National Grinding Wheel
Division of Federal-Mogul Corporation

Hydrogeologic Investigation
Landfill Site

980-795
April, 1981

Advanced Environmental Systems Inc.
Conestoga-Rovers & Associates

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1.0 INTRODUCTION

In December, 1980, Advanced Environmental Systems, Inc. with Conestoga-Rovers & Associates submitted a proposal to National Grinding Wheel to evaluate a former waste disposal area at their North Tonawanda plant. The study was initiated in response to a request from the New York State Department of Environmental Conservation to investigate the possibility of phenol migration from the former waste disposal area. The site is located along the northern edge of the property as shown in Figure 1.

On December 19, 1980, National Grinding Wheel commissioned Advanced Environmental Systems, Inc. and Conestoga-Rovers & Associates to conduct the hydrogeologic investigation. This report presents the results of that investigation.

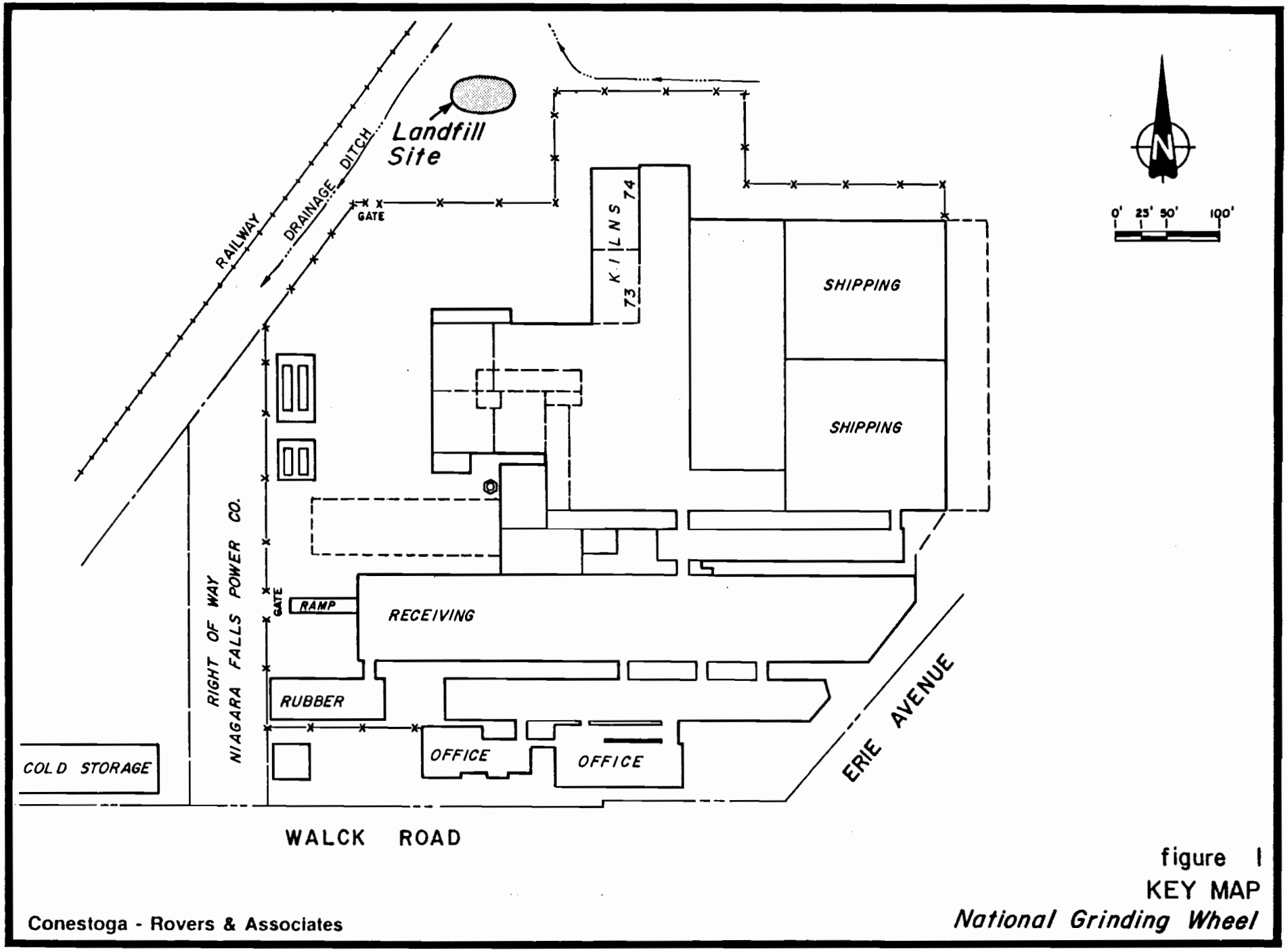

figure 1
KEY MAP
National Grinding Wheel

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2.0 LANDFILL OPERATION

The landfill site at National Grinding Wheel's North Tonawanda plant basically consisted of one large open excavation into which waste materials were periodically discarded and covered. According to Mr. A. Ricotta of National Grinding Wheel, the site was probably in operation seven or eight years ago and was used for an approximate period of one half year.

Around the site location, there is evidence of some surficial debris, a portion of which was placed to provide suitable access to the disposal facility. The site was reported to have been graded on several occasions which may have resulted in some pocketed fill areas.

The best description of the landfilling activities at National Grinding Wheel is found in Mr. A. Ricotta's statement of August 17, 1978, which reads as follows:

> "To the best of our knowledge we determined the size of the pit to be approximately 30 feet x 60 feet x 18 feet deep. The buried material consists of broken vitrified and bakelite wheels, rubber wheels, shellac wheels. There is also miscellaneous items such as raw resinoid mix, dust collector fines, old gloves, paper and sand. The percentage of volume of each material is indeterminate at this time. This refuse is covered with approximately three feet of soil which at present is not seeded."

3.0 OBSERVATION WELL INSTALLATION PROGRAM

From January 12 to 14, 1981, Empire Soils Investigations, Inc. installed a total of five (5) groundwater monitoring wells in and around the former disposal area as shown in Figure 2. Four (4) of these monitoring wells were installed around the perimeter of the disposal area in order to identify groundwater movement through the landfill area. The remaining well was installed directly into the disposal area to provide landfill characteristic information including landfill depth, groundwater conditions and refuse components.

Each of the perimeter wells were installed to the depth of the overburden interface delineating the impermeable clay strata from the more pervious overlaying sand and silt layers. In each of these cases, this interface was encountered at a depth of less than seven (7) feet from the ground surface.

The wells were constructed of two inch diameter black steel pipe welded to a two foot length of Johnson stainless steel well screen (#10 slots). Following the installation of a measured sandpack and bentonite seal around the screen, the remaining annular space around the well was backfilled with a cement grout mixture to the ground surface. Each well was then fitted

