MEVERS & ASSOCIATES, INC.
ENGINEERING CONSULTANTS

HYDROGEOLOGIC EVALUATION

HARDEE EVALUATION
WACHULA, FLORIDA

PREPARED FOR:

MR. STEVE DUTCH, P.E.
WADE-TRIM, INC.
4919 MEMORIAL HIGHWAY
SUITE 200
TAMPA, FLORIDA

MARCH 1993

2310 Tall Pines - Suite 210 - Largo, Florida 34641 - (813) 530-3533

MEYERS & ASSOCIATES, INC.
ENGINEERING CONSULTANTS

DATE: March 17, 1993

TO: Mr. Steve Dutch, P.E.
Wade-Trim, Inc.
4919 Memorial Highway
Suite 200
Tampa, Florida 33634

RE: Hydrogeologic Evaluation
of Hardee County Landfill
Wachula, Florida

Dear Mr. Dutch:

In accordance with our proposal to you dated December 15, 1992, we have completed our evaluation of the Hardee County Landfill. The following report summarizes our scope of services and the results of our evaluation.

In order to provide the information requested by DER, the following tasks were completed:

Task 1: Collected all of the existing data on the Leachate Control and Removal System, evaluated the condition and effectiveness of the system; model the system using the HELP model; and provided conclusions and recommendations on the overall system design and performance.

Task 2: Evaluated the design and operation of the spray irrigation system associated with the Leachate Collection System, including evaluating the existing soils and groundwater data for the spray area and developing a model of the system using MODFLOW; and provide model data and water balance calculations.

Task 3: Collected all of the existing shallow groundwater data; conducted a series of shallow soil borings both inside and outside of the landfill liner for the purpose of measuring the shallow groundwater level; obtained ground elevation data at all of the boring locations and from this data, generated a groundwater contour map for the facility.

Task 4: Evaluate the existing groundwater monitoring plan and analytical data and develop recommendations for any additional wells that may be necessary, and any additional parameters needed to monitor the quality of the shallow groundwater beneath the landfill facility.

FIELD WORK

For our evaluation, we conducted nine (9) power auger borings and installed eleven (11) shallow piezometers. Several of the piezometers were installed within the landfill, across from existing monitoring wells. The locations of all the borings, existing monitoring wells, and piezometers are indicated on Plate 6. In addition, we also conducted some field permeability testing to verify the permeability of the shallow soils.

The results of our field testing are summarized on Plates 1 through 3 and indicate that the subject site is underlain by a 10 to 15 foot thick surficial aquifer consisting mainly of fine sand to clayey fine sand. These results are in general agreement with the site soil conditions reported by Envisors, Inc. in 1982. According

to Envisors, Inc. (1982), the surficial aquifer is separated from the deeper Floridan aquifer by a continuous confining clay layer which varies in thickness from 14 feet to 35 feet with an average thickness of about 25 feet. Based upon the results of our field permeability testing, the surficial aquifer has an average horizontal permeability of about 5 feet/day.

Task 1: Evaluation of Leachate Collection System

In order to evaluate the Leachate Collection System, we reviewed all of the existing data and generated a water balance for the system. The water balance was generated utilizing data from the "Hydrologic Evaluation of Landfill Performance (HELP)" computer model developed by the U.S. Army Corps of Engineers, Waterways Experiment Station in Vicksburg, Mississippi. This program models the effects of all of the hydrologic processes, including precipitation, surface storage, runoff, infiltration, percolation, evapo-transpiration, soil moisture storage, and lateral drainage, that are input into the water balance equation. Daily rainfall and temperature data for Tampa, Florida were used in the HELP model analyses. These data were modified to be more representative of reported average values for Wachula.

The results of the HELP model are included in Appendix A. Table 1 presents a water balance analyses based on the results of the HELP model simulation for the present landfill conditions.

Task 2: Evaluation of Spray Irrigation System

Based on available records, it is estimated that approximately 25,000 gpd of leachate from the dewatering ditch are spray irrigated. From as-built drawings for the spray irrigation system,

it is estimated that the system covers approximately 10 acres of land south of the dewatering ditch. Using the estimated area of coverage and the estimated disposal rate, an application rate of 0.94 inches per week was calculated.

The hydraulic capacity of an effluent disposal area (spray field) is basically a function of the ability of the subsurface soil to receive and percolate effluent applied to the area. Treated effluent applied over the area percolates downward through the unconfined aquifer and, upon reaching the water table or a restrictive layer (such as clay), begins to form a mound. As the recharge mound rises in elevation, lateral flow is induced under the increasing hydraulic gradient. The amount of rise in the recharge mound and the rate of rise depend on several factors including the thickness, porosity and permeability (transmissivity) of the shallow aquifer, leakance through the effective aquifer layers, the effluent application rate and the geometry of the loaded area.

In order to simulate the field conditions at the site, average aquifer parameters were estimated from the results of available field and laboratory testing data for the site. Previously for this site, field and laboratory testing had been conducted by Envisors. Based on the results of their testing the average groundwater elevation was determined to be +82.0 MSL. The average depth to a restrictive layer (clay) was estimated at about 15 feet below the ground surface. This correlates to an elevation of approximately +70.0 ft MSL. Based on permeability testing conducted in the field, the horizontal permeability of the upper sands was measured to be about 5 feet per day. Also, based on previous testing, the porosity of the upper sands was estimated to be 0.2.

The groundwater model that was used for our analysis of the sprayfield area was titled "A Modular Three-Dimensional Finite Difference Groundwater Flow Model" (MODFLOW), developed by McDonald and Harbaugh (1984) under contract with the USGS. This computer model simulates groundwater flow in three dimensions for variable elevations of the head in the aquifer. Using the three-dimensional model, all aquifer parameters can be varied from node to node and the groundwater flow can be steady-state or transient, with any selected node in the grid system being defined as either variable head, constant head or inactive to simulate field conditions.

