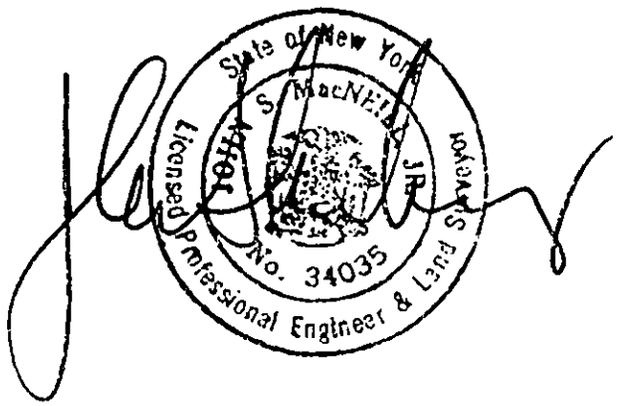
PRELIMINARY ENGINEERING REPORT

FOR THE
CORTLAND COUNTY LONG TERM LANDFILL

PREPARED FOR THE
CORTLAND COUNTY SOLID WASTE DEPARTMENT

FILE# E-70-86
APRIL 10, 1987



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CORTLAND COUNTY LANDFILL

INTRODUCTION

This preliminary engineering report is intended to outline, and form the basis of, the collective work leading to the final design and approval of a long term solid waste management and disposal site adjacent to the existing Cortland County Sanitary Landfill. The proposed long term facility will be owned by Cortland County and operated under the control of the Cortland County Solid Waste Department.

The Cortland County Solid Waste Department has retained John S. MacNeill, Jr., P.C. to perform preliminary design services and assist with the S.E.Q.R. process to determine the overall suitability of this site for a sanitary landfill. Pending the outcome of the environmental review, the final design of a landfill on this site will begin.

Any design proposed during the various steps of this process will be in accordance with current NYSDEC part 360 requirements. The existing Cortland County Landfill is under consent order to close in accordance with current NYS Department of Conservation requirements. To bridge the time span between closure of the current landfill and bringing a long term facility on line, the County has constructed an interim landfill cell. The expected usefull life of this interm cell is 2 to 3 years. As of April 1, 1987, no solid waste has been deposited in the interm cell.

During the planning and permiting stage of this process, various methods of waste stream reduction will be evaluated, including re-use and recycling, in accordance with the solid waste management goals of the New York State Department of Environmental Conservation. The

evaluation process will include methods of implimentation, market availability, costs (both incurred and avoided) and other aspects of this method of waste management.

SITE SELECTION

The county choose the site for a long term facility based on a site analysis conducted by Resource Engineering of Cortland, New York. This study was intitled "Site Analysis, Long Term Landfill for Cortland County Solid Waste, Committee County, Cortland, New York, 13045", October 23, 1984. The authors developed site criteria guidelines that were used to determine potenial sites within the County. This process identified three potential sites, which were evaluated further with the final choice being the proposed site, adjacent to the existing landfill, west of Town Line Road.

SITE DESCRIPTION

The proposed site is adjacent to the existing County landfill as shown on the location map in Appendix A. The disposal facility shall be situated on the west side of the Town Line Road, with the northern part of the Town of Homer and the southern part of the Town of Cortlandville. The total area of this site is 200± acres, comprized of 30% idle land, 40% brush land and woods and the remaining 30% is currently agricultural. This site is an upland site with steeper slopes to the north west and the extreme southeast. There is a ridge running north-south through the center of the site. The depth to bedrock varies with relation to this ridge, with approximately 4' of overburden on the top increasing to greater than 30' on the lower portions of the side slopes. The soil investigation to date is discussed in detail later in this report.

The Cortland County Highway Department (which was responsible for solid waste management before the formation of the Solid Waste Dept.) contracted with Empire Soils Investigation, inc. in November, 1984 to collect field data and prepare an initial soil report for the proposed long term site. This investigation included ten soil borings, 6 bedrock borings and installation and development of 3 monitoring wells. This report is attached in Appendix "B". In summary, this report indicated that the overburden in this area is a "compact silt with embedded sand, gravel and cobbles. The silt also contains numerous boulders. This material is interpreted to be glacial till. The depth of the till is variable; ranging from 5 feet... to over 32 feet...". This glacial till overlies interbedded shale and siltston bedrock, with the snale exibiting numerous nonhorizontal fracturing.

The report prepared by Empire Soils Investigations also evaluated the Hydro-geology of the site, concluding that the water table around the crest of the ridge is in bedrock and in the till on the side slopes. As part of the field investigations planned prior to the submittion of the Environmental Assessment Form, John S. MacNeill, Jr., P.C. proposes to expand on this initial geological and hydrogeological information to better understand and predict this groundwater movement through this site. The initial program is attached in Appendix "C".

Watershed

As described earlier, the site sits at the top of a ridge, with the ridge dividing the site into two separate watersheds. The western and northern portion of the site are in the Mosquito Creek watershed, which the south and east portion is in the watershed of an unnamed

tributary to Trout Brook. Both of these water sheds are parts of the Trout Brook Watershed that is a tributary to the Tioughnioga River.

The existing landfill is located on the east side of the ridge that divides the proposed site, therefore, all the surface runoff is contained in the watershed of the unnamed tributary. The Solid Waste Department wants to keep all deposited waste in the same watershed as the current landfill. This restriction limits the cell area and dictates direction of surface drainage ditches for the site. See attached watershed map in Appendix A.

Transporation

Because the proposed site is adjacent to the existing, there are developed traffic patterns and transportation networks all ready in place for the proposed site. Town Line Road will continue to be the main artery for traffic entering the landfill, traveling south past the existing landfill entrance to the new cell areas. Haul roads will be established on the fill to allow uninterupted flow of both loaded and unloaded hauling vehicles. Town Line Road south of the existing landfill entrance and the haulroads will be improved so that the hauling vehicles have easy access throughout the year.

SITE DEVELOPMENT

The development of this site for use as a state of the art sanitary landfill involves modifying many of the existing site characteristics. The site will be changed for two major uses, one for borrow and one for waste deposition. The site changes and impacts due to these two uses shall be investigated and minimized during the actual design of the landfill.

Borrow Areas

A substantial quantity of borrow material will required for the operation of the landfill. This borrow will come from two separate locations on site. One possible area is north of the ridge wholely in the Town of Homer. The other area is to the west of the ridge, opposite from the cell area. The soil boring program includes several locations within both of these areas to determine the suitability and volume of the overburden as cover material. Haul roads will be constructed to allow the movement of material from the borrow areas to the active fill areas. The quantity of borrow required is large enough to require large earth moving equipment, either pans or belly-dumps, both of which require haul roads to operate efficiently.

This borrow operation will be an integral part of the landfill operation, therefore, there will be an active borrow site throughout the useful life of the landfill. The borrow operation will be planned to minimize site disturbance over the extended period that the borrow area is open.

The final use and condition of the borrow area will be addressed during the design stage, as will the final use and configuration of the closed cells.

Deposition Area Location and Development

The municipal solid waste (M.S.W.) that is generated in Cortland County and transported to this landfill site will be deposited in the deposition area. The deposition area will be excavated to design grade and then lined with an approved lining system.

The M.S.W. will be deposited on top of this liner. This deposit of M.S.W. will rise to a predetermined height and then the "mound"

will be capped to prevent any precipitation from entering the deposited material. The waste will be deposited in cells in order to segregate the landfill to facilitate its management.

The active cells shall be located in the southeast portion of the site. The location of the cells was dictated by site topography, operational concerns and current NYSDEC part 360 Guidelines. This is the only location on the site that is in the same watershed as the existing landfill, which is the main constraint imposed by the Solid Waste Department to date. Also, the ridge has the thinnest overburden on the site, dictating that the landfill be on one side or the other of this ridge.