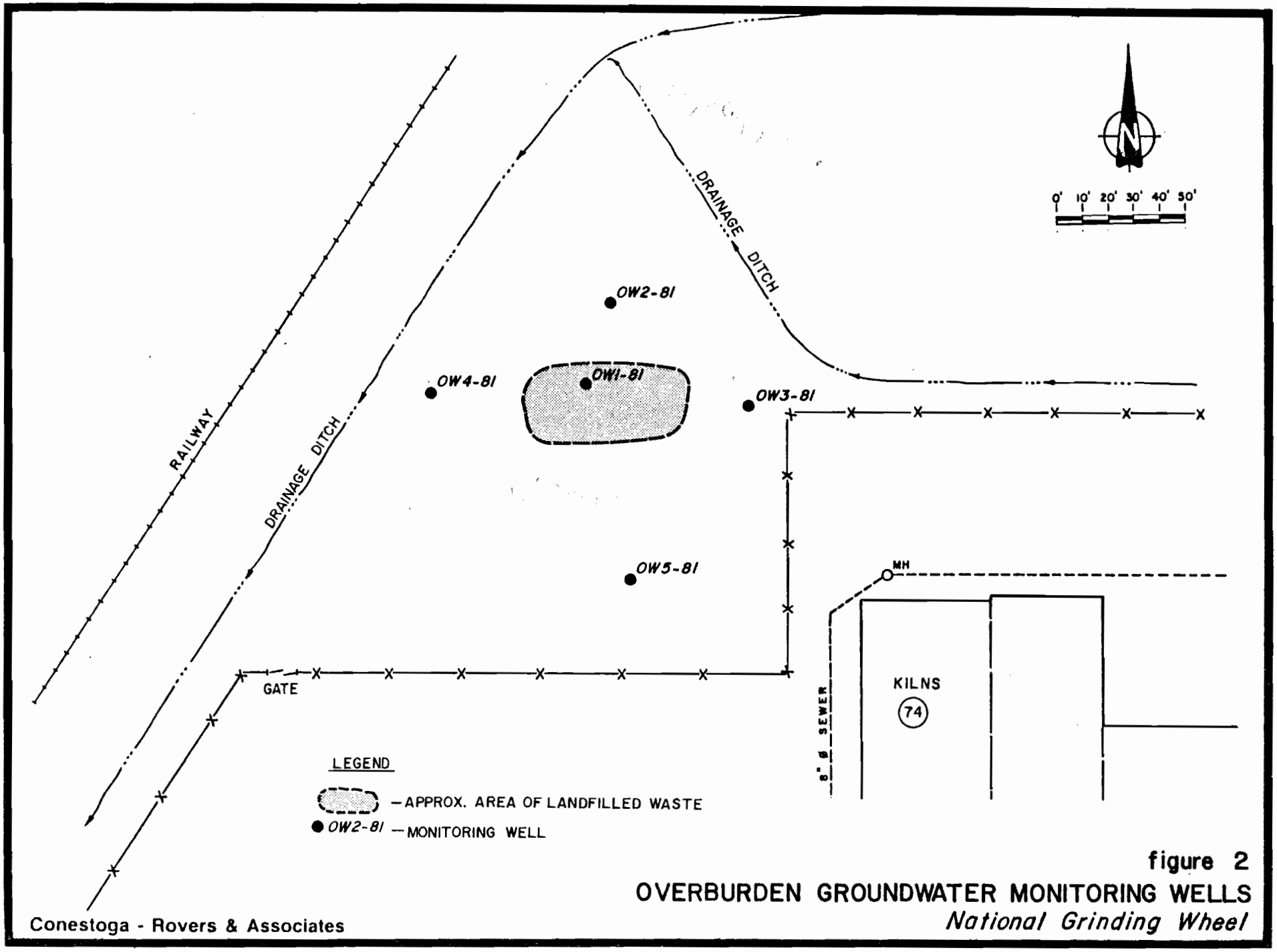

figure 2

OVERBURDEN GROUNDWATER MONITORING WELLS

National Grinding Wheel

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with a lockable cap. Complete installation details of a typical monitoring well installation are illustrated in Figure 3. Details of the well installation program are presented in Table 1.

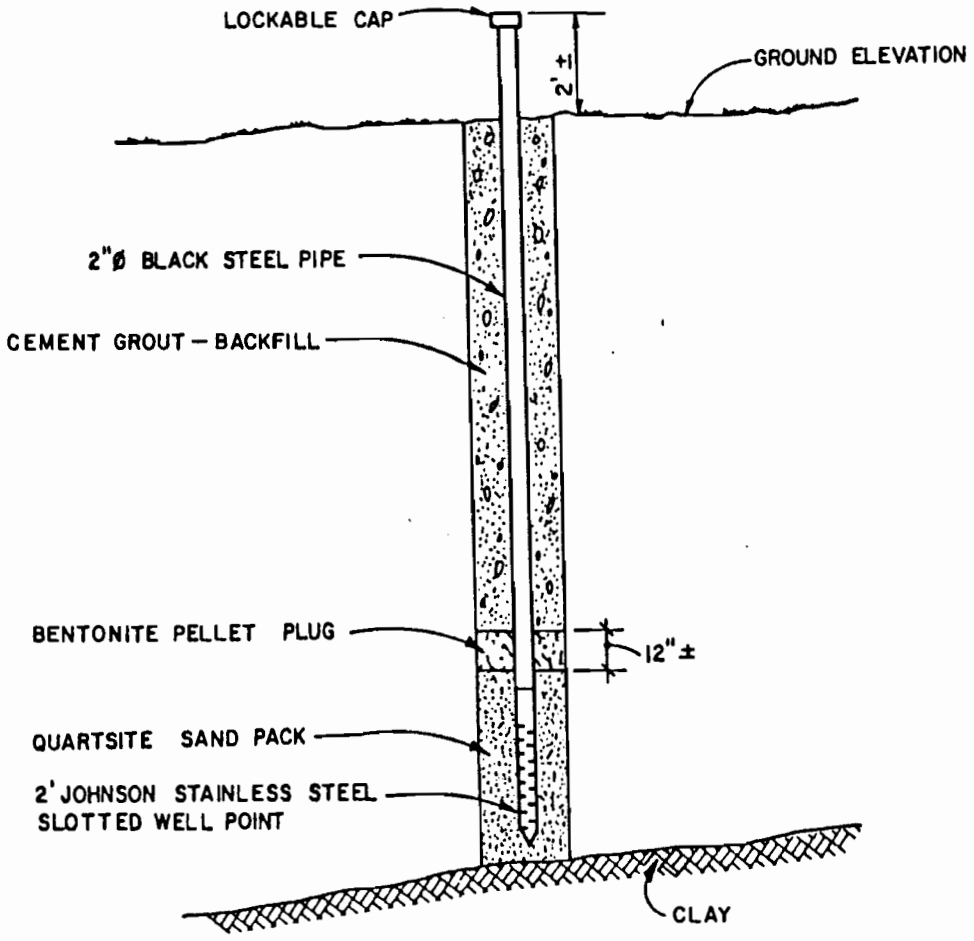

figure 3
TYPICAL MONITORING
WELL INSTALLATIONS
National Grinding Wheel

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TABLE 1

WELL INSTALLATION DETAILS
NATIONAL GRINDING WHEEL

Well No.	Installation Type	Top of Casing Elevation	Ground Elevation	Bottom of Well Screen Elevation	Sandpack Interval Elevations
OW 1-81	Overburden - Landfill Base	101.92	100.1	89.9	90.1 to 95.1
OW 2-81	Overburden - Clay Interface	101.97	99.8	95.0	95.0 to 97.8
OW 3-81	Overburden - Clay Interface	103.64	99.4	94.6	94.4 to 97.4
OW 4-81	Overburden - Clay Interface	103.37	99.9	96.1	94.9 to 98.1
OW 5-81	Overburden - Clay Interface	103.30	100.2	93.7	93.2 to 95.7

Benchmark Note: The reference benchmark for this project was the concrete floor slab in Building 74, elevation = 99.96 feet.

4.0 HYDROGEOLOGIC INVESTIGATION

4.1 ON-SITE STRATIGRAPHY

The overburden material at the former disposal site was sampled during the monitoring well installation program through the use of a split spoon sampler. The soil stratigraphy encountered was similar to that logged during a previous soil investigation conducted for the Production Building Expansion foundation in 1978. The drilling logs from the 1981 landfill investigation are contained in Appendix 'A'. Appendix 'B' contains the 1978 drilling logs for the foundation investigation.

The stratigraphic pattern at the site consists of an upper zone of silt and sand materials. This strata was generally limited to the upper five feet of overburden materials. A perched water table was encountered in this soil strata. Underlying the silt and sand is a stiff, layered, silty clay three to five feet in thickness. Beneath this layered zone the silty clay becomes soft and changes to a consistent reddish-brown color. Underlying the silty clay materials a silt till was encountered. The foundation investigation indicates that the till layer was an average of four feet thick.

No sampling beyond the till layer was conducted during the course of the landfill investigation. However, the driller's logs for the foundation investigation from 1978 indicate that underlying the till was a mixture of sand, silt and rock fragments. All of the boreholes conducted for the foundation investigation terminated with refusal on the dolostone bedrock formation at an average depth of 38 feet.

Two cross-sections of the soil stratigraphy in the landfill area have been prepared. The plan view showing the cross-section locations is presented in Figure 4. The two cross-sections are presented in Figures 5 and 6.