Subsurface conditions at this site were conservatively modelled using a one-layer system. Simulation of groundwater flow within such a system required the input of variable physical and hydraulic parameters at predetermined nodes within the grid system. The distance between nodes was determined by the existing geologic and hydrologic conditions at this site, as well as the size of the site and boundary conditions. Boundary conditions were also estimated for input into the model in order to allow the modelled aquifer to respond and perform more like the in-situ aquifer would.

The estimation of long-term groundwater mounding beneath the sprayfield area was determined by simulating the application of leachate within the sprayfield area, and evaluating the resulting hydraulic heads predicted by the groundwater flow model. The modelling approach for this project consisted of applying effluent within the sprayfield area at a constant rate for two (2) stress periods equal to 365 days (1 year) each and observing the cumulative mounding effects after 2 years. A variable head analysis was utilized in the model by setting the heads in sprayfield area equal to the head in the surrounding shallow aquifer and the allowing the head to rise in response to the application of effluent. After a period of 2 years the heads in

the sprayfield area were evaluated to make sure that they did not rise above the ground surface in the sprayfield area.

The results of our three-dimensional computer groundwater analysis for the disposal system are presented on the computer output sheets included in Appendix B. Based on the results of our modelling, the sprayfield area should be capable of handling 25,000 gpd of effluent without any long-term accumulation of water over the spray field.

Task 3: Development of Groundwater Contour Map

One of the requirements by DER for renewal of the landfill operating permit was that a shallow groundwter contour map be developed, and from this map, determine if the side liner and perimeter Leachate Collection System were effective in maintaining a negative gradient inward towards the landfill.

Using this data as input to the MODFLOW model previously discussed, the groundwater levels were predicted across the site. From this data, groundwater contours were developed and are indicated on the site plan (Plate 6). Based on these contours, it can be seen that the side liner and the perimeter Leachate Collection System are effectively maintaining a head differential of from -1 to -4 feet between the inside and the outside of the side liner.

Task 4: Evaluation of Existing Groundwater Monitoring Plan

Based on conversations with DER, the existing groundwater quality data does not indicate any significantly elevated levels of the parameters being monitored. They have requested that a complete set of drinking water parameters be analyzed for in the next sampling event.

Based on the groundwater levels encountered in the sprayfield area and the resulting groundwater mound predicted by the computer model, it appears that there is a gradient in the sprayfield area towards the creek along the south side of the spray area. Based on this, it is recommended that an additional groundwater monitoring well be installed approximately 50 feet north of the creek and midway along the sprayfield area to monitor the groundwater flowing in this direction.

We trust that the contents of this report are sufficient for your needs. Mevers & Associates, Inc. appreciates the opportunity to present our hydrogeologic consulting services to you. If you have any questions regarding this report, please do not hesitate to contact us.

Sincerely,

MEVERS & ASSOCIATES, INC.

Gary E. Mevers, P.E.
President

Attachments: Table 1 & 2
Plates 1 through 6
Appendices A & B

TABLE 1

WATER BALANCE SUMMARY

MONTH	ET*	PERC.*	TOTAL WATER LOST	PREC.*	LEACHATE* COLLECTED	TOTAL WATER AVAIL	AVAILABLE SPRAY IRRIGATION	STORAGE REQ.	TOTAL STORAGE
Jan.	1.77	0.53	1.33	2.26	0.27	2.53	4.34	-3.14	0
Feb.	1.66	0.36	2.02	2.36	0.15	2.51	4.34	-3.85	0
March	2.28	0.37	2.65	2.95	0.36	3.31	4.34	-3.68	0
April	1.44	0.38	1.82	2.01	0.22	2.23	4.34	-3.93	0
May	2.38	0.54	2.92	3.68	0.54	4.22	4.34	-3.04	0
June	4.14	0.77	4.91	8.59	1.61	10.2	4.34	0.95	0.95
July	4.50	0.89	5.39	7.89	2.61	10.5	4.34	0.77	1.72
Aug.	4.74	0.91	5.65	6.50	1.78	8.28	4.34	-1.71	0
Sept.	3.76	0.84	7.40	6.89	1.67	8.56	4.34	-3.18	0
Oct.	1.93	0.87	2.80	2.91	1.36	4.27	4.34	-2.87	0
Nov.	1.20	0.46	1.66	0.84	0.33	1.17	4.34	-4.83	0
Dec.	1.95	0.50	2.45	3.50	0.30	3.80	4.34	-2.99	0
Total	31.75	18.62	41.00	50.98	11.20	61.58	52.08	-31.50	2.67

All values are in inches.

