table>
<tr><th>Parameter</th><th>12/28/79</th><th>3/7/80</th><th>6/3/80</th><th>7/2/80</th></tr>
<tr><td>pH</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total Alkalinity</td><td rowspan="17">--- well obstructed-no sample ---</td><td rowspan="17">--- well obstructed-no sample ---</td><td rowspan="17">--- well obstructed-no sample ---</td><td rowspan="17">--- well obstructed-no sample ---</td></tr>
<tr><td>Hot Acidity</td></tr>
<tr><td>Chloride</td></tr>
<tr><td>Nitrite-N</td></tr>
<tr><td>Nitrate-N</td></tr>
<tr><td>Ammonia-N</td></tr>
<tr><td>Iron (total)</td></tr>
<tr><td>Manganese</td></tr>
<tr><td>Sodium</td></tr>
<tr><td>BOD (5-day)</td></tr>
<tr><td>COD</td></tr>
<tr><td>TOC</td></tr>
<tr><td>Total Dissolved Solids</td></tr>
<tr><td>Total Suspended Solids</td></tr>
<tr><td>Specific Conductance</td></tr>
<tr><td>Copper</td></tr>
<tr><td>Chromium</td></tr>
<tr><td>Nickel</td><td></td><td></td><td></td><td></td></tr>
</table>

All values expressed as mg/l with the exception of pH (Standard Units) and Specific Conductance (umhos/cm).

QUARTERLY MONITORING RESULTS

DUNKIRK SANITARY LANDFILL

Sample DLS-05

Parameter	12/28/79	3/7/80	6/3/80	7/1/80
pH	7.4	7.5	6.7	6.8
Total Alkalinity	92	87	115	136
Hot Acidity	-94	-75	-85	-93
Chloride	36	49	73	91
Nitrite-N	--	0.015	0.059	0.061
Nitrate-N	1.3	0.37	0.45	0.35
Ammonia-N	0.20	0.33	<0.1	0.40
Iron (total)	0.26	0.22	0.55	0.47
Manganese	0.09	0.12	0.15	0.15
Sodium	21	26	41	31
BOD (5-day)	<1	<1	18	<1
COD	3.8	40	22	15
TOC	--	8.7	24	11
Total Dissolved Solids	--	300	369	364
Total Suspended Solids	6	4	16	10
Specific Conductance	380	335	--	--
Copper	--	--	--	<0.01
Chromium	--	<0.01	<0.01	<0.01
Nickel	--	<0.03	<0.03	<0.03

All values expressed as mg/l except pH (Standard Units) and Specific Conductance (umhos/cm).

QUARTERLY MONITORING RESULTS

DUNKIRK SANITARY LANDFILL

Sample DLS-06

Parameter	12/28/79	3/7/80	6/3/80	7/1/80
pH	7.3	7.2	7.0	6.3
Total Alkalinity	78	84	97	123
Hot Acidity	-80	-73	-89	-117
Chloride	34	49	68	49
Nitrite-N	--	0.025	0.059	0.067
Nitrate-N	1.0	1.9	0.42	0.35
Ammonia-N	0.11	0.24	0.15	0.71
Iron (total)	0.34	0.29	0.55	0.31
Manganese	0.09	0.11	0.11	0.11
Sodium	19	25	33	26
BOD (5-day)	<1	3.2	1.4	1.8
COD	12	40	3.9	17
TOC	--	7.0	1.4	11
Total Dissolved Solids	--	290	329	281
Total Suspended Solids	36	18	2	11
Specific Conductance	334	310	--	--
Copper	--	--	--	<0.01
Chromium	--	<0.01	<0.01	<0.01
Nickel	--	<0.03	<0.03	<0.03

All values expressed as mg/l with the exception of pH (Standard Units) and Specific Conductance (umhos/cm).

QUARTERLY MONITORING RESULTS

DUNKIRK SANITARY LANDFILL

Sample DLS-07

Parameter	12/28/79	3/7/80	6/3/80	7/1/80
pH	6.7	6.6	6.6	6.2
Total Alkalinity	26	25	43	56
Hot Acidity	-16	-2.0	-52	-45
Chloride	8.0	34	27	12
Nitrite-N	--	0.010	0.006	<0.001
Nitrate-N	0.49	0.27	0.06	0.01
Ammonia-N	0.20	0.51	<0.1	0.27
Iron (total)	0.77	0.40	1.18	0.74
Manganese	0.12	0.22	0.50	0.21
Sodium	2.3	8.0	4.1	4.5
BOD (5-day)	<1	6.0	7.2	7.8
COD	19	69	27	29
TOC	--	15	15	14
Total Dissolved Solids	--	244	166	173
Total Suspended Solids	92	9	18	25
Specific Conductance	118	235	--	--
Copper	--	--	--	<0.01
Chromium	--	<0.01	<0.01	<0.01
Nickel	--	<0.03	<0.03	<0.03

All values expressed as mg/l with the exception of pH (Standard Units) and Specific Conductance (umhos/cm).

QUARTERLY MONITORING RESULTS

DUNKIRK SANITARY LANDFILL

Sample DLS-08

Parameter	3/11/80	6/3/80	7/2/80
pH	8.0	7.7	7.4
Total Alkalinity	1,000	890	880
Hot Acidity	-910	-965	-250
Chloride	3.6	7.8	7.3
Nitrite-N	0.001	0.80	0.018
Nitrate-N	0.34	0.87	0.19
Ammonia-N	23	1.0	0.095
Iron (total)	1.26	1.01	2.31
Manganese	0.92	0.86	2.34
Sodium	389	378	390
BOD (5-day)	6.6	15	16
COD	149	85	158
TOC	136	200	140
Total Dissolved Solids	2,435	2,491	2,755
Total Suspended Solids	30	16	64
Specific Conductance	2,100	--	--
Copper	--	--	<0.01
Chromium	<0.01	<0.01	<0.01
Nickel	0.06	<0.03	0.06

All values expressed as mg/l with the exception of pH (Standard Units) and Specific Conductance (umhos/cm).