The drilling of the monitoring well into the central portion of the landfill site revealed a number of the landfill characteristics. Typical materials recovered from the split spoon sampling included sand, grinding wheel fragments, glass, rock, and plastic film. The wet condition of the materials encountered indicated that the landfill was in a saturated condition. One interesting note regarding the water encountered in the landfill well was its reddish color. The depth of fill material extended to approximately 10.5 feet.

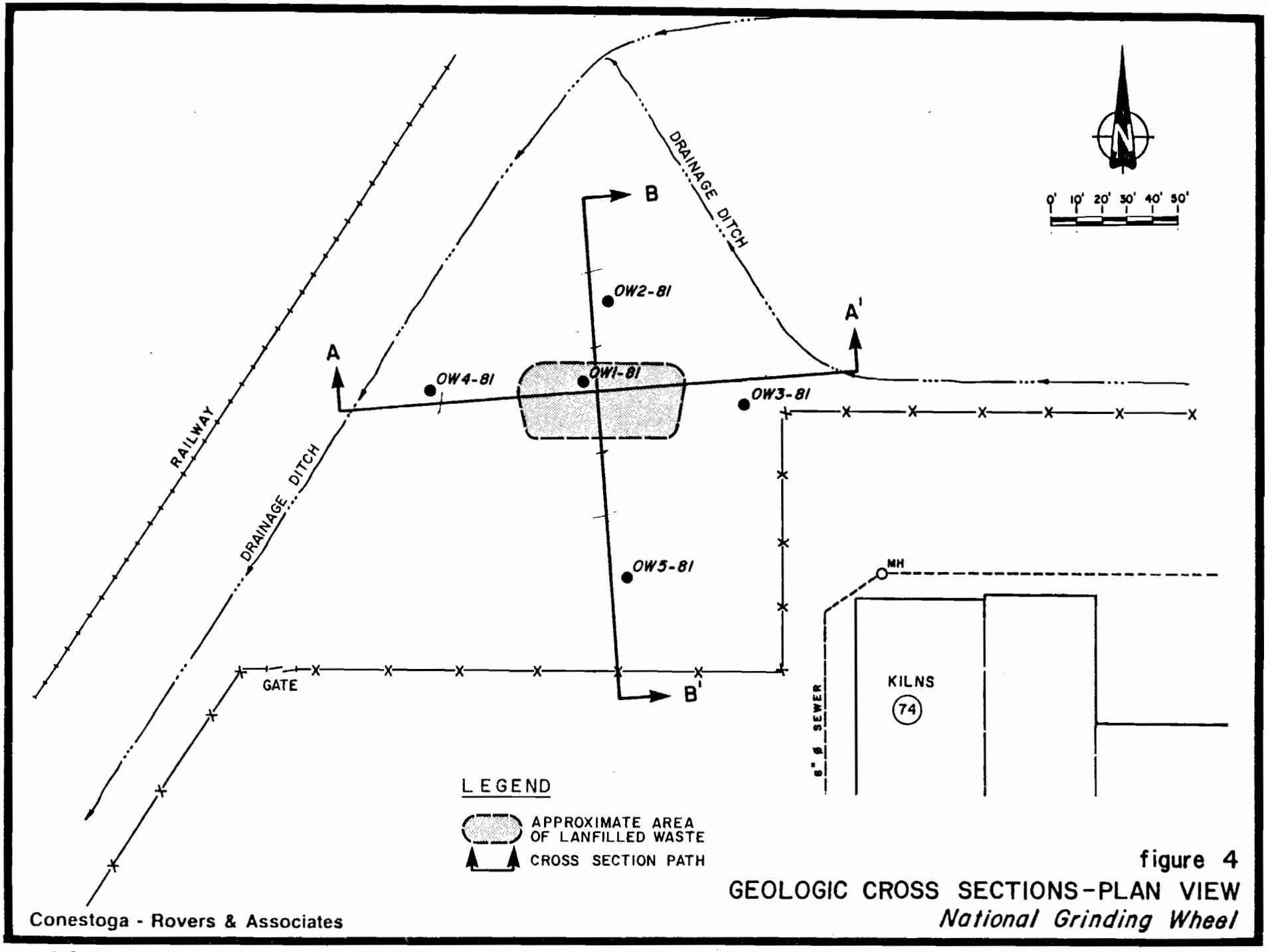

figure 4

GEOLOGIC CROSS SECTIONS - PLAN VIEW

National Grinding Wheel

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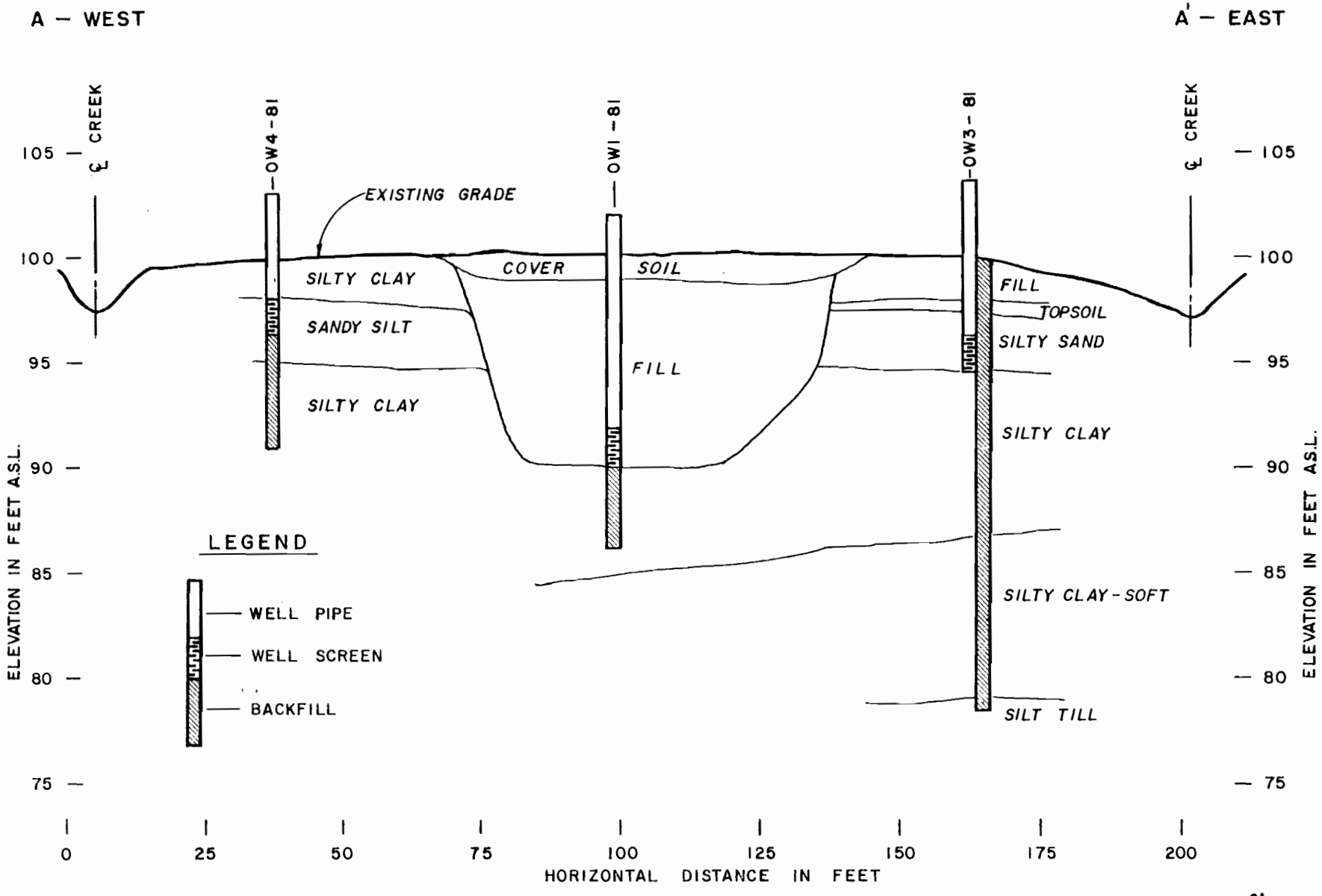

figure 5

GEOLOGIC CROSS SECTION A-A'