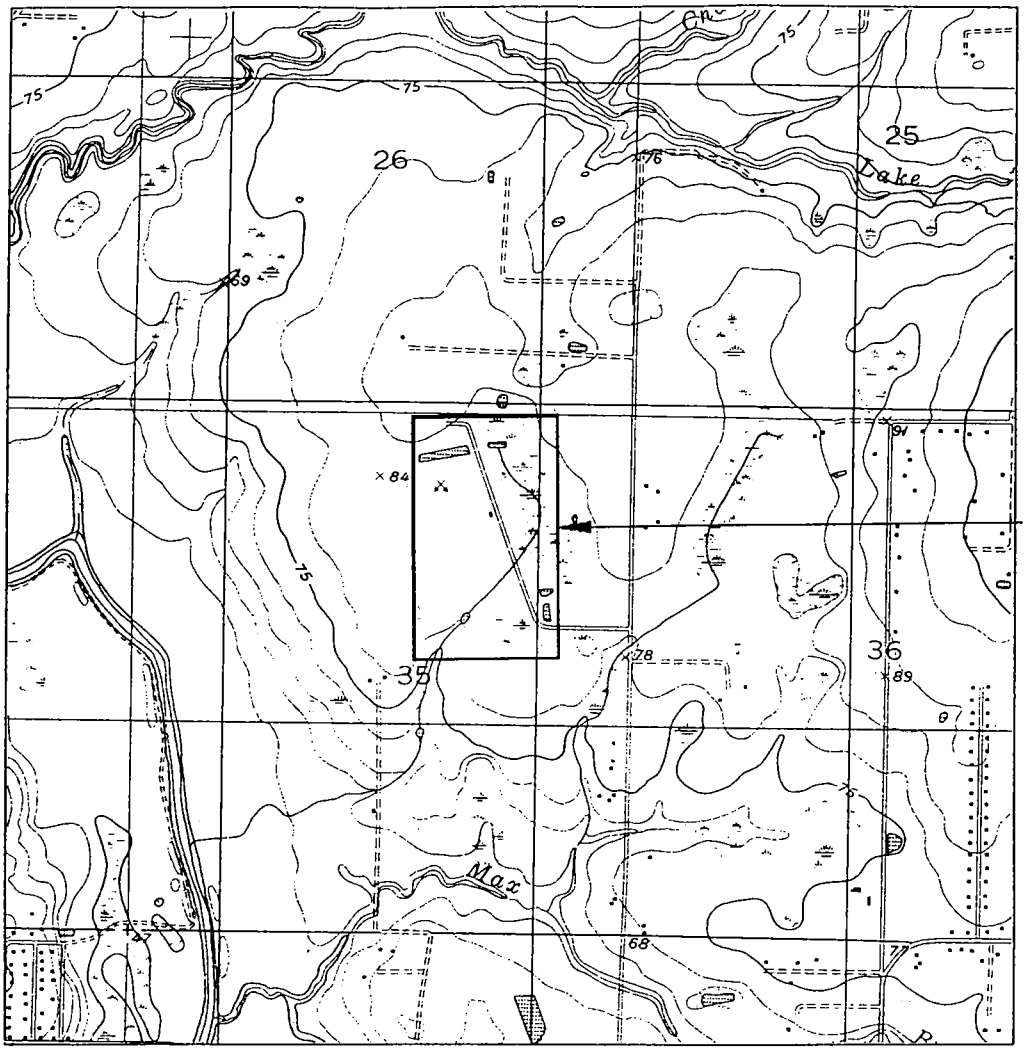
*Obtained from results of HELP Model.

No date

TABLE 2

GROUNDWATER ELEVATION

Location	Elevation Top of Casing	Elevation at Land Surface	Height of Casing Above L.S.	Water Depth from Top of Casing	Water Depth from Land Surface	Groundwater Elevation
MW-1	87.97	86.24	1.73	4.12	2.39	83.85
MW-2	85.86	83.68	2.18	5.08	2.90	80.78
MW-3	87.75	86.07	1.68	4.98	3.30	82.77
MW-4	87.16	84.44	2.72	5.53	2.81	81.63
MW-5	88.76	85.76	3.00	8.60	5.60	80.16
MW-6	87.94	84.68	3.26	4.37	1.11	83.57
MW-7	87.51	84.55	2.96	4.49	1.53	83.02
P-1	91.27	88.97	2.30	10.68	8.38	80.59
P-2	90.66	87.66	3.00	11.00	8.00	79.66
P-3	89.05	86.60	2.45	4.11	1.66	84.94
P-4	88.24	85.36	2.88	4.97	2.09	83.27
P-5	89.25	86.42	2.83	4.48	1.65	84.77
P-6	85.94	83.44	2.50	3.48	0.98	82.46
P-7	84.04	81.84	2.20	2.68	0.48	81.36
P-8	84.74	82.67	2.08	3.30	1.21	81.44
P-9	87.06	84.81	2.25	9.00	6.75	78.06
P-10	88.56	86.40	2.16	9.90	7.74	78.66
P-11	87.16	85.08	2.08	6.90	4.82	80.26
PA-1	-----	80.94	-----	-----	1.00	79.94
PA-2	-----	80.74	-----	-----	1.30	79.44
PA-3	-----	83.96	-----	-----	2.40	81.56
PA-4	-----	83.26	-----	-----	1.90	81.36
PA-5	-----	81.26	-----	-----	0.60	80.66
PA-6	-----	84.57	-----	-----	2.50	82.07
PA-7	-----	85.27	-----	-----	1.60	83.67
PA-8	-----	86.46	-----	-----	6.30	80.16
PA-9	-----	85.45	-----	-----	2.50	82.95