The progression of landfilling shall start at the upper (north) end of the site and progress down (south) ward. Also, we propose developing the overall waste depostion area in two stages, first the north half and then the lower or southern half. This schedule was choosen from many reasons.

The downward progression was choosen to reduce the amount of leachate generated. The active face will always be the downhill slope, therefore, any precipitation will flow out of, not into the cell, as it would it if we progressed uphill. Once the initial cell reaches final height, the northern most slope, the top and parts of the side slopes can receive final cover. The final cover at the upper end of the landfill will prevent the migration of surface runoff through deposited material and into the leachate collection system.

The plan for developing the landfill in 2 independent stages will essentially divide the deposition area into 2 separate landfills. The northern half will be developed first, consisting of the surface

drainage, detention pond, leachate collection main, underground leachate storage tanks and all the components of the first cell. This first half will then be filled in a succession of cells until it is filled to capacity, at which point the southern half will be developed in the same fashion. This two staged development has several advantages over a single stage development. One big factor was the initial investment will be less to develop one half of the facility. Another advantage is that is as the landfill matures, the two separate leachate collection systems can be used to better monitor the cap efficiency, waste decomposition, liner efficiency and long term leachate production. Also as the north half is developed, the liner efficiency can be monitored and if any difficencies are detected, the liner system for the southern half can be revised and changed to take advantage of developing liner technologies.

Surface Drainage

The surface drainage around the deposition area will be managed with a series of collection and interception ditches. Any surface runoff moving off the top of the ridge toward the cell area shall be diverted by the surface run off interceptors, around the cells, and across the ridge and down the western slope. These interceptors will convey runoff from the outside of the fill areas. This runoff will not be contaiminated by the material placed in the cells.

Within the surface runoff interceptors, there shall be perimeter ditches which will convey any surface leachate that breakes out of the side slopes or runs off the open face. The ditches shall be grass lined with flat sideslopes and minimal channel slope to deter erosion during high flows. These surace leachate ditches shall convey any surface runoff from the cell areas down to a detention pond.

The detention pond will be lined with a liner that meets the same requirmeents as the liner under the landfill cells. There will be a valved bottom drain that will be connected to the leachate collection tanks so that the bottom of the pond can be drawn into the leachate system and disposed of with the leachate collected from the bottom of the landfill cells. This collection/storage system is proposed because this will be a high volume, low concentration leachate that has a higher organic content than inorganic. Because of the potential volume produced, underground storage would be very costly. Also the organic content of the leachate will have more opportunity to oxidize in the aerobic pond verses an anaerobic storage tank. The detention pond will be used as a landfill cell when the landfilling operation progresses to that stage. The bottom drain shall be connected into the leachate collection system. The detention pond for the southern half will have to remain until the landfill reaches capacity and is closed.

Leachate Management

There will be two types of leachate generated, either surface leachate or leachate collected from the bottom of the landfill. Both types will have to be managed as part of the overall operation of the landfill.

The surface leachate will be intercepted, conveyed and stored as previously described. The treatment effectiveness of the pond will be two fold, namely serving to concentrate the leachate through evaporation and to reduce the organic concentration through biological oxidation. The settled material shall be drawn off at period intervals into the leachate storage tanks. The drawdown of the pond will be scheduled around the seasonal weather variation to take full

advantage of the cetention/treatment time, balanced against tne possibility and consequences of overflow from the detention pond.

Both types of leachate collected in the underground storage structure will be periodically pumped out and transported to the City of Cortland Sewage Treatment Facility for final disposal. This treatment plant is uniquely capable to treat this type of waste due to its carbon absorption design. The solic waste department is planning to dispose of the leachate from the interim landfill at the City's treatment plant. This arrangement shall continue in the future to handle the leachate from both the interim and the long term landfill.

Landfill Gas (Methane) Management

The typical decomposition of landfilled waste is a complex physical/biological process with various by products. This process does not produce a steady rate of by products during the decomposition phase, but varies throughout. Two of the principal byproducts that will have to be managed during the active life and post closure are methane gas and carbon dioxide (CO_2). Both of these gases are detrimental to plant life when they are allowed to accumulate in the upper soil horizons. Methane also can be explosive when concentrated, and has caused considerable damage to underground structures when the concentration reaches the explosive level.

The final closure of the individual cells will include a gas colleciton system. This system will collect and convey any gases to exit ports in the final cap. The end use, either as a fuel, flaring or venting will be examined in detail during the actual design phase.

The possibility exists for a steady, long term production of methane over the life of the landfill due to the proposed sequencing of landfill develooment. Once the first cell is closed and methane

production begins, the second cell will be being filled. The gas collection for the second cell will be connected into the first, thereby allowing the same processing equipment to process gas from all cells, reclaiming any methane produced by the individual cells.

ESTIMATED USEFUL LIFE OF LONG TERM LANDFILL

The estimated life to the landfill was developed based on existing waste production rates, characteristics, and operating procedures. The basic assumptions used are as follows:

A. 35,000 TPY of M.S.W.

B. Inplace Density 800 LB/CY

C. Additional 25% Volume for Cover Material

$$35{,}000 \frac{T}{Y} \times 2000 \frac{lb}{T} \times \frac{CY}{800\ lb} = 88{,}000\ CY/YR\ M.S.W$$

+25% = 22,000 CY/YR Cover

Total Annual In-Place Volume = 109,000 CY

The final volume available for disposal on this site is difficult to estimate at this time. The allowable depth below grade of the landfill base will be determined by the geologic and hydrogeologic site investigations. The following calculations are based on a 10' average depth below original ground:

Max. Practical Height Above O.G.	85'
Max. Bottom Width	675'
Min. Allowable Top Width	200'
Max. Length	3300'
Side Slopes	3 H on 1 V
Max. Depth of Cell below O.G.	10'

Maximum top width was choosen to allow equipment sufficient room to operate at final grade.

Volume calculated based on average end areas.