National Grinding Wheel

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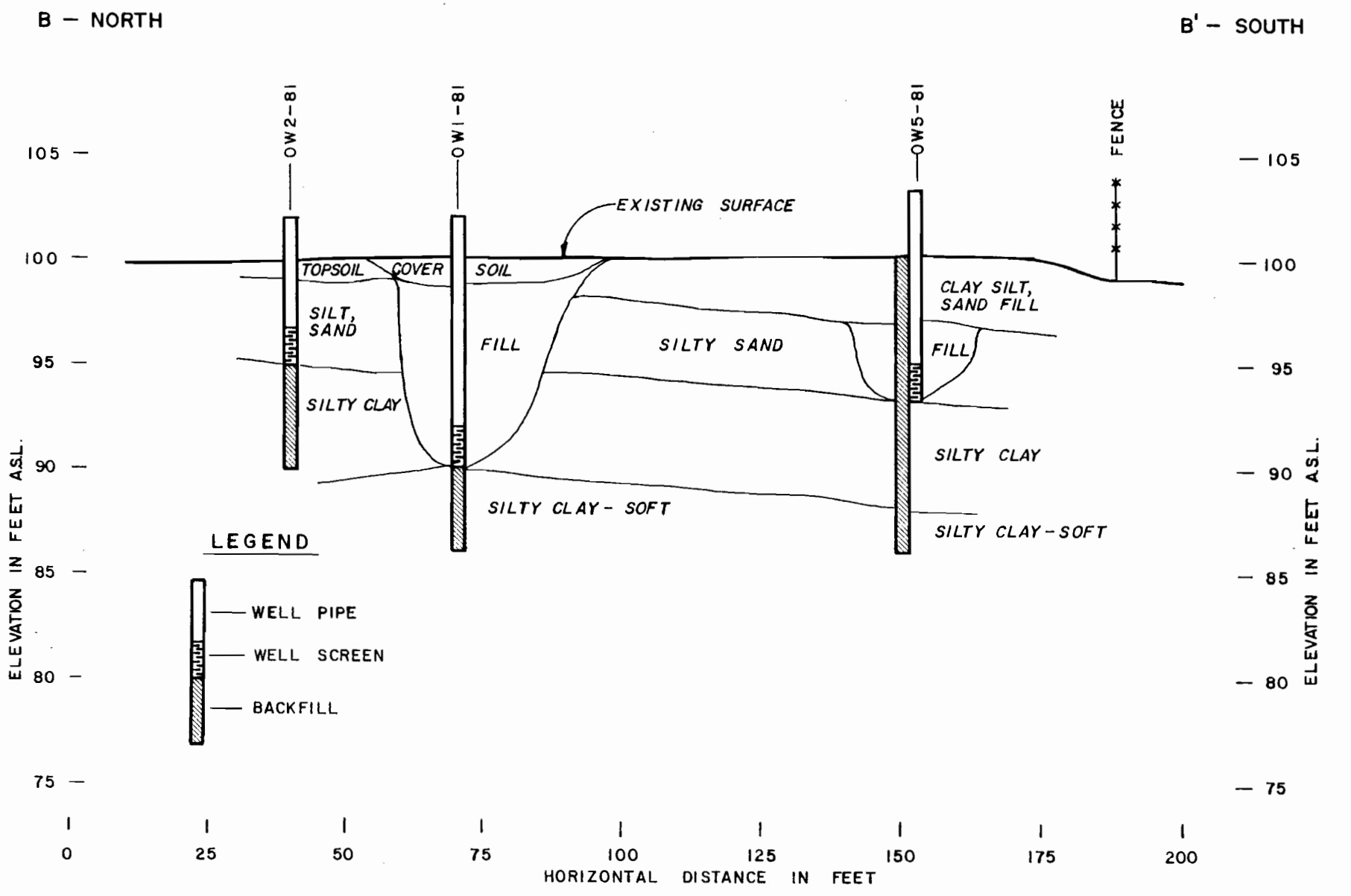

figure 6

GEOLOGIC CROSS SECTION B – B'

National Grinding Wheel

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The drilling program also identified the possibility that there may be other smaller pockets of deposited refuse as was noted at OW 5-81.

4.2 GROUNDWATER

The drilling indicated that a perched water table is present in the silt and sand deposits of the upper overburden regime. As no water was encountered in the less pervious silty clay materials, the monitoring wells were set into the overlying silt and sand deposits. The exceptions to this were OW 1-81 and OW 5-81 which were set into the base of the fill materials encountered.

In order to establish the groundwater flow pattern through the landfill area, a groundwater level monitoring program was initiated. Through this program, groundwater elevations were measured on a weekly basis. The results of the monitoring program are presented in Table 2.

Review of the groundwater data collected indicates that a slight mounding of the

TABLE 2

GROUNDWATER MONITORING PROGRAM
NATIONAL GRINDING WHEEL

DATE / WELL NO.	WELL CASING ELEV.	Jan. 22 1981	Jan. 29 1981	Feb. 6 1981	Feb. 9 1981	Feb. 19 1981	Feb. 27 1981	Mar. 6 1981	Mar. 13 1981	Mar. 23 1981	Mar. 31 1981
		WATER ELEVATION									
OW 1-81	101.92	97.64	97.89	98.27	98.05	99.57	98.71	98.39	98.28	98.26	98.24
OW 2-81	101.97	96.99	98.23	98.09	97.77	99.32	98.26	97.90	97.89	98.21	98.13
OW 3-81	103.64	97.08	97.97	98.07	97.84	99.23	98.38	97.95	97.79	97.84	97.60
OW 4-81	103.37	--	96.84	97.44	96.92	97.76	97.52	96.99	97.18	97.03	96.00
OW 5-81	103.30	99.24	97.83	98.65	97.69	98.56	97.93	97.64	97.73	97.67	97.51

Benchmark Note: The reference benchmark for this project was the concrete floor slab in Building 74, elevation = 99.96 feet.

groundwater table has occurred in the waste disposal area. This indicates that precipitation infiltration through the disturbed cover material is presently occurring and exceeds the infiltration through the surrounding soil. The net result of the mounding effect is that flow from the landfill cell generally radiates outward in all directions as noted in Figure 7.

The groundwater gradient is steepest in the westward direction toward OW 4-81. This is probably the result of the fact that the soils at OW 4-81 appeared to be the least pervious of the perched water bearing zones encountered.

During the installation of OW 3-81, some reddish colored water (similar to that encountered in OW 1-81) was noted. This indicates an impact from the site exceeding that in other areas around the site. This suggests that the major quantity of overburden groundwater flow from the landfill is easterly.