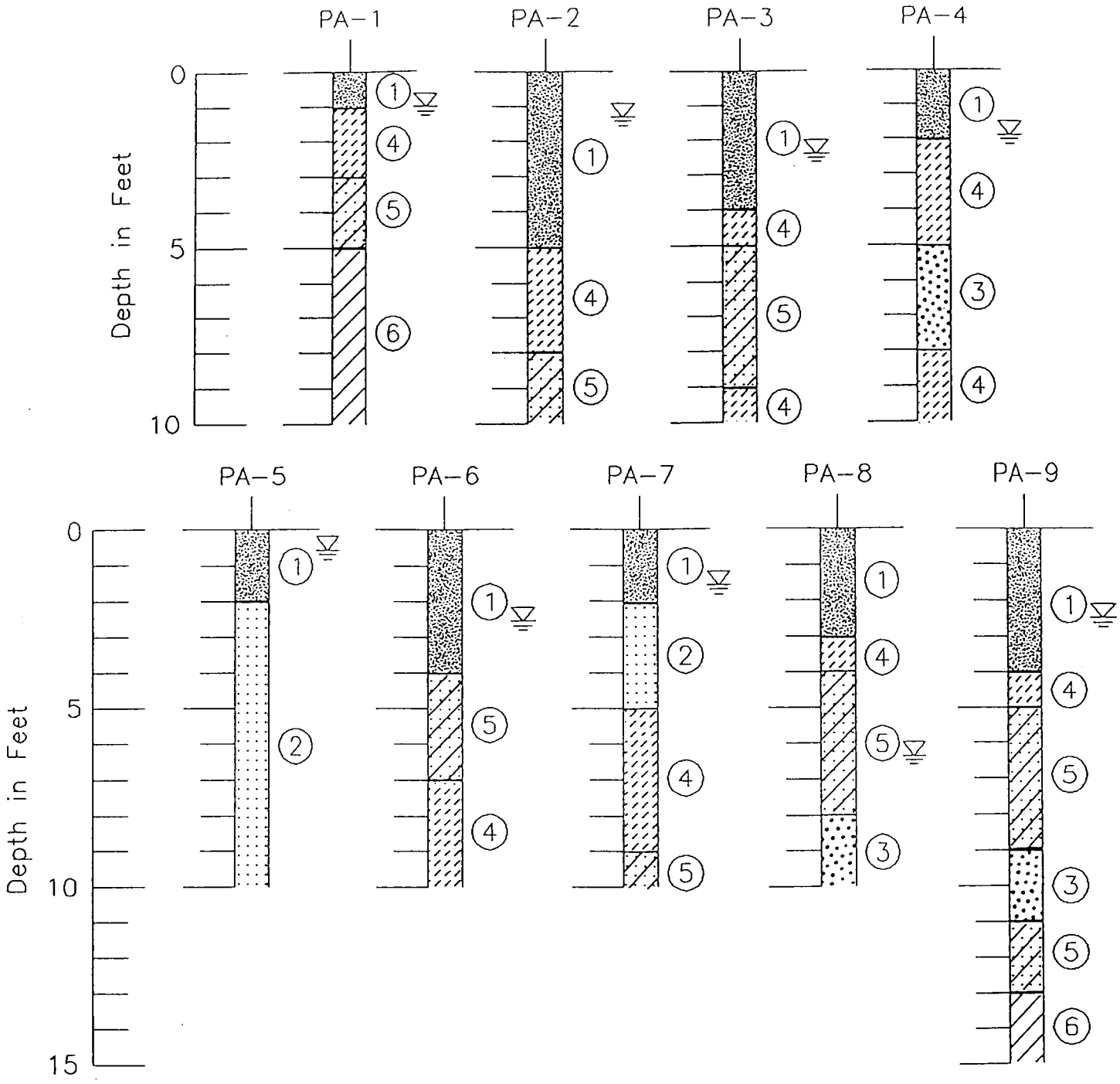


USGS QUAD MAP

Scale: 1" = 2000'

REFERENCE: USGS Quadrangle Map of
Wauchula, Florida
Prepared in 1954–55
Photorevised in 1987

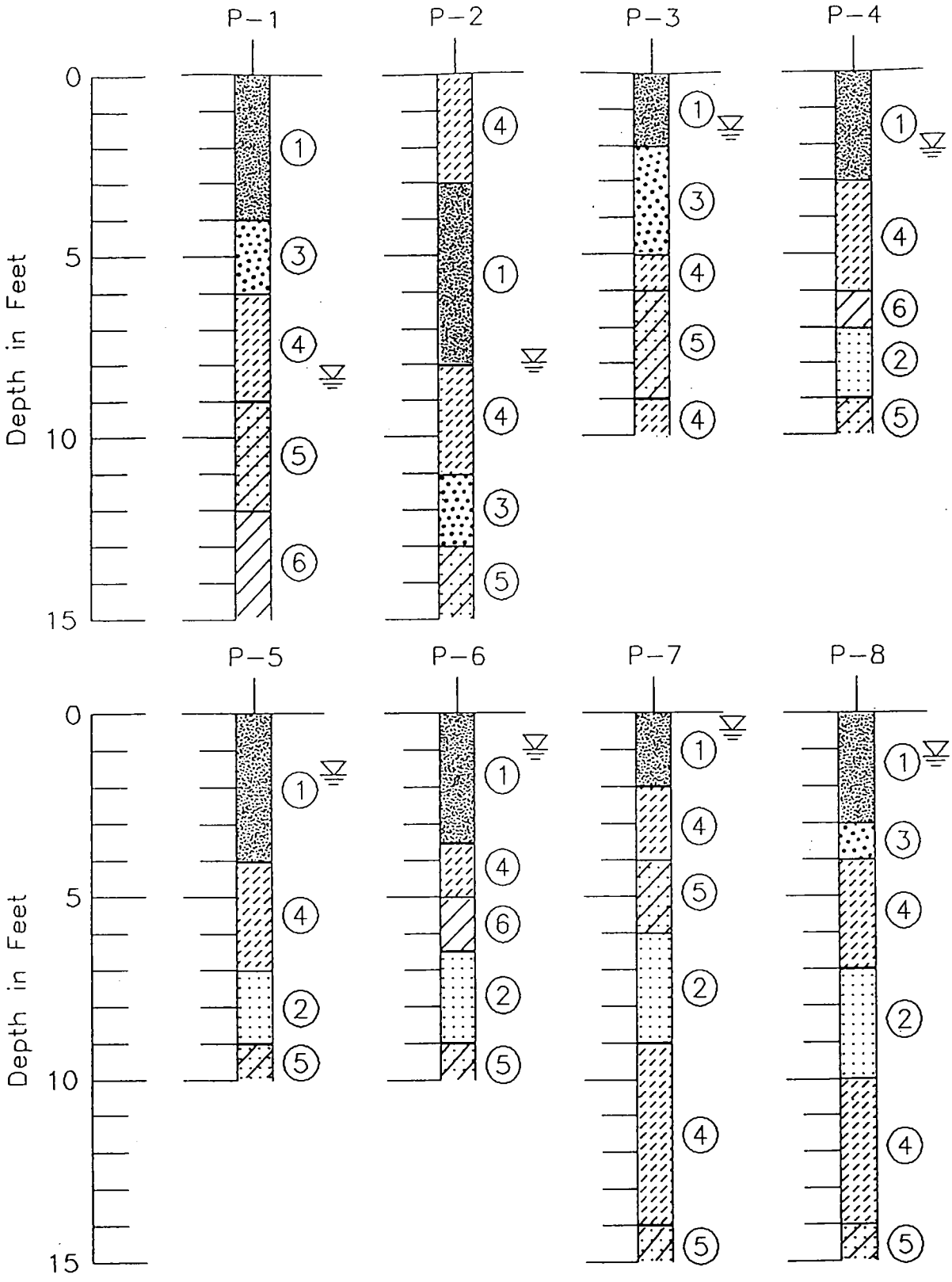
Project No.: 93–H–103	HYDROGEOLOGIC EVALUATION	MEVERS & ASSOCIATES, INC.
Date: March 1993	HARDEE COUNTY LANDFILL	Engineering Consultants
Plate 1	WAUCHULA, FLORIDA	