I. Volume above O.G.

$$\text{Vol.} = (A_{top} + A_{bot})1/2 \times \text{Average Height}$$

$$= (W_{top} \times L_{top} + W_{bot} \times L_{bot})1/2 \times 85'$$

$$= (200 \times L_{top} + 675 \times 3300)1/2 \times 85'$$

Where $L_{top} = L_{bot} - 6(\text{height}) = 2790'$

$$= (200 \times 2790 + 675 \times 3300)1/2 \times 85'$$

$$\text{Volume} = 1.18 \times 10^{8} \text{ Ft}^3$$

II. Volume Below O.G.

$$\text{Vol.} = (A_{top} + A_{bot})1/2 \times \text{Average Height}$$

$$= [(675 \times 3300) + (615 \times 3240)]1/2 \times 10'$$

$$= 2.11 \times 10^{7} \text{ FT}^3$$

III. Total Volume Available

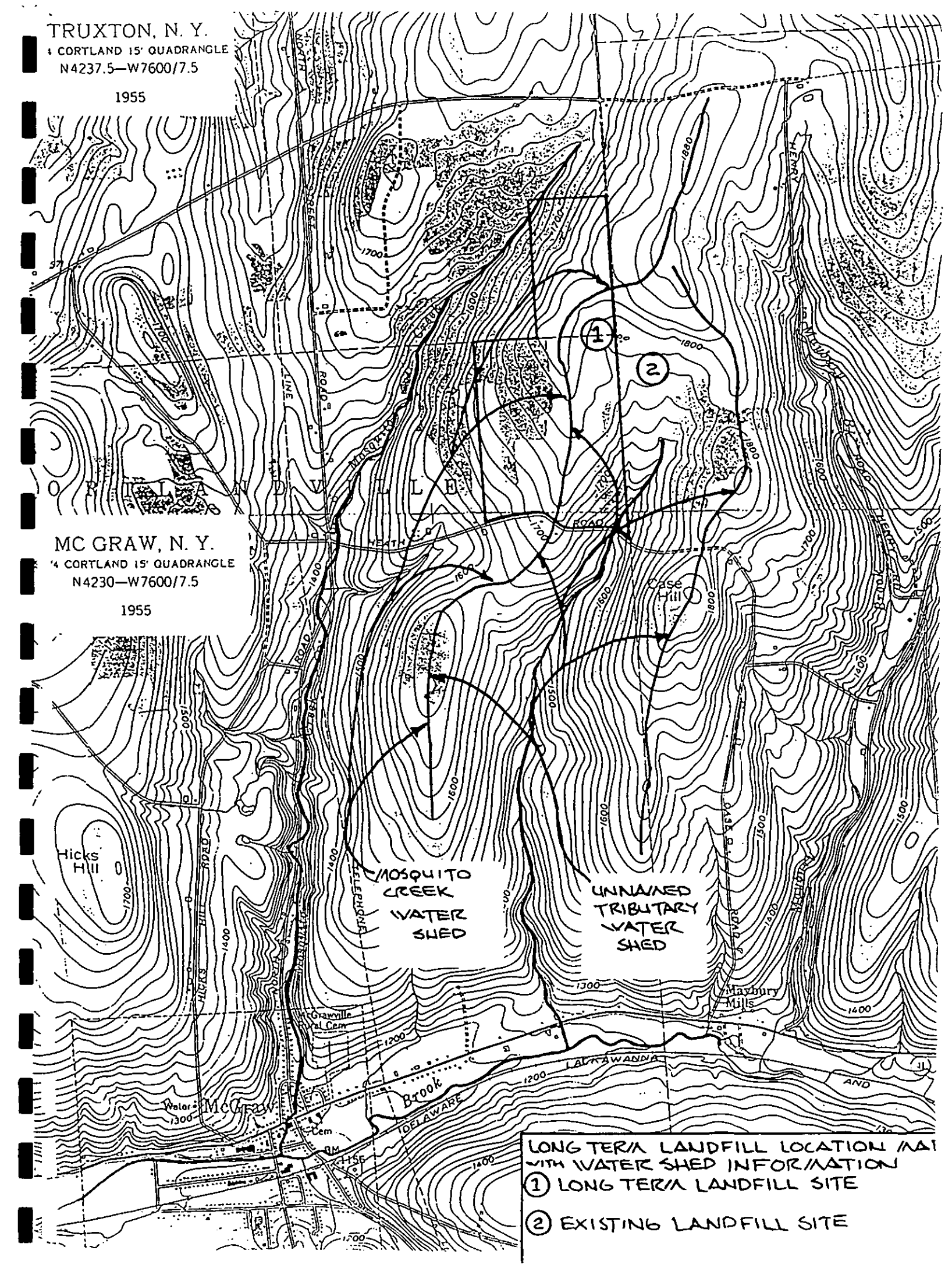
$$1.18 \times 10^{8} + 2.11 \times 10^{7} = 1.39 \times 10^{8} \text{ FT}^3 = 5.17 \times 10^{7} \text{ CY}$$

IV. Estimated Useful Life

$$5.17 \times 10^{7} \text{ CY} / 109{,}000 \text{ CY/YR} = 47 \text{ YRS.}$$

The estimated usefull life does not account for future waste stream reduction through reuse or recycling programs.

APPENDIX A - MAP


TRUXTON, N. Y.
4 CORTLAND 15' QUADRANGLE
N4237.5—W7600/7.5
1955
MC GRAW, N. Y.
4 CORTLAND 15' QUADRANGLE
N4230—W7600/7.5
1955
MOSQUITO CREEK WATER SHED
UNNAMED TRIBUTARY WATER SHED
1
2
Case Hill
Hicks Hill
McGrawville Cem
Maxbury Mills
LACKAWANNA
DELAWARE
Brook
LONG TERM LANDFILL LOCATION MAP WITH WATER SHED INFORMATION
(1) LONG TERM LANDFILL SITE
(2) EXISTING LANDFILL SITE

APPENDIX B

EMPIRE
SOILS INVESTIGATIONS INC.

CORTLAND COUNTY LANDFILL EXPANSION
CORTLAND, NEW YORK

FOR

Cortland County Highway Department

Cortland, New York

Job No. GD-84-96

January 1985

105 CORONA AVENUE, GROTON, NY 13073, 607-898-5881

THOMSEN ASSOCIATES

CORTLAND COUNTY LANDFILL EXPANSION
CORTLAND, NEW YORK

1.0 INTRODUCTION

This report presents the results of a soil boring and monitoring well installation program at the proposed site of the Cortland County Landfill Expansion conducted by Empire Soils Investigations, Inc. The work was performed pursuant to an agreement with the Cortland County Highway Department dated November 20, 1984.

The scope of services provided by Empire Soils Investigations, Inc. included:

- o Ten soil borings to an average depth of 25 feet.
- o Taking bedrock cores in 6 of the borings.
- o Installing groundwater monitoring wells in 3 of the borings.
- o Developing the 3 ground water monitoring wells.
- o Preparing a brief report of the subsurface investigation findings.

2.0 METHODOLOGY

Locations for borings LT 1-8 were staked in the field by Tim Buhl of Resource Engineering. Locations for borings X-1 and X-2 were staked in the field by Ralph Pitman of the Cortland County Highway Department. The Cortland County Highway Department was responsible for surveying the boring locations and elevations.

The soil borings were advanced through the overburden with 2¼ inch hollow stem augers. The augers served to stabilize the boreholes, and allowed soil samples to be taken and monitoring wells to be installed. Continuous soil samples were taken with split barrel samplers. Water levels were monitored during drilling and are noted on the subsurface logs (Appendix A). Rock cores (NX size) were taken in 6 of the borings (LT-2, LT-3, LT-4, LT-5, LT-6, X-1). The shallow overburden necessitated coring the rock at these locations. Those borings not utilized for groundwater monitoring wells were backfilled from the bottom of the boring to the ground surface with a cement grout.

Groundwater monitoring wells were installed in borings LT-3, LT-7 and LT-8. The monitoring wells were constructed of 2 inch, threaded, flush joint PVC pipe. The screened portions of the wells were 10 feet long with 0.02 inch slots; they extended from the bottom of the well upward. A 4Q filter sand pack was placed around the well screen and extended to 2 feet above the top of the well screen. A 2 foot bentonite pellet seal was placed above the filter sand. The remainder of the annular space was backfilled with native soil. A locking guard pipe was then fitted over the well and a cement seal placed around the guard pipe. The 3 wells were developed by bailing. Details of the individual monitoring well constructions are presented in Appendix A.

3.0 INVESTIGATION FINDINGS

3.1 Site Location

The project site is located adjacent to the west side of the existing Cortland County Landfill; in the towns of Homer and Cortlandville, New York.

3.2 Site Geology

The overburden encountered at the site consisted of a compact silt with embedded sand, gravel and cobbles. The silt also contains numerous boulders. This material is interpreted to be glacial till. The depth of the till is variable; ranging from 5 feet at boring LT-2 to over 32 feet at boring LT-7. The till is generally less then 10 feet thick on the crest of ridge which trends north-south across the site (borings LT-2, LT-3, X-1, LT-5) and over 20 feet on the flanks of the ridge (borings LT-1, LT-4, LT-6, LT-7, LT-8, X-2).