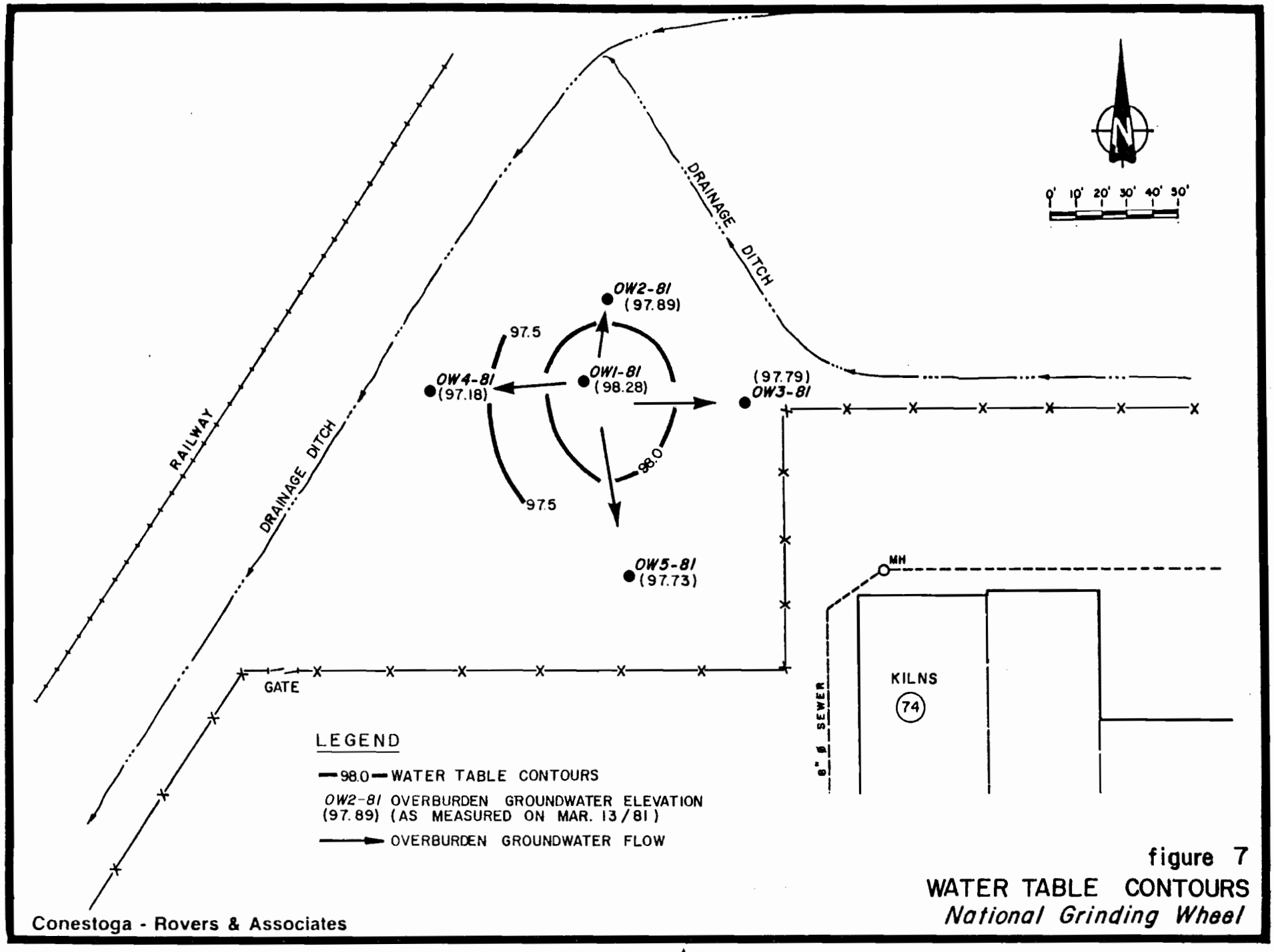

figure 7
WATER TABLE CONTOURS
National Grinding Wheel

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5.0 CHEMICAL ANALYSIS

5.1 SAMPLING PROGRAM

The sampling program conducted as a part of the hydrogeologic investigation of the landfill site included the collection of both soil and water samples.

The soil sample was collected as a composite to represent the landfill wastes encountered during the drilling of OW 1-81. This composite was submitted to Advanced Environmental Systems, Inc. for a New York State Leaching Potential Test.

Water samples were collected from each of the installed groundwater monitoring wells on two separate occasions (February 17, 1981 and March 4, 1981). These samples were taken to Advanced Environmental Systems, Inc. for chemical analysis. Each sample was tested for pH (on-site), conductivity, total organic carbon, phenolics (total recoverable), and aluminum (total).

5.2 ANALYTICAL RESULTS

The analytical results for the soil sample collected during the drilling program are presented in Table 3. The analytical results of water samples collected on February 17, 1981, and March 4, 1981, are presented in Table 4.

From the analytical water sampling results, it is noted that all five parameters were measured at elevated levels in the landfill well, OW 1-81. Comparatively speaking, the parameter levels measured in the perimeter wells show significantly reduced chemical concentrations. The phenol concentration in the water at OW 3-81 and the aluminum concentration at OW 3-81, OW 4-81 and OW 5-81 show that some chemical migration from the area of disposal has occurred.

TABLE 3

ANALYTICAL RESULTS - SOIL SAMPLE

NATIONAL GRINDING WHEEL

Analysis	Matrix	Results
pH Composite	Sample	9.29
Phenols	Leachate	18.7 (mg/l)
TOC	Leachate	90.4 (mg/l)
Aluminum	Leachate	<0.500 (mg/l)
Conductivity	Leachate	817. (umhos)

New York State Leaching Potential Test

Analysis Performed By: Advanced Environmental Systems, Inc.

TABLE 4

CHEMICAL ANALYSIS
MONITORING WELL SAMPLES
NATIONAL GRINDING WHEEL

Sample	pH		Conductivity (umhos/cm)		TOC (mg/l)		Phenols (mg/l)		Aluminum (mg/l)	
	2/17/81	3/4/81	2/17/81	3/4/81	2/17/81	3/4/81	2/17/81	3/4/81	2/17/81	3/4/81
OW 1-81	10.1	10.0	7,660.	7,020.	5,300.	5,740.	952.	1,150.0	14.5	6.75
OW 2-81	7.34	6.84	1,740.	1,500.	43.3	4.6	0.018	0.006	0.50	<0.5
OW 3-81	7.00	6.66	1,800.	1,600.	21.1	19.3	1.68	1.04	1.75	<0.5
OW 4-81	7.26	6.81	1,610.	1,450.	5.0	17.1	0.011	0.028	1.60	3.35
OW 5-81	7.26	6.71	1,320.	1,140.	5.1	6.8	0.013	0.011	70.0	1.35
Creek	7.03		423.		15.8		0.005		0.50	
Field Blank	8.32	6.66	3.97	4.3	1.4	<1.0	<0.001	<0.001	<0.50	<0.5

Analysis Performed By: Advanced Environmental Systems, Inc.

6.0 ENVIRONMENTAL CONCERNS

The excavation of the landfill pit and subsequent disposal into the overburden regime should not pose a significant environmental hazard with respect to the groundwater regime at depth. The low permeability of the silty clay which forms the landfill walls and base appear to be suitable for such containment. Even if the landfill were to extend to a depth of 18 feet, as reported, the landfilled wastes should still be within the confines of the silty clay and silt till regimes. This is based on the fact that the silt till layer was encountered 20 feet below the surface at OW 3-81. Assuming an average 4 foot depth of till material, and one foot of silt, sand and rock, similar to that encountered on the foundation drilling program in 1978, the overburden-bedrock interface should be on the order of 25 feet below grade.

The perched groundwater table is impacted by the presence of the landfilled wastes. However, it is difficult to determine the extent to which this low level contamination results from the main landfill body as small isolated waste pockets similar to that identified at OW 5-81 may be contributing to the contaminant levels noted.

The elevated levels of chemicals in the water in the disposed waste are of concern and should be contained to protect the surrounding area. The drainage ditch which circumnavigates all but the south side of the landfill is probably connected to the perched groundwater regime. Only a high TOC level was noted in the water sample taken from the drainage ditch.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are formulated from the hydrogeologic investigation presented in this report:

1. It is concluded that with the exception of the upper ±5 feet of the overburden regime, the disposed waste is contained in a relatively impermeable soil of silty clay.

2. It is concluded that radial flow of leachate from the disposed waste is occurring.

3. It is concluded that the leachate flow has resulted in low level off-site chemical impact.

4. It is recommended that a program be initiated to determine the extent of small waste pockets in the landfill area.

5. It is recommended that a clay barrier wall be installed around the perimeter of the defined landfill area keyed to a depth of two feet into the native clay regime.

6. It is recommended that the area within the barrier wall be graded to provide suitable drainage from the landfill.

7. It is recommended that the entire landfill area be covered with a three foot clay cover having a maximum permeability of 10^{-7} cm/sec.

8. It is recommended that the clay capped area be covered with topsoil and seeded to prevent erosion.

All of which is respectfully submitted,

ADVANCED ENVIRONMENTAL SYSTEMS INC.

W. Joseph McDougall

W. Joseph McDougall, PhD
President

and CONESTOGA-ROVERS & ASSOCIATES

Frank A. Rovers, P.Eng.

James Kay

James K. Kay, P.Eng.