SHALLOW SOIL PROFILES

For legend see Plate 5

Project No.: 93-H-103	HYDROGEOLOGIC EVALUATION	MEVERS & ASSOCIATES, INC.
Date: March 1993	HARDEE COUNTY LANDFILL	Engineering Consultants
Plate 2	WAUCHULA, FLORIDA	



SHALLOW SOIL PROFILES

For legend see Plate 5

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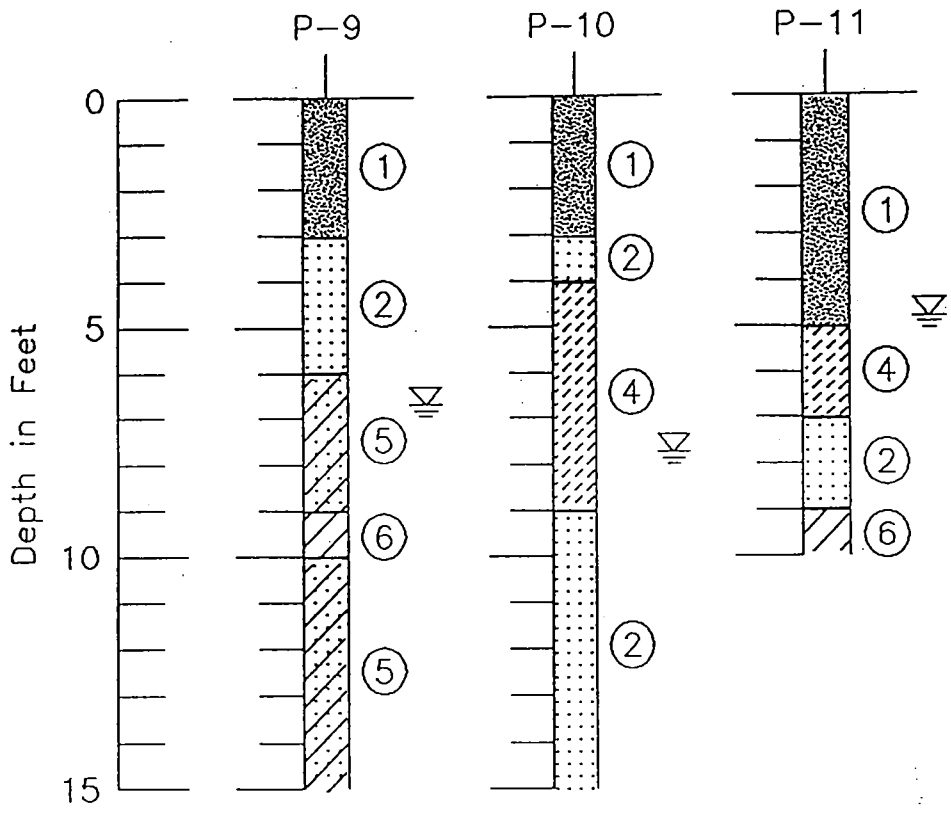
Date: March 1993	HARDEE COUNTY LANDFILL	Engineering Consultants
Plate 3	WAUCHULA, FLORIDA	



SHALLOW SOIL PROFILES

For legend see Plate 5

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Date: March 1993	HARDEE COUNTY LANDFILL	Engineering Consultants
Plate 4	WAUCHULA, FLORIDA	

LEGEND

①  Gray to dark gray fine sand to slightly silty fine sand (SP/SP–SM)

②  Light gray to light brown fine sand to slightly silty fine sand (SP/SP–SM)

③  Dark brown slightly silty to silty fine sand (SP–SM/SM)

④  Gray–brown slightly clayey to clayey fine sand (SM–SC/SC)

⑤  Light gray clayey fine sand to sandy clay (CH)

⑥  Gray–green to green slightly sandy clay to clay (CH)

 Groundwater level, March 1993

SP Unified Soil Classification group symbol as determined by visual review

Project No.: 93–H–103	HYDROGEOLOGIC EVALUATION	MEVERS & ASSOCIATES, INC.
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Plate 5	WAUCHULA, FLORIDA	

1552150 (1)

NORTH

Legend

- Power Auger Location
- Piezometer Location
- Monitoring Well Location

7/29/87 Elevations GW (Spraying began in 1985)