The glacial till overlies bedrock composed of interbedded shale and siltstone. The bedrock is gray, thin bedded to bedded and weathered. In general, the siltstone layers are thicker bedded and less weathered than the shale. Additionally, the shale exhibits abundant non-horizontal fracturing.

3.3 Hydrogeology

Monitoring wells LT-7 and LT-8 are in the till, and well LT-3 is in the bedrock. The water levels measured in LT-3 on January 16, 1985 (9.5' below ground surface) and January 18, 1985 (9.8') respectively indicate the water table near the crest of the hill is in the bedrock (Table 1). These readings were taken prior to bailing. This well recharged fairly rapidly during well development as a result of the numerous fractures within the shale zones.

The water level in LT-7 on January 16, 1985 was 7.3' and in LT-8 on January 18, 1985 was 4.3'. This indicates that the water table on the flanks of the hill is within the till. The rate of recovery in LT-7 was slow. A water level of 7.3' was recorded on January 16, 1985 prior to bailing the well dry. Prior to bailing again on January 18, 1985, a water level of 23.6' was recorded. This poor rate of well recovery suggests the permeability of the till is relatively low.

TABLE 1

Water Levels In Monitoring Wells

Well	Date	Water Levels (ft. below ground surface)
LT-3	June 16, 1985	9.5'
	Jan. 18, 1985	9.8'
LT-7	Jan. 16, 1985	7.3'
	Jan. 18, 1985	23.6'
LT-8	Jan. 18, 1985	4.3'

Respectfully submitted,
EMPIRE-THOMSEN

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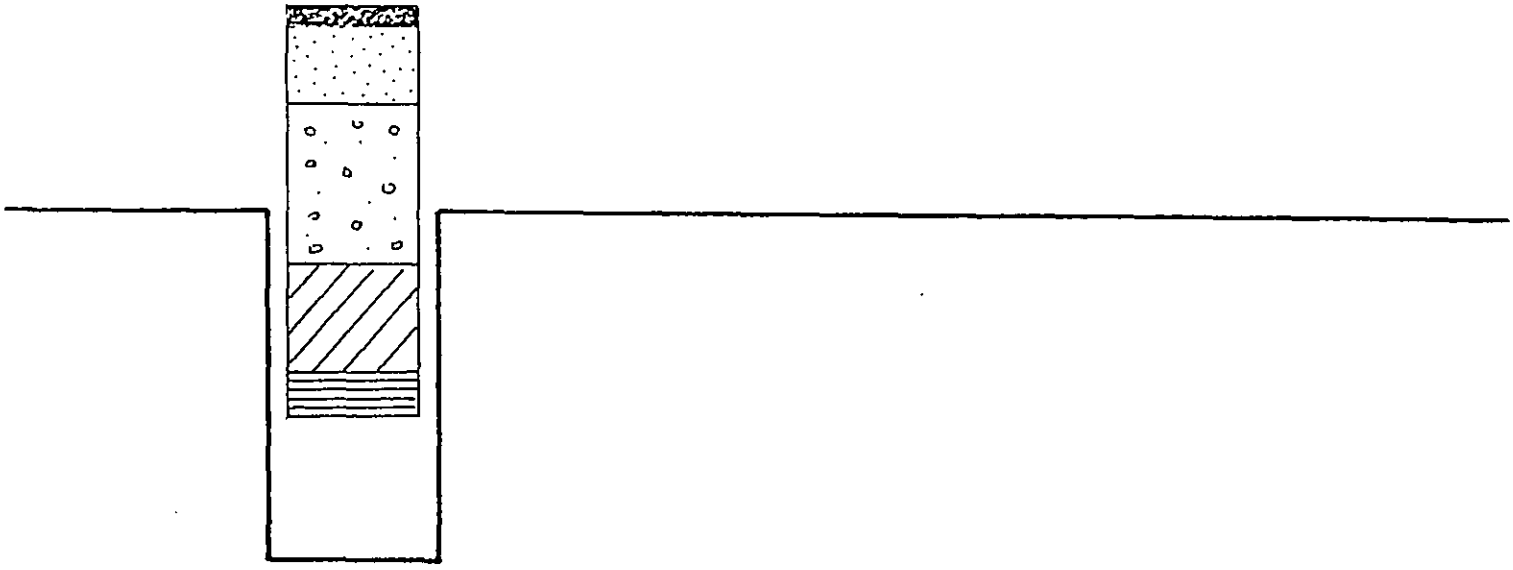
Hydrogeologist

Marjory B. Rinaldo-Lee / FCE
Marjory B. Rinaldo-Lee, C.P.G.S.

SUBSURFACE LOGS



GENERAL INFORMATION & KEY TO SUBSURFACE LOGS

The Subsurface Logs attached to this report present the observations and mechanical data collected by the driller while at the site, supplemented by classification of the materials removed from the borings as determined through visual identification by technicians in the laboratory. It is cautioned that the materials removed from the borings represent only a fraction of the total volume of the deposits at the site and may not necessarily be representative of the subsurface conditions between adjacent borings or between the sampled intervals. The data presented on the Subsurface Logs together with the recovered samples will provide a basis for evaluating the character of the subsurface conditions relative to the proposed construction. The evaluation must consider all the recorded details and their significance relative to each other. Often analyses of standard boring data indicate the need for additional testing and sampling procedures to more accurately evaluate the subsurface conditions. Any evaluations of the contents of this report and the recovered samples must be performed by Professionals having experience in Soil Mechanics and Foundation Engineering. The information presented in the following defines some of the procedures and terms used on the Subsurface Logs to describe the conditions encountered.

① The figures in the Depth column defines the scale of the Subsurface Log.

② The Sample column shows, graphically, the exact depth range from which a sample was recovered. See Table I for a description of the symbols used to signify the various types of samples

③ The Sample No. is used for identification on sample containers and/or Laboratory Test Reports.

④ Blows on Sampler – shows the results of the "Penetration Test", recording the number of blows required to drive a split spoon sampler into the soil beneath the casing. The number of blows required for each six inches penetration is recorded. The total number of blows required for the last 12 inches of penetration are summarized in the "N" column. The outside diameter of the sampler, the hammer weight and the length of drop are noted at the bottom of the Subsurface Log.

⑤ Blows on Casing – shows the number of blows required to advance the casing a distance of 12 inches. The casing size, the hammer weight and the length of drop are noted at the bottom of the Subsurface Log. If the casing is advanced by means other than driving, the method of advancement will be indicated in the Notes column or under Method of Investigation at the bottom of the Subsurface Log.

⑥ All recovered soil samples are reviewed in the laboratory by technicians. The visual descriptions are made on basis of the sample as recovered and in accordance with the Unified Classification System. Guide Lines for the terms used in descriptions are presented in Tables II and III. The description of the relative soil compactness or consistency is based upon the penetration records as defined in Table IV. The description of the soil moisture is based upon the condition of the sample as recovered. The moisture condition is described as dry, damp, moist or wet. Water used to advance the boring may have affected the in-situ moisture content of the sample. Special terms are used as required to describe materials in greater detail; several such terms are listed in Table V. When sampling gravelly soils with a standard two-inch diameter split spoon, the true percentage of gravel is often not recovered due to the relatively small sampler diameter. The presence of boulders and large gravel is sometimes, but not necessarily, detected by an evaluation of the casing and sampler blows or through the "action" of the drill rig as reported by the driller.

⑦ The description of rock shown is based upon the recovered rock core. Terms frequently used in the description are included in Table VI.