APPENDIX "A"

1981 MONITORING WELL INSTALLATIONS

DRILLING LOG

Project Name: National Grinding Wheel Landfill Site
Job No. 980-795
Client: NATIONAL GRINDING WHEEL
Borehole Type: 8" Ø Hollow Stem Augers
Location: Center of Disposal Area

Borehole No. OW1-81
Date Completed Jan. 12 - 13/81
Geologist/Engineer J. Kay
Elevation 100.1

Profile			Sample			Penetration Test Blows/Foot	Piezometer or Standpipe Installation
Depth (Elev.)	Stratigraphy	Description & Remarks	Number	Type	Blows/Foot	20 40 60 80	
0		Br. red & or. silt & cl. cover-mottled	1	SS	5		Cap 101.92
			1	SS	18		100.1
		Fill - grinding wheels, stone, glass and plastic in a sand and fine gravel matrix - wet	2	SS	41		Grout
		- reddish black oily liquid	2	SS	17		Bentonite Plug
5			3	SS	23		
			3	SS	33		Sandpack
			4	SS	4		
			4	SS	10		Well Screen
			5	SS	38		
10			5	SS	4		90.1
		Medium brown silty clay - soft	6	SS	5		Native Backfill
			6	SS	4		
			7	SS	5		
			7	SS	4		86.1
15							
		Notes - Augered to 10' depth - Well Screen - Johnson Stainless Steel - 2' long - 2" dia. - #10 slots - Well pipe - 2" dia. Black Steel Pipe					

Project Name: National Grinding Wheel Landfill Site
Job No. 980-795
Client: NATIONAL GRINDING WHEEL
Borehole Type: 8" Ø Hollow Stem Augers
Location: North of Disposal Area

Borehole No. OW2-81
Date Completed Jan. 13/81
Geologist/Engineer J. Kay
Elevation 99.8

Depth (Elev.)	Stratigraphy	Description & Remarks	Sample Number	Sample Type	Sample Blows/Foot	Penetration Test Blows/Foot (20 40 60 80)	Piezometer or Standpipe Installation
							Cap 101.97
0 (99.8)		Topsoil	1	SS	5		99.8 Grout
		Br. & or. silty fine sand-some vegetat.	1	SS	5		Bentonite Plug
		Medium brown silty fine sand	2	SS	7		
		- orange streaks	2	SS	19		Sandpack
		- wet at 4'	3	SS	15		Well Screen
5 (94.8)		Red, brown and gray silty clay layers	3	SS	31		
		- stiff	4	SS	43		
		- occasional parting of fine sand & silt	4	SS	48		
			5	SS	46		Bentonite Plug
		Reddish br. & gr. silty clay - stiff	5	SS	50		89.8
10							
15							

Notes - Augered to 5' depth
- Well Screen - Johnson Stainless Steel
  - 2' long
  - 2" dia.
  - #10 slots
- Well Pipe - 2" dia. Black Steel Pipe

Project Name: National Grinding Wheel Landfill Site
Job No. 980-795
Client: NATIONAL GRINDING WHEEL
Borehole Type: 8" Ø Hollow Stem Augers
Location: East of Disposal Area

Borehole No. OW3-81
Date Completed Jan. 13/81
Geologist/Engineer J. Kay
Elevation 99.4

Depth (Elev.)	Stratigraphy	Description & Remarks	Sample Number	Sample Type	Sample Blows/Foot	Penetration Test Blows/Foot (20 40 60 80)	Piezometer or Standpipe Installation
0		Fill - brown and orange silt, sand and clay	1	SS	7		Cap 103.64; 99.4; Grout
			1	SS	11		
		Topsoil					Bentonite Plug
		Medium brown silty fine sand - wet					Sandpack
5							Well Screen 94.4
		Brown, red and gray silty clay layers	2	SS	17		
			2	SS	33		
		Medium brown silty clay					
10			3	SS	18		
			3	SS	22		
		Medium and reddish brown silty clay - soft					
15			4	SS	Wh**		
			4	SS	3		
			Shelby Tube				
			5	SS	Wr*		
20		Reddish brown clayey silt till	5	SS	9		
		Notes - original borehole augered to 17' depth and samples to 21' depth - backfilled with cement grout - well installed in borehole located 3' North of original borehole - Shelby Tube sample taken 17' to 19' depth Well Screen & Well Pipe same as #1-81					
25							

* Wr - Weight rods
** Wh - Weight rods and hammer

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Project Name: National Grinding Wheel Landfill Site
Job No. 980-795
Client: NATIONAL GRINDING WHEEL
Borehole Type: 8" Ø Hollow Stem Augers
Location: West of Disposal Area

Borehole No. OW4-81
Date Completed Jan. 14/81
Geologist/Engineer J. Kay
Elevation 99.9

Depth (Elev.)	Stratigraphy	Description & Remarks	Sample Number	Sample Type	Sample Blows/Foot	Penetration Test Blows/Foot (20 40 60 80)	Piezometer or Standpipe Installation
							Cap 103.37
0 (99.9)		Brown, red and tan silty clay	1	SS	8		99.9
			1	SS	7		Grout
		Medium brown fine sandy silt - very moist					Bentonite Plug
							Sandpack
5		Brown, gray, red and tan silty clay layers - occasional parting of silt and fine sand	2	SS	14		Well Screen 94.9
			2	SS	22		
			3	SS	37		Bentonite Plug
			3	SS	46		90.9
10							

NOTES - Augered to 5' depth
- Well Screen - Johnson Stainless Steel
  - 2' long
  - 2" dia.
  - #10 slots
- Well Pipe - 2" dia. Black Steel Pipe

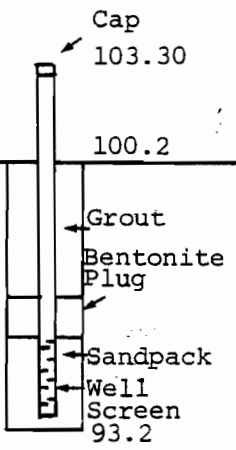
Project Name: National Grinding Wheel Landfill Site
Job No. 980-795
Client: NATIONAL GRINDING WHEEL
Borehole Type: 8" Ø Hollow Stem Augers
Location: South of Disposal Area

Borehole No. OW5-81
Date Completed Jan. 14/81
Geologist/Engineer J. Kay
Elevation 100.2

Depth (Elev.)	Stratigraphy	Description & Remarks	Sample Number	Sample Type	Sample Blows/Foot
0		Fill - Brown and orange clay silt, and fine sand - trace vegetation and topsoil	1	SS	12
			1	SS	10
5		Fill - grinding wheels and stones - few chunks of medium brown sandy silt - wet	2	SS	9
			2	SS	14
10		Reddish brown and gray silty clay	3	SS	15
			3	SS	23
		Reddish brown silty clay - soft	Shelby Tube		
15		Notes - Original borehole augered to 10' depth and sampled to 14' depth - backfilled with cement grout - Well installed in borehole located 3' South of original borehole - Shelby Tube sample taken 12' to 14' depth - Well screen - same as #1-81 - Well Pipe - same as #1-81			

Penetration Test Blows/Foot: 20 40 60 80

Piezometer or Standpipe Installation



APPENDIX "B"

1978 FOUNDATION INVESTIGATION

DRILLING LOG

DATE
STARTED 3/14/78
FINISHED 3/14/78
SHEET 1 OF 2

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-1
SURF. ELEV.
G. W. DEPTH See Note

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
0								FILL: BRICK, CINDERS 2.0'	Note: At completion, no free water
		1	9	4	5	9		Gray slightly Organic SILT, Some Clay, trace fine sand, occasional seams of fine sand, rust stained throughout (Moist to Wet- Medium to Stiff) 8.0'	
5		2	3	4	10	14			
10		3	9	14	18	32		Reddish Brown Varved CLAY, occasional partings of silt (Moist-Very Stiff to Hard)	
15		4	1	1	1	2		-becomes Very Soft (Wet)	
20		5	1/1.0'		1	1			
25		6	1/1.0'		1	1		(Moist to Wet-Hard to Soft) 28.0'	
30		7	2	6	3	9		Brown SILT & fine SAND, little clay and fine gravel (Moist to Wet-Loose) 33.0'	
35		8	11	0	116/0.4'			Gray, Brown fine SAND & SHALE FRAGMENTS, little silt -grades Gray Brown fine SAND, fine GRAVEL & ROCK FRAGMENTS	
40									

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.
METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

CLASSIFICATION Visual by Soils Technician

DATE
STARTED 3/14/78
FINISHED 3/14/78
SHEET 2 OF 2

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-1 cont
SURF. ELEV
G. W. DEPTH