CONSTRUCTION DEBRIS AREA

POND

COVER MATERIAL AREA

RECYCLE CENTER

POND

POND W.L. 78.7

DITCH

SPRAY FIELD

MONITORING WELL 7 77.55

MONITORING WELL 3 ~~77.80~~ 78.04

MONITORING WELL 6 77.27

PA 9 82.95

PA 8 80.16

MONITORING WELL 5 78.23

PERIMETER SWALE

PA 7 83.67

P 2 79.66

P 1 81.54

P 5 84.77

P 8 78.06

P 7 81.36

P 4 83.27

P 10 79.66

P 11 80.26

P 9 78.80

P 6 82.46

PA 6 82.07

MONITORING WELL 1 81.21 83.85

DEWATERING DITCH

PUMP STATION

MAINTENANCE BUILDING

MONITORING WELL 2 79.20

CONTROL STRUCTURE

POND W.L. 81.9

PA 2 79.64

PA 1 79.94

W.S. EL. = +78.0

W.S. EL. = +80.0

WOODED DETENTION AREA

PA 5 80.66

PA 4 81.56

MONITORING WELL 4 ~~72.80~~ 81.62

PA 3 81.86

BARBED WIRE FENCE

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Date: March 1993	HARDEE COUNTY LANDFILL	Engineering Consultants
Plate 6	WAUCHULA, FLORIDA	

APPENDIX A

HELP MODELLING RESULTS

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HARDEE COUNTY LANDFILL
WACHULA, FLORIDA
MARCH 16, 1993

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POOR GRASS

LAYER 1

LATERAL DRAINAGE LAYER

THICKNESS	=	144.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.1053 VOL/VOL
WILTING POINT	=	0.0466 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1053 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.003060000017 CM/SEC
SLOPE	=	5.00 PERCENT
DRAINAGE LENGTH	=	25.0 FEET

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	300.00 INCHES
POROSITY	=	0.4224 VOL/VOL
FIELD CAPACITY	=	0.3495 VOL/VOL
WILTING POINT	=	0.2648 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4224 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000850000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	73.68
TOTAL AREA OF COVER	=	600000. SQ FT
EVAPORATIVE ZONE DEPTH	=	10.00 INCHES

POTENTIAL RUNOFF FRACTION	=	0.150000
UPPER LIMIT VEG. STORAGE	=	4.3700 INCHES
INITIAL VEG. STORAGE	=	0.9846 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	141.8832 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR TAMPA FLORIDA

MAXIMUM LEAF AREA INDEX	= 0.00
START OF GROWING SEASON (JULIAN DATE)	= 0
END OF GROWING SEASON (JULIAN DATE)	= 367

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
61.80	62.80	68.20	73.60	79.10	82.90
84.20	85.20	83.90	76.50	68.70	63.30

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.26	2.36	2.95	2.01	3.68	8.59
	7.89	6.50	6.89	2.91	0.84	3.50
STD. DEVIATIONS	1.49	1.10	1.93	2.13	2.48	4.43
	2.92	2.93	2.73	1.72	0.78	1.42
RUNOFF						
TOTALS	0.002	0.000	0.001	0.001	0.002	0.037
	0.006	0.006	0.015	0.002	0.000	0.000
STD. DEVIATIONS	0.006	0.000	0.003	0.004	0.004	0.052
	0.010	0.012	0.027	0.007	0.000	0.001
EVAPOTRANSPIRATION						
TOTALS	1.772	1.656	2.281	1.440	2.377	4.137
	4.504	4.735	3.755	1.933	1.197	1.949
STD. DEVIATIONS	0.888	0.733	0.919	0.978	1.315	1.258

	1.197	1.030	0.774	0.901	0.717	0.639

LATERAL DRAINAGE FROM LAYER 1

TOTALS	0.2724	0.1469	0.3604	0.2223	0.5362	1.6118
	2.6104	1.7699	1.6667	1.3606	0.3283	0.3039
STD. DEVIATIONS	0.2819	0.1848	0.6656	0.2653	0.6015	1.3739
	1.8910	0.8141	1.2424	1.1690	0.5009	0.2655

PERCOLATION FROM LAYER 2

TOTALS	0.5263	0.3613	0.3657	0.3821	0.5441	0.7680
	0.8860	0.9053	0.8410	0.8695	0.4545	0.5035
STD. DEVIATIONS	0.3257	0.3000	0.3453	0.3534	0.3693	0.1815
	0.0739	0.0228	0.1271	0.0859	0.3266	0.2738

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	50.38	(9.199)	2518850.	100.00
RUNOFF	0.074	(0.055)	3703.	0.15
EVAPOTRANSPIRATION	31.736	(3.092)	1586779.	63.00
LATERAL DRAINAGE FROM LAYER 1	11.1898	(5.6736)	559491.	22.21
PERCOLATION FROM LAYER 2	7.4074	(1.1818)	370369.	14.70
CHANGE IN WATER STORAGE	-0.030	(0.897)	-1491.	-0.06

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	3.88	194000.0
RUNOFF	0.086	4309.5
LATERAL DRAINAGE FROM LAYER 1	0.3548	17741.2
PERCOLATION FROM LAYER 2	0.0306	1530.5
HEAD ON LAYER 2	17.7	

SNOW WATER 0.00 0.0

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3047

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0432

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FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	15.82	0.1099
2	126.72	0.4224
SNOW WATER	0.00	