⑧ Miscellaneous observation and procedures noted by the driller are shown in this column, including water level observations. It is important to realize that the reliability of the water level observations depend upon the soil type (water does not readily stabilize in a hole through fine grained soils), and that drill water used to advance the borings may have influenced the observations. The ground water level typically will fluctuate seasonally. One or more perched or trapped water levels may exist in the ground seasonally. All the available readings should be evaluated. If definite conclusions cannot be made, it is often prudent to examine the conditions more thoroughly through test pit excavations or water observation installations.

⑨ The length of core run is defined as length of penetration between retrievals of the core barrel from the bore hole, expressed in feet and tenths of feet. The core recovery expresses the length of core recovered from the core barrel per core run, in percent. The size core barrel used is also noted. The more commonly used sizes of core barrels are denoted "AX" and "NX". The "NX" core, being larger in diameter than "AX" core, often produces better recovery, and is frequently utilized where accurate information regarding the geologic conditions and engineering properties is needed.

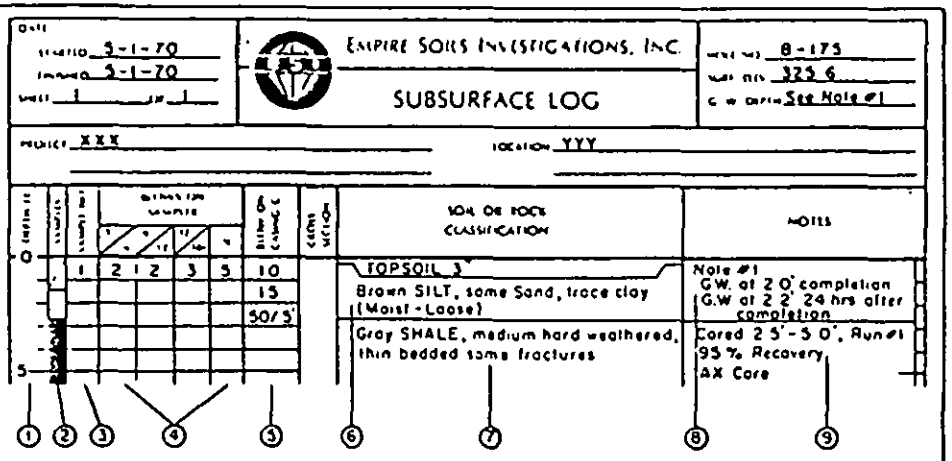


TABLE I

- Split Spoon Sample
- Shelby Tube Sample
- Auger or Pit Sample
- Rock Core

TABLE II

Identification of soil type is made on basis of estimate of particle sizes, and in the case of fine grained soils also on basis of plasticity.

Soil Type	Soil Particle Size	
Boulder	>12"	
Cobble	3" – 12"	
Gravel - Coarse	3" – 3/4"	Coarse Grained (Granular)
- Fine	3/4" – #4	
Sand - Coarse	#4 – #10	
- Medium	#10 – #40	
- Fine	#40 – #200	
Silt - Non Plastic (Granular) Clay - Plastic (Cohesive)	<#200	Fine Grained

TABLE III

The following terms are used in classifying soils consisting of mixtures of two or more soil types. The estimate is based on weight of total sample.

Term	Percent of Total Sample
"and"	35 – 50
"some"	20 – 35
"little"	10 – 20
"trace"	less than 10

(When sampling gravelly soils with a standard split spoon, the true percentage of gravel is often not recovered due to the relatively small sampler diameter.)

TABLE IV

The relative compactness or consistency is described in accord with the following terms.

Granular Soils		Cohesive Soils	
Term	Blows per Foot, N	Term	Blows per Foot, N
Loose	< 10	Very Soft	< 2
Firm	11 – 30	Soft	3 – 5
Compact	31 – 50	Medium	6 – 15
Very Compact	> 51	Stiff	16 – 25
		Hard	> 26

(Large particles in the soils will often significantly influence the blows per foot recorded during the Penetration Test.)

TABLE V

Varved -	Alternating layers, seams, and partings of soils.
Layer -	Soil deposit more than 6" thick.
Seam -	Soil deposit less than 6" thick.
Parting -	Soil deposit less than 1/8" thick.
Uniform -	All grains are of about the same diameter.

TABLE VI

Rock Classification Terms

Term		Meaning
Hardness	Soft	Scratched by fingernail
	Medium Hard	Scratched easily by penknife
	Hard	Scratched with difficulty by penknife
	Very Hard	Cannot be scratched by penknife
Weathering	Very Weathered	Judged from the relative amounts of disintegrating iron staining, core recovery, clay seams, etc.
	Weathered	
	Sound	
Bedding	Laminated	Natural Breaks in Rock Layers: < 1"
	Thin bedded	1" – 4"
	Bedded	4" – 12"
	Thick bedded	12" – 36"
	Massive	> 36"

(Fracturing refers to natural breaks in the rock oriented at some angle to the rock layers.)

DATE
STARTED 1-3-85
FINISHED 1-3-85
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC. SUBSURFACE LOG

HOLE NO LT-1
SURF ELEV
G. W. DEPTH See Notes

PROJECT Cortland County Landfill
LOCATION Town of Solon, Cortland County

DEPTH	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	1	3	3	6	5"	Brown, moist, loose, SILT, little fine-coarse sand, trace gravel	5" TOPSOIL
			3						
		2	9	19	19	38	13"	Similar	
			76						Cobbles encountered throughout soil profile
5		3	37	20	36	56	9"	Similar	
			47						
		4	12	14	18	32	18"	Similar	
			18						
		5	12	12	12	24	17"	Similar	Water @ 9' 1-3-85 12:30 PM
			18						
10		6	9	12	16	28	12"	Similar	Water @ 3' 1-3-85 1:00 PM
			17						
		7	17	19	29	48	8"	Similar, grades to gray	
			33						
15		8	22	24	30	54	6"	Similar	
			33						
		9	46	60	100/.4'		4"	Similar	
		10	18	35	60	95	10"	Similar	
			65						
20		11	11	29	37	66	15"	Similar	
			44						
		12	42	38	28	66	12"	Similar	
			40						
25		13	25	35	43	78	10"	Similar	
			37						
		14	38	90	82	172	10"	Similar	
			75						
		15	41	40	56	96	4"	Similar	
			102						
30								Terminated @ 30.0'	

N = No. blows to drive 2 " spoon 12 " with 140 lb pin wt. falling 30 "per blow

C = No. blows to drive ____ " casing ____ " with ____ lb. weight falling ____ "per blow

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼"I.D. Hollow Stem Augers/Standard Penetration Test

DATE
STARTED 1-4-85
FINISHED 1-4-85
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC. SUBSURFACE LOG

HOLE NO LT-2
SURF ELEV.
G. W. DEPTH See Notes

PROJECT Cortland County Landfill

LOCATION Town of Solon
Cortland County

DEPTH	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	2	2	2	4	10"	Brown,wet,loose TOPSOIL-SILT, Some fine-coarse sand, little gravel, roots 2.0'	Set 4" casing to 4.7', Roller bit to 5.3'
			2						
		2	12	33	45	78	18"	Brown,moist very compact,SILT,Some fine-coarse sand,little gravel, cobbles 4.0'	
			17						
		3	64	100/.2'			5"	Brown,dry,DECOMPOSED SHALE 4.7'	
5								SILTSTONE w/interbedded SHALE, Gray medium hard, very weathered thin bedded	Run #1:5.3'-10.3' 5' Recovery RQD 0%
10								weathered, numerous fractures	Run #2:10.3'-15.3' 5' Recovery RQD 0%
								Terminated @ 15.3'	Boring dry prior to rock coring