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18-	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
40		9	42	105	65	170		Gray to Light Gray GYPSUM & ROCK FRAGMENTS (Mst-V.Cmpt) 41.8'	
		10	175/0.4'					Gray DOLOSTONE, HARD, FRACTURED	Cored 41.8' - 46.3' Run #1 40% Recovery BX Core
45								45.0 to 46.3 Gray to Light Gr. Gypeous DOLOSTONE, Medium Hard, Fractured	
								Bottom of Hole @ 46.3'	
50									

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 Soils Technician

METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

DATE
STARTED 3/15/78
FINISHED 3/15/78
SHEET 1 OF 2

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-2
SURF. ELEV.
G. W. DEPTH See Note

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18-	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
0								FILL: CINDERS 2.0'	Note: Driller indicates ground water @ 4.0' after taking Sample #2. At completion, free water @ 19.0'
		1	7	7	12	19		Grayish Brown SILT, Some to little Clay (Moist-Firm) occasional rust stained partings of fine sand, grades Brown very fine SAND & SILT, with thin fine to medium Sand seams (Wet-Firm) 9.0'	
5		2	5	8	15	23			
10		3	7	10	15	25		Reddish Brown Varved CLAY (Moist-Very Stiff)	
15		4	2	2	1	3		-becomes Soft (Wet)	
20		5	1	1	1	3		-becomes Very Soft	
25		6	1/1.0'		1	1		(Moist to Wet-Very Stiff to Very Soft) 28.0'	
30		7	1	2	4	6		Brown SILT, Some fine Sand & fine embedded Gravel, little clay (Wet-Loose)	
35		8	35	120	125	245		-grades Reddish Brown SILT & fine SAND, Some fine embedded Gravel (Moist-Very Compact)	
40									

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
METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

CLASSIFICATION Visual by Soils Technician

DATE
STARTED 3/15/78
FINISHED 3/15/78
SHEET 2 OF 2

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-2 cont
SURF. ELEV.
G. W. DEPTH

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT.	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18-	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
40		9	200/0.4'					Grayish Brown SILT, fine SAND & ROCK FRAGMENTS	
		10	100/0.2'					(Moist-Very Compact)	
45								Auger Refusal and Bottom of Hole @ 43.8'	

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 Soils Technician

METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

DATE
STARTED 3/15/78
FINISHED 3/15/78
SHEET 1 OF 2

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-3
SURF. ELEV.
G. W. DEPTH See Note

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18-	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
0								FILL: CINDERS 2.0'	Note: Driller notes ground water @ 14.0' after taking Sample #7. At completion, free water @ 27.0'
		1	6	10	12	22		Brown CLAY, little silt, trace fine sand	
5		2	3	5	11	16		-with occasional thin fine sand seams (Wet) 9.0'	
10		3	7	10	13	23		Reddish Brown Varved CLAY, occasional Gray silt partings	
								-grades to Medium Stiff	
15		4	4	4	5	9			
								-becomes Very Soft (Wet)	
20		5	Wt. of Drill Rods						
25		6	Wt. of Drill Rods					(Moist to Wet-Very Stiff to Very Soft) 28.0'	
30		7	3	9	18	27		Reddish Brown SILT, Some fine Sand & fine Gravel, little clay (Moist-Firm)	
								-grades Gray Rock Fragments, fine to medium Sand (Wet-Very Compact)	
35		8	30	47	60	107			
								39.0'	
40		9	100/0.0'						

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
METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place
CLASSIFICATION Visual by Soils Technician

DATE
STARTED 3/15/78
FINISHED 3/15/78
SHEET 2 OF 2

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-3 cont
SURF. ELEV.
G. W. DEPTH

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18-	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
40								Gray to Light Gray Gypseous Dolostone, Medium Hard, fractured Gypsum seams @41.0' and 42.0'	Cored 39.0' - 44.0' Run #1 75% Recovery BX Core
45								Bottom of Hole @ 44.0'	

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 Soils Technician

METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

DATE
STARTED 3/16/78
FINISHED 3/16/78
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-4
SURF. ELEV.
G. W. DEPTH See Note

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
0								FILL: SAND, CINDERS, GRAVEL SILT, fine SAND, trace glass	Note: At completion, free water @ 15.0'
		1	10	6	6	12		(Moist-Firm) 4.0'	
5		2	5	9	9	18		Gray Brown SILT & fine SAND, trace clay & roots with thin fine Sand seams (Wet-Firm) 6.0'	
								Reddish Brown Varved CLAY, occasional partings of silt	
10		3	6	12	15	27		(Moist-Very Stiff)	
								-becomes Soft	
15		4	4	3	3	6			
20		5	1/1.0'		1	1		-becomes Very Soft (Wet)	
25		6	1	2	1	3		(Moist to Wet-Very Stiff to Very Soft) 27.0'	
								Reddish Brown SILT & fine SAND, Some fine embedded Gravel and Rock Fragments	
30		7	9	22	30	52			
35		8	50	78	56	134		(Moist-Very Compact) 36.0'	
		9	37	101	125/0.4'			Gray Light Gray ROCK FRAGMENTS weathered GYPSUM, Some fine Sand (Moist-V.Compact) 37.1'	
40								Bottom of Hole @ 37.1'	

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 Soils Technician

METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

DATE
STARTED 3/17/78
FINISHED 3/17/78
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO B-78-5
SURF. ELEV
G. W. DEPTH See Note

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
0								TOPSOIL 3'	Note: Driller indicates ground water @ 14.5' after taking Sample #4. At completion, free water @ 24.5'
								FILL: SILT, CINDERS, SAND 2.0'	
		1	5	5	6	11		Grayish Brown SILT & fine SAND rust stained (Wet-Firm) 4.0'	
5		2	7	7	14	21		Brown SILT, Some Clay, trace sand (Moist-Very Stiff)	
								-grades to Reddish Brown Varved CLAY, occasional partings of silt	
10		3	6	15	15	30			
								-grades to Medium-Stiff	
15		4	3	3	3	6			
								-becomes Very Soft (Wet)	
20		5	1	1	10'	1			
25		6	Wt. of Hammer					(Moist to Wet-Hard to Very Soft) 28.0'	
								Brown fine to medium SAND, little silt	
30		7	6	11	23	34		(Wet-Compact) 33.0'	
								Gray ROCK FRAGMENTS, Some weathered Gypsum & fine Sand (Wet-Very Compact) 34.5'	
35		8	160/0.5'					Bottom of Hole @ 34.5'	
40									

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 Soils Technician

METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

DATE
STARTED 3/17/78
FINISHED 3/17/78
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-6
SURF. ELEV
G. W. DEPTH See Note

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18-	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
0								FILL: CINDERS, BRICK, SAND 2.0'	Note: Driller indicates ground water @ 14.0' after taking Sample #4 At completion, free water @ 16.0'
		1	6	9	9	18		Grayish Brown SILT & fine SAND with thin fine Sand Seams, rust stained throughout (Moist-Firm) 5.0'	
5		2	8	11	13	24			
								Reddish Brown Varved CLAY, occasional partings of silt (Moist-Very Stiff)	
10		3	6	13	15	28		-becomes Very Soft (Wet)	
15		4	WOH	1	1	2			
20		5	Wt. of Hammer						
25		6	Wt. of Hammer					(Moist to Wet-Very Stiff to Very Soft) 29.0'	
30		7	2	2	4	6		Reddish Brown SILT, Some fine Sand & fine embedded Gravel, little clay (Wet-Loose) -grades Brown SILT, fine SAND & fine GRAVEL (Moist-Very Compact) 34.0'	
35		8	77	135	115	250		Gray ROCK FRAGMENTS, Some fine Sand, weathered Gypsum	
		9	60	78	100	178		(Moist-Very Compact) 38.0'	
40								Bottom of Hole @ 38.0'	

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 Soils Technician

METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

DATE
STARTED 3/17/78
FINISHED 3/17/78
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-7
SURF. ELEV.
G. W. DEPTH See Note