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HARDEE COUNTY LANDFILL
WACHULA, FLORIDA
MARCH 16, 1993

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POOR GRASS

LAYER 1

LATERAL DRAINAGE LAYER

THICKNESS = 144.00 INCHES
POROSITY = 0.4370 VOL/VOL

APPENDIX B

MODFLOW MODELLING RESULTS

1 U.S. GEOLOGICAL SURVEY MODULAR FINITE-DIFFERENCE GROUND-WATER MODEL
OHARDEE COUNTY LANDFILL
1 LAYERS 28 ROWS 30 COLUMNS
2 STRESS PERIOD(S) IN SIMULATION
MODEL TIME UNIT IS DAYS
OI/O UNITS:
ELEMENT OF IUNIT: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
I/O UNIT: 3 0 0 0 0 0 0 11 12 0 0 14 0 0 0 0 0 0 0 0 0 0 0 0
OBAS1 — BASIC MODEL PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 1
ARRAYS RHS AND BUFF WILL SHARE MEMORY.
START HEAD WILL BE SAVED
7622 ELEMENTS IN X ARRAY ARE USED BY BAS
7622 ELEMENTS OF X ARRAY USED OUT OF 100000
OBCF1 — BLOCK-CENTERED FLOW PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 3
STEADY-STATE SIMULATION
CONSTANT HEAD CELL-BY-CELL FLOWS WILL NOT BE PRINTED
LAYER AQUIFER TYPE
1 1
1681 ELEMENTS IN X ARRAY ARE USED BY BCF
9303 ELEMENTS OF X ARRAY USED OUT OF 100000
ORCH1 — RECHARGE PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 11
OPTION 1 — RECHARGE TO TOP LAYER
840 ELEMENTS OF X ARRAY USED FOR RECHARGE
10143 ELEMENTS OF X ARRAY USED OUT OF 100000
OSIP1 — STRONGLY IMPLICIT PROCEDURE SOLUTION PACKAGE, VERSION 1, 12/08/83 INPUT READ FROM UNIT 12
MAXIMUM OF 50 ITERATIONS ALLOWED FOR CLOSURE
5 ITERATION PARAMETERS
3565 ELEMENTS IN X ARRAY ARE USED BY SIP
13708 ELEMENTS OF X ARRAY USED OUT OF 100000
1HARDEE COUNTY LANDFILL
0

BOUNDARY ARRAY FOR LAYER 1 WILL BE READ ON UNIT 1 USING FORMAT: (3013)

OAQUIFER HEAD WILL BE SET TO 999.99 AT ALL NO-FLOW NODES (IBOUND=0).
0

INITIAL HEAD FOR LAYER 1 WILL BE READ ON UNIT 1 USING FORMAT: (30F10.0)

OHEAD PRINT FORMAT IS FORMAT NUMBER -9 DRAWDOWN PRINT FORMAT IS FORMAT NUMBER 0
OHEADS WILL BE SAVED ON UNIT 20 DRAWDOWNS WILL BE SAVED ON UNIT 20
OOUTPUT CONTROL IS SPECIFIED EVERY TIME STEP
0 COLUMN TO ROW ANISOTROPY = 1.000000
0

DELR WILL BE READ ON UNIT 3 USING FORMAT: (30F10.0)

0

DELC WILL BE READ ON UNIT 3 USING FORMAT: (28F10.0)

0 HYD. COND. ALONG ROWS = 5.000000 FOR LAYER 1
0

BOTTOM FOR LAYER 1 WILL BE READ ON UNIT 3 USING FORMAT: (30F10.0)

SOLUTION BY THE STRONGLY IMPLICIT PROCEDURE

MAXIMUM ITERATIONS ALLOWED FOR CLOSURE = 50
ACCELERATION PARAMETER = 1.0000
HEAD CHANGE CRITERION FOR CLOSURE = .10000E-01
SIP HEAD CHANGE PRINTOUT INTERVAL = 999
CALCULATE ITERATION PARAMETERS FROM MODEL CALCULATED WSEED
STRESS PERIOD NO. 1, LENGTH = 365.0000

NUMBER OF TIME STEPS = 1

MULTIPLIER FOR DELT = 1.000

INITIAL TIME STEP SIZE = 365.0000

RECHARGE WILL BE READ ON UNIT 11 USING FORMAT: (30F10.0)

AVERAGE SEED = .00147650
MINIMUM SEED = .00024738

5 ITERATION PARAMETERS CALCULATED FROM AVERAGE SEED:

.0000000E+00 .8039763E+00 .9615747E+00 .9924678E+00 .9985235E+00

16 ITERATIONS FOR TIME STEP 1 IN STRESS PERIOD 1
MAXIMUM HEAD CHANGE FOR EACH ITERATION:
HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL

-4.171	(1, 8, 16)	-2.469	(1, 11, 17)	-1.612	(1, 6, 18)	-1.222	(1, 5, 26)	.4635	(1, 7, 23)
-.1224	(1, 10, 26)	.9093E-01	(1, 5, 25)	.1726	(1, 5, 25)	-.3582E-01	(1, 7, 22)	-.9069E-01	(1, 5, 26)
.1874E-01	(1, 6, 21)	.2976E-01	(1, 5, 26)	.1635E-01	(1, 5, 24)	.3065E-01	(1, 5, 25)	-.1062E-01	(1, 6, 23)
.3456E-02	(1, 10, 25)								

HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 1 CELL-BY-CELL FLOW TERM FLAG = 0
OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
1	0	1	0