N = No. blows to drive 2 " spoon 12 " with 140 lb. pin wt. falling 30 "per blow

C = No. blows to drive " casing " with lb. weight falling "per blow

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼" I.D. Hollow Stem Augers/Standard Penetration Test,4"Casing,NX Roc

DATE
STARTED 1-2-85
FINISHED 1-2-85
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC. — SUBSURFACE LOG

HOLE NO. LT-3
SURF ELEV.
G. W. DEPTH See Notes

PROJECT Cortland County Landfill
LOCATION Town of Solon, Cortland County

DEPTH	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0"/6"	6"/12"	12"/18"	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	1 2	2	2	4	8"	Brown, moist, loose, SILT, Some fine-coarse Sand, little gravel, roots	6" TOPSOIL
		2	24 62	82	30	112	10"	Similar	Decomposed cobbles throughout soil profile
5		3	33 24	30	24	54	10"	Similar	Water @ 6.2' prior to rock coring
		4	25 100/.1'	35	55	110	18"	Similar	Water @ 9.5' in well 1-16-85
								7.6'	Run #1: 7.6'-12.6' 5' Recovery RQD 47.5'
10								Siltstone w/interbedded shale gray, medium hard, thin bedded, few fractures	Water Level @ 9.8' on 1-18-85
									Run #2: 12.6'-17.6' 5' Recovery RQD 55%
15									
								Terminated @ 17.6'	Monitoring Well Installed
20									

N = No. blows to drive 2 " spoon 12 " with 140 lb. pin wt. falling 30 "per blow

C = No. blows to drive ____ " casing ____ " with ____ lb. weight falling ____ "per blow.

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2½" I.D. Hollow Stem Augers/Standard Penetration Test, NX Rock Core

DATE
STARTED 12-28-84
FINISHED 12-31-84
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC. SUBSURFACE LOG

HOLE NO LT-4
SURF ELEV
G. W. DEPTH See Notes

PROJECT Cortland County Landfill

LOCATION Town of Solon
Cortland County

DEPTH	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	2	1	1	2	8"	Brown, wet, loose, SILT, little fine-coarse sand, trace gravel	
			1						
		2	8	20	16	36	12"	Similar	Encountered cobbles throughout soil profile
			33						
		3	7	9	14	23	14"	Similar	
5			18						
		4	22	33	30	63	18"	Similar	
			29						
		5	100/.1'					No Sample Recovery	Run #1: 8.2'-13.5' 4.7' Recovery
10								Till w/siltstone boulders	
		6	25	44	43	87	6"	Similar	Boring dry prior to rock coring
			67						
15		7	33	100/.3'			9"	Similar	
		8	100/.3'					Similar	
20		9	37	53	84	137	11"	Similar	
			61					22.1'	Run #2: 23.0'-28.0' 5' Recovery RQD 25%
								Shale w/interbedded SILTSTONE Gray, medium hard, weathered, thin bedded, few fractures	
25									
									Run #3: 28.0'-33.0' 5' Recovery RQD 25%
30									
								Terminated @ 33.0'	
35									

N = No. blows to drive 2 " spoon 12 " with 140 lb. pin wt. falling 30 "per blow

C = No. blows to drive _____" casing _____" with _____lb. weight falling _____"per blow.

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼" I.D. Hollow Stem Augers/Standard Penetration Test, NX Rock Core

DATE
STARTED 12-26-84
FINISHED 12-27-84
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC. SUBSURFACE LOG

HOLE NO LT-5
SURF ELEV.
G. W. DEPTH See Notes

PROJECT Cortland County Landfill

LOCATION Town of Solon
Cortland County

DEPTH FT	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	3	2	2	4	8"	Brown, firm, moist, SILT, little fine-coarse sand, little gravel, wood fragments	6" TOPSOIL
			10						
		2	27	61	37	98	14"	Similar	Encountered cobbles throughout soil profile.
			27						
		3	100/.0'					No Sample Recovery	4.2'-5.9' Boulders
5									water @ approx. 8.0' 12-26-84
		4	21	24	17	41	8"	Similar grades to gray	8.2'-9.3' boulder
			17						auger to 11.8', pull augers, drop 4" casing roller bit to 13.0'
		5	100/.2'						
		6	43	100/.4'			6"	Gray, Moist Decomposed SHALE	
10									
								SILTSTONE, Gray, medium hard, sound bedded 15.5'	Run #1: 13.0'-18.0' 4.9' Recovery RQD 46.6%
15								SHALE, Gray, medium hard, thin bedded weathered, few fractures	Run #18.0'-23.0' 4' Recovery (Left 1' of core in hole) RQD 55% lost approx. 100 gal. of water during run
20								Terminated @ 23.0'	
25									

N = No. blows to drive 2 " spoon 12 " with 140 lb. pin wt. falling 30 "per blow

C = No. blows to drive ____ " casing ____ " with ____ lb. weight falling ____ "per blow.

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼" I.D. Hollow Stem Augers/Standard Penetration Test, 4"Casing, NX Ro

DATE
STARTED 12-22-84
FINISHED 12-26-84
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC. SUBSURFACE LOG

HOLE NO LT-6
SURF ELEV
G. W. DEPTH See Notes

PROJECT Cortland County Landfill
LOCATION Town of Solon, Cortland County

DEPTH	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0"/6"	6"/12"	12"/18"	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	3	1	1	2	18"	Brown, wet, loose, SILT, trace fine-coarse sand, trace gravels, roots 2.0'	6" TOPSOIL
			14						
		2	22	26	25	51	12"	Brown, moist very compact, SILT, little fine-coarse sand, trace gravel	encountered cobbles throughout soil profile
			29						
5		3	11	12	12	24	20"	Similar	Water @ 1.0' 12-26-84
			14						
		4	13	15	18	33	17"	Similar	
			20						
		5	15	18	21	39	12"	Similar	
			81						
10		6	10	25	29	54		No Sample Recovery	
			25						
		7	25	33	47	80	8"	Similar	
			48						
15		8	25	34	35	69	10"	Same, Wet	
			82						
		9	44	44	81	125	4"	Same,	
			65						
		10	100/.3'					No Sample Recovery	18.0'-18.5' Boulder
20		11	49	71	64	135	6"	Similar	
			83						
		12	80	100/.4			6"	Similar	
25		12A	100/.2'				.2'	Similar	
		13	200/.4'				.1'	Similar	
30		14	100/.2'				.1'	Gray, Decomposed SHALE Terminated @ 30.2'	
35									

N = No. blows to drive 2" spoon 12" with 140 lb. pin wt. falling 30" per blow
C = No. blows to drive ___" casing ___" with ___ lb. weight falling ___" per blow

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼" I.D. Hollow Stem Augers/Standard Penetration Test

DATE
STARTED 12-21-84
FINISHED 12-22-84
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC. SUBSURFACE LOG

HOLE NO. LT-7
SURF ELEV. ____
G. W. DEPTH See Notes

PROJECT Cortland County Landfill

LOCATION Town of Solon
Cortland County

DEPTH FT	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	2	1	2	3	3'	Brown, wet, loose, SILT, little fine-coarse sand, little gravel, organic debris	7" TOPSOIL
			7						
		2	11	12	20	32	14"	Similar	
			16						
5		3	10	13	11	24	5"	Similar	
			15						
		4	7	8	11	19	21"	Similar	Water @ 7'4" in well 1-16-84
			16						
		5	10	10	23	33	15"	Similar	
			30						
10		6	15	19	29	48	4"	Similar, grades to Gray	
			29						
		7	22	32	35	57	18"	Similar	
			66						
15		8	23	44	100/.4'		7"	Similar	
		9	16	18	18	36	19"	Similar	
			49						
		10	16	19	31	50	7"	Similar	Water Level @ 23.6' on 1-18-85
20			44						
		11	51	22	31	53		No Sample Recovery	
			36						
		12	20	32	31	63	3"	Similar	
			40						
25		13	12	18	32	50	7"	Similar	
			30						
		14	100/.4'					Similar	Monitoring Well Installed
		15	100/.3'					No Sample Recovery	
30									
								Terminate @ 32.0'	
35									