PROJECT National Grinding Wheel Co., Inc. LOCATION North Tonawanda, New York

DEPTH-FT.	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
0								FILL: CINDERS, BRICK, GRAVEL, fine SAND (Wet-Firm) 3.5'	Note: At completion, no free water. 24 hours after completion, water @ 11.0'
	/	1	3	7	10	17			
5	/	2	9	9	14	23		Grayish Brown SILT & very fine sand, rust stained throughout (Wet-Firm) 9.0'	
10	/	3	8	16	24	40		Reddish Brown Varved CLAY (Moist-Hard) -becomes Soft (Moist to Wet)	
15	/	4	4	3	2	5		-becomes Very Soft (Wet)	
20	/	5	WOH		1	1			
25	/	6	1	1	1	2		(Moist to Wet-Hard to Very Soft) 30.0'	
30	/	7	WOH		4	4		Gray SILT, Some fine Sand & fine Gravel, trace clay (Wet-Loose) -grades Reddish Brown SILT & fine SAND, Some fine embedded Gravel (Moist-V.Cmpt) 35.5'	
35	/	8	70	120	100/0.4'			Bottom of Hole @ 35.5'	
40									

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 Soils Technician

METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place

DATE
STARTED 3/20/78
FINISHED 3/20/78
SHEET 1 OF 1

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE LOG

HOLE NO. B-78-8
SURF. ELEV
G. W. DEPTH See Note

PROJECT National Grinding Wheel Co., Inc LOCATION North Tonawanda, New York

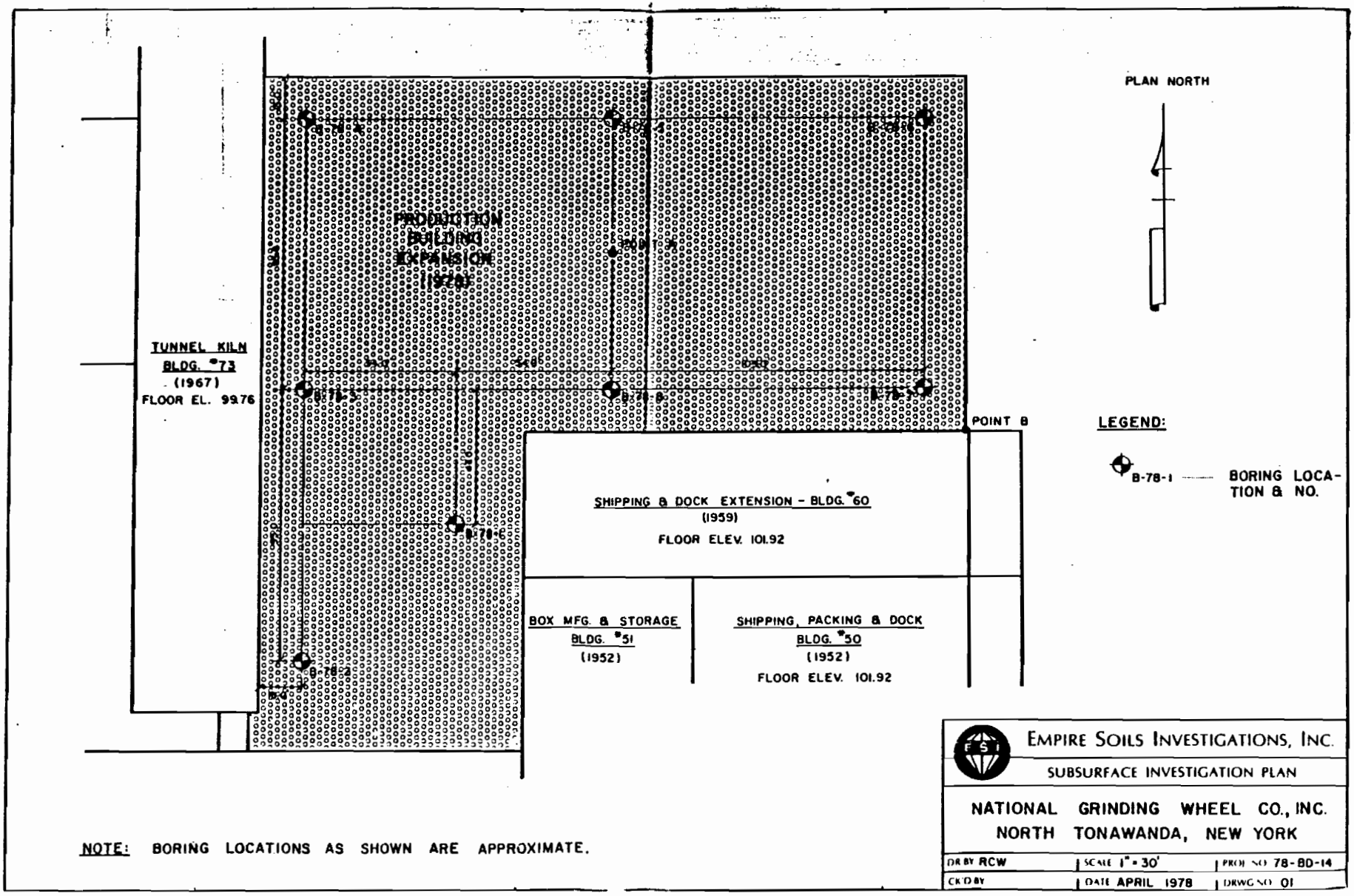
DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18-	N	BLOW ON CASING C	SOIL OR ROCK CLASSIFICATION	NOTES
0								FILL: CINDERS, BRICK, SAND, GRAVEL 2.0'	Note: At completion, free water @ 18.0'
		1	11	6	7	13		Grayish Brown SILT, Some fine Sand, little clay, trace roots (Moist-Firm)	
5		2	6	7	10	17		-grades Grayish Brown SILT & very fine SAND, rust stained throughout (Wet-Firm) 8.0'	
								Reddish Brown Varved CLAY (Moist-Hard)	
10		3	10	14	23	37			
								-becomes Soft (Wet)	
15		4	Shelby Tube						Tube 14.0'-16.0' 300# Pressure 24" Recovery
								-becomes Very Soft	
20		5	Shelby Tube						Tube 19.0'-21.0' 200# Pressure 24" Recovery
25		6	Shelby Tube						Tube 24.0'-26.0' 200# Pressure 24" Recovery
30		7	WOH	1	2	3		(Moist to Wet-Hard to Very Soft) 32.0'	
								Grayish Brown fine SAND & ROCK FRAGMENTS, Some Silt (Moist-Very Compact)	
35		8	40	58	55	113		-grades Gray fine SAND & ROCK FRAGMENTS& weathered Gypsum	
		9	53	67	130	197		(Wet-Very Compact) 37.0'	
40								Bottom of Hole @ 37.0'	

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 Soils Technician

METHOD OF INVESTIGATION Cased Boring, Casing Drilled in Place



NOTE: BORING LOCATIONS AS SHOWN ARE APPROXIMATE.

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE INVESTIGATION PLAN

NATIONAL GRINDING WHEEL CO., INC.
NORTH TONAWANDA, NEW YORK

DR BY RCW	SCALE 1" = 30'	PROJ NO 78-80-14
CK'D BY	DATE APRIL 1978	DRWG NO 01

N

CULVERT PIPE

DUREZ

N. Y. CENTRAL RAILROAD

CLOSE

64

Aloha

56

HYG Plant

Vit Mix
30-2

TO NIAGARA FALLS BLVD

Rubber Dept
21-1 DOWN
21-2 UP

21

Machine Shop

Cold Storage
14

13
Storage

12
Office

WALCK ROAD

LANDFILL

14

73

63

KILN

11

10

62

Box Shop

60

61

51

50

Shipping Room

53

Speeder

52

41 1/2

41

40

Cutter Room

Die Mfg & Press 30-2

Vit Press 30-2

Chucks 30-2

30 — 30-1 DOWN STAIRS
30-2 UP STAIRS

Mfg & Stock Rm. 30-1

20

Lathe Room

11-1
11-2

Shipping

10

Erie Railroad

NATIONAL GRINDING WHEEL CO., INC NORTH TONAWANDA, NEW YORK	
TITLE: PLOT PLAN	
DR A.R. DATE 1-26-59	CK. DATE
SCALE	APP. DATE

A.I.A. AND ENGINEERING SER.	SUPPLY ALL SCREWS, BOLTS, NUTS, RIVETS, WASHERS, DOWELS, TAPER	ALL SCREW THREADS TO BE