N = No. blows to drive 2" spoon 12" with 140 lb. pin wt. falling 30" per blow

C = No. blows to drive ____" casing ____" with ____ lb. weight falling ____" per blow

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼" I.D. Hollow Stem Augers/Standard Penetration Test

DATE
STARTED 12-18-84
FINISHED 12-20-84
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC — SUBSURFACE LOG

HOLE NO LT-3
SURF ELEV
G. W. DEPTH See Notes

PROJECT Cortland County Landfill

LOCATION Town of Solon
Cortland County

DEPTH FEET	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	1	2	3	5	15"	Brown, moist, loose, SILT, little fine-coarse sand, little gravel, roots	5" TOPSOIL
			11						Water Level @ 4.3' on 1-18-85
		2	15	30	25	60	12"	Similar	
			30						Encountered cobbles throughout soil profile
5		3	19	12	15	27	10"	Similar	
			11						
		4	10	9	15	24	12"	Similar	
			27						
		5	7	10	10	20	18"	Similar	
			10						
10		6	9	12	16	28		No Sample Recovery	
			19						Water @ 11.6' 12-18-84
		7	25	44	100/.4'		10"	Similar	
								Till w/Siltstone Boulder	Run #1: 13.4'-16.4' 2.1' Recovery
15									
		8	33	62	100/.1'		7"	Similar	Boulders: 19.9'-20.9' 21.4'-22.3' 23.9'-24.5' 25.0'-26.6' 27.5'-28.5' 28.7'-29.2'
		9	150/.3'				.3'	Similar	
20		10	150/.3				.4'	Similar, grades to gray	
		11	200/.3'				.3'	Similar	
		12	210/.5'				5"	Similar	
25									Monitoring Well Installed
		13	200/.3'				.3'	Similar	
		14	69	118			9"	Similar	
30								Terminated @ 30.4'	
35									

N = No. blows to drive 2 " spoon 12 " with 140 lb. pin wt. falling 30 "per blow

C = No. blows to drive _____ " casing _____ " with _____ lb. weight falling _____ "per blow

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼" I.D. Hollow Stem Augers/Standard Penetration Test, NX Rock Co

DATE STARTED 1-7-85
FINISHED 1-7-85
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC. SUBSURFACE LOG

HOLE NO X-1
SURF ELEV.
G. W. DEPTH See Notes

PROJECT Cortland County Landfill

LOCATION Town of Solon
Cortland County

DEPTH	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	1	3	7	10	6"	Brown, wet, loose, SILT, little fine-coarse sand, trace gravel organic debris	6" TOPSOIL
			9						
		2	11	12	15	27	12"	Similar	
			13						
		3	9	8	7	15	7"	Similar	
5			8						
		4	9	10	11	21	10"	Similar	Water @ Approximately 9.3'
			14						
		5	100/.2				2"	Similar	
10		6	62	100/.2'			6"	Similar	
								SHALE, w/siltstone 12.2'-12.9' Gray, medium hard, weathered thin bedded, few fractures	Run #1: 11.2'-15.3' 3.8' Recovery RQD 23%
15									
								Terminated @ 15.3'	
20									

N = No. blows to drive 2 " spoon 12 " with 140 lb. pin wt. falling 30 "per blow

C = No. blows to drive ___ " casing ___ " with ___ lb. weight falling ___ "per blow

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼" I.D. Hollow Stem Augers/Standard Penetration Test, NX Rock Core

DATE
STARTED 1-8-85
FINISHED 1-8-85
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

HOLE NO X-2
SURF ELEV
G. W. DEPTH See Notes

PROJECT Cortland County Landfill

LOCATION Town of Solon
Cortland County

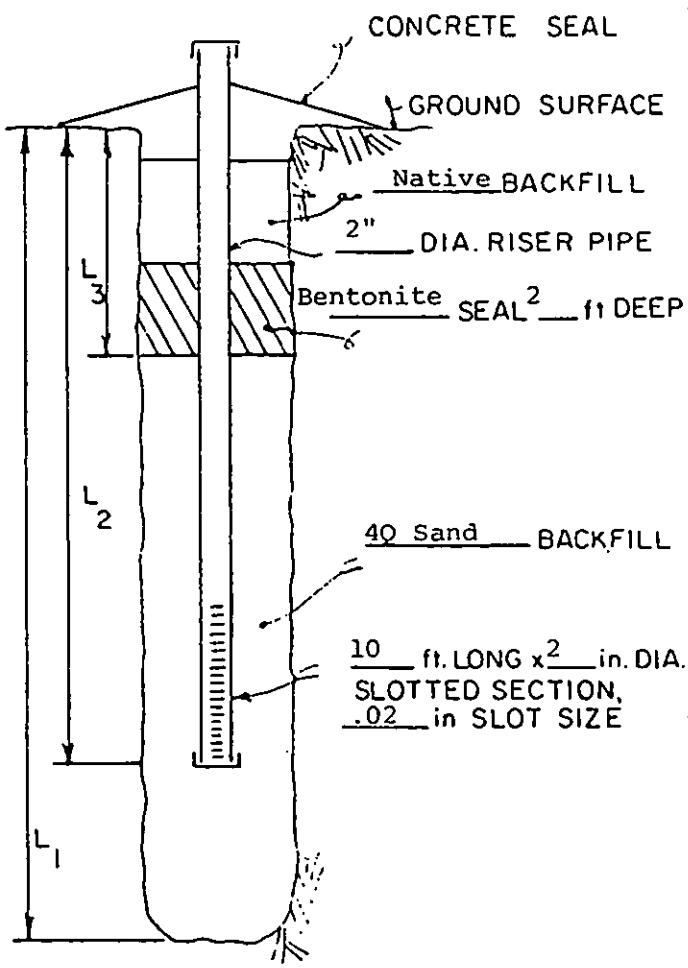
DEPTH FT	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	Sample Rec.	SOIL OR ROCK CLASSIFICATION	NOTES
0									
		1	1	3	8	11	7"	Gray, moist, firm, SILT, little fine-coarse sand, trace gravel, oxidation staining	5" TOPSOIL
			13						
		2	17	32	22	54	12"	Similar	
			20						
5		3	14	10	13	23	18"	Similar	Cobbles encountered through soil profile
			26						
		4	27	24	22	56	15"	Similar	
			37						
		5	17	26	31	57	7"	Similar	
			35						
10		6	28	100/.3'			6"	Similar	Boring Dry
		7	16	19	22	41	10"	Similar	
			30						
15		8	21	23	33	56	12"	Similar	
			40						
		9	37	36	57	93	10"	Similar	
			67						
20		10	37	100/.2'			2"	Similar	
		11	38	21	49	70	10"	Similar	
			63						
		12	19	27	36	63	18"	Similar	
25			44						
		13	46	100/.2'					
		14	48	57	59	116	13"	Similar	
			82						
30								Terminated @ 30.0'	

N = No. blows to drive 2 " spoon 12 " with 140 lb. pin wt. falling 30 "per blow

C = No. blows to drive _____ " casing _____ " with _____ lb. weight falling _____ "per blow.

CLASSIFICATION Visual by Geologist

METHOD OF INVESTIGATION 2¼" I.D. Hollow Stem Augers/Standard Penetration Test



WELL NO.	L_1	L_2	L_3
LT-3	17.6'	17.6'	5.5'
LT-8	32.0'	30.0'	18.0'
LT-7	32.0'	31.0'	18.0'

6" Protective Pipe w/Locking Cap

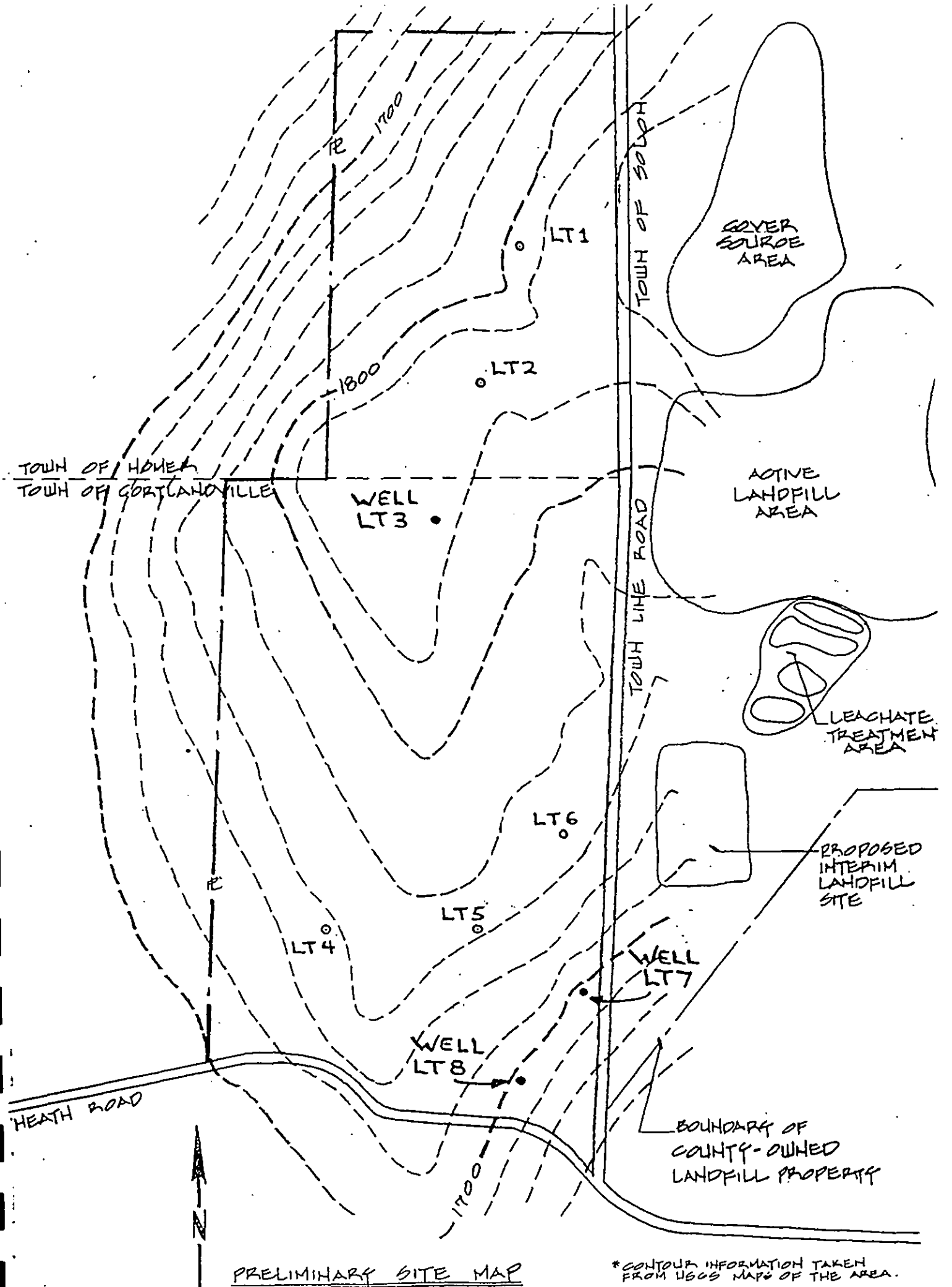
EMPIRE SOILS INVESTIGATIONS, INC

OBSERVATION WELL DETAILS

CORTLAND COUNTY LANDFILL EXPANSION

CORTLAND COUNTY HIGHWAY DEPARTMENT

DR BY FCE	SCALE -	PROJ NO GD-84-96
CKD BY [illegible]	DATE 1-17-85	DRWG NO NA



PRELIMINARY SITE MAP

*CONTOUR INFORMATION TAKEN FROM USGS MAPS OF THE AREA.

APPENDIX C

INTERPRETATION OF EXISTING GEOLOGICAL INFORMATION AND PROPOSED BORING PROGRAM

The site map shows the locations of ten borings which have already been made on the property, as well as ten more which are proposed for the initial program. The information from the original work can be summerized as follows:

Summary of Existing Boring Information

Boring No	Total Depth	Depth to Rock	Depth to Water	Notes
LT1	30	N/E*	9/3	grey @ 12 ft +/-
LT2	15.3	5.3	dry	brown thoughout
LT3 (well)	17.6	7.6	6/9.5	brown thoughout
LT4	33.0	22.1	dry	brown thoughout
LT5	23.0	9.3	8	grey @ 7 ft +/-
LT6	30.2	N/E	1	wet @ 15 ft
LT7 (well)	32.0	N/E	7.3/23.6	grey @ 10 ft
LT8 (well)	30.4	N/E	4.3/11.6	not wet, not grey
X1	15.3	11.2	9.3	wet throughout
X2	30.0	N/E	dry	grey throughout

*N/E indicated Not Encountered

From this information we conclude that (1) the depth of bedrock is very shallow along the topographic ridge that extends NE/SW across the site and plunges to relatively large depths on either side, and (2) the unconsolidated deposits are relatively impervious and any significant groundwater movement will be in the fractured zones of the bedrock. The significance of this is that we will probably be limited to the easterly half of the property as the useful area. Furthermore, it is not likely that a true groundwater table is as shallow as might be indicated by the recorded observations in LT 7 and LT 8.

This leads us to propose a program which is briefy described as follows:

Summary of Proposed Borings

Boring No	Criteria
87-01 87-02	Drill 10' into bedrock & set monitoring well
87-03 thru 87-10	Drill to the lesser of 5' into bedrock or 25' total depth; if bedrock is encountered, instal a well in the rock.

Note that the proposed locations are such as to provide, when taken in conjunction with the previous borings, profiles which are more or less at right angles to the anticipated rock slopes. Also, it is our belief that there is no need to determine the rock depth if it is greater than 25 feet, except in the two downgradient corners. That is, it is our current opinion that a cell depth of twenty feet below existing ground surface is the pragmatic maximum. Hence, there is no need for exploring depths greater than 25 feet. This is especially true on the westerly side which will probably be used only for borrow.

Now -- in respect to monitoring wells, it is our opinion that we need a well set into the bedrock on the downgradient end of the site, on both sides of the divide. These would be Nos. 87-01 & -02. In addition, any other borings which encounter the bedrock should be fitted with wells set into it. In respect to the overburden, we proposed to do in-situ moisture contents, as well as chunk density test if suitable samples can be obtained from the solit-spoon. This, along with the color, should give us reasonable evidence of the zone of saturation. We will then make additional borings, without sampling, to set companion wells just below the zone of saturation and/or in any zones that appear to be relatively permeable. Thus, each location on our sketch will represent a cluster of between one and three wells.

This information and initial boring program was proposed to James Craft, a geologist with the New York State Department of Environmental Conservation for reviewal, comment and future site concurance of boring locations.