HEAD IN LAYER 1 AT END OF TIME STEP 1 IN STRESS PERIOD 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00
2	82.00	82.82	83.10	83.27	83.30	83.20	82.75	83.01	82.65	82.52	82.44	82.40	82.36	82.32	82.28	82.19	81.96	81.39	81.81	81.40
3	82.00	83.26	83.74	84.03	84.13	83.99	83.00	83.74	82.94	82.72	82.62	82.55	82.49	82.44	82.37	82.22	81.80	80.20	81.58	80.20
4	82.00	83.44	84.01	84.39	84.56	84.47	83.85	84.26	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
5	82.00	83.58	84.22	84.68	84.91	84.89	84.52	84.73	85.00	85.00	82.19	79.44	77.89	77.08	76.68	76.63	77.11	77.94	78.93	79.70
6	82.00	83.67	84.33	84.95	85.30	85.38	85.20	85.22	85.12	84.58	82.07	79.05	76.69	74.00	75.18	76.16	76.97	77.90	78.93	79.72
7	82.00	83.58	84.05	85.06	85.66	85.90	85.89	85.71	85.18	84.22	81.86	78.72	76.34	74.00	74.78	75.77	76.74	77.82	78.89	79.72
8	82.00	82.96	81.50	84.43	85.49	85.92	86.07	85.85	84.80	84.06	81.82	78.67	76.18	74.00	74.66	75.61	76.60	77.71	78.80	79.63
9	82.00	83.11	83.17	83.90	84.89	85.26	85.48	85.65	85.10	84.05	81.80	78.71	76.33	74.00	74.70	75.57	76.51	77.60	78.69	79.49

```
 0 10  82.00 82.74 82.63 81.40 83.73 83.60 83.60 84.97 84.74 83.87 81.75 78.71 76.33 74.00 74.75 75.60 76.49 77.56 78.59 79.33
 0 11  82.00 81.86 81.94 81.40 83.49 83.60 83.60 84.66 84.06 83.63 81.75 78.76 76.37 74.00 74.78 75.72 76.65 77.65 78.54 79.15
 0 12  82.00 80.76 81.26 81.90 83.45 83.90 84.14 84.55 83.30 83.51 81.81 78.88 76.45 74.00 74.86 75.91 76.85 77.74 78.51 79.04
 0 13  82.00 78.50 80.26 81.90 83.36 84.01 84.37 84.51 83.30 83.50 81.92 79.11 76.64 74.00 75.05 76.25 77.13 77.83 78.49 78.96
 0 14  82.00 80.12 78.50 81.61 83.19 83.99 84.43 84.47 83.75 83.56 82.11 79.56 77.18 74.00 75.71 76.87 77.51 77.92 78.44 *****
 0 15  82.00 80.91 78.60 81.14 82.91 83.85 84.33 84.36 83.90 83.62 82.34 80.32 79.06 78.34 77.96 77.80 78.00 77.97 ***** 81.85
 0 16  82.00 81.43 78.70 80.31 82.50 83.58 84.09 84.11 83.83 83.63 82.56 80.93 80.05 79.51 78.89 78.29 78.14 ***** 82.13 81.92
 0 17  82.00 81.88 80.23 78.70 81.95 83.21 83.76 83.75 83.60 83.62 82.78 81.30 80.71 80.50 ***** ***** ***** 81.12 82.00 82.03
 0 18  82.00 82.26 81.11 78.80 81.30 82.71 83.33 83.23 83.18 83.60 83.03 ***** ***** ***** 82.57 82.46 82.06 80.80 82.00 82.00
 0 19  82.00 82.58 81.76 78.80 80.39 82.09 82.82 82.50 82.50 83.59 ***** 82.77 82.73 82.68 82.61 82.46 82.13 81.43 82.00 82.00
 0 20  82.00 82.85 82.33 80.49 78.90 81.32 82.26 82.38 82.63 ***** 82.46 82.66 82.64 82.60 82.54 82.40 82.12 81.63 82.00 82.00
 0 21  82.00 83.09 82.82 81.48 78.90 80.39 81.59 82.04 ***** 81.20 82.26 82.49 82.48 82.44 82.39 82.24 81.96 81.50 82.00 82.00
 0 22  82.00 83.29 83.23 82.23 80.46 79.00 80.75 81.56 81.17 80.82 82.01 82.26 82.25 82.21 82.14 81.98 81.65 81.00 81.00 81.00
 0 23  82.00 83.52 83.71 83.06 81.84 80.58 79.00 80.77 80.88 79.40 81.55 81.84 81.81 81.75 81.65 81.42 81.00 81.00 81.00 81.00
 0 24  82.00 83.71 84.09 83.67 82.72 81.65 80.00 79.50 80.60 80.60 81.13 81.13 80.97 80.81 80.58 80.00 80.00 80.00 80.00 80.00
 0 25  82.00 83.66 84.07 83.62 82.46 81.84 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00
 0 26  82.00 83.26 83.67 82.98 80.00 81.77 81.34 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 82.00 81.99
 0 27  82.00 82.00 83.03 82.90 82.21 82.34 82.07 81.38 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.91 80.70 82.10
 0 28  82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00
1                    HEAD IN LAYER  1 AT END OF TIME STEP  1 IN STRESS PERIOD  1
                    ------------------------------------------------------------

          21    22    23    24    25    26    27    28    29    30
  ..........................................................
 0  1  82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00
 0  2  82.15 82.41 82.54 82.65 82.77 82.88 82.90 82.80 82.52 82.00
 0  3  82.13 82.56 82.75 82.92 83.09 83.36 83.70 83.21 82.73 82.00
 0  4  ***** ***** ***** ***** ***** ***** ***** 83.12 82.75 82.00
 0  5  80.39 80.85 81.14 81.25 81.29 81.31 ***** 83.06 82.75 82.00
 0  6  80.38 80.84 81.13 81.23 81.27 81.28 ***** 83.05 82.76 82.00
 0  7  80.35 80.80 81.08 81.15 81.17 81.16 ***** 83.15 82.82 82.00
 0  8  80.25 80.70 80.96 80.97 80.87 80.60 ***** 83.90 83.12 82.00
 0  9  80.10 80.57 80.87 80.98 81.00 80.99 ***** 83.16 82.81 82.00
 0 10  79.86 80.39 80.77 80.94 81.02 81.05 ***** 83.02 82.72 82.00
 0 11  79.53 80.21 80.66 ***** ***** ***** 83.38 83.24 82.81 82.00
 0 12  79.19 80.10 ***** 84.16 84.11 83.92 83.66 83.39 82.87 82.00
 0 13  78.70 ***** 83.74 84.05 84.07 83.92 83.71 83.45 82.90 82.00
 0 14  ***** 82.00 83.53 83.93 84.01 83.89 83.70 83.46 82.91 82.00
 0 15  80.30 82.00 83.32 83.80 83.92 83.84 83.67 83.44 82.91 82.00
 0 16  80.30 82.00 83.06 83.64 83.82 83.78 83.63 83.41 82.90 82.00
 0 17  82.00 82.00 82.66 83.46 83.72 83.71 83.58 83.38 82.88 82.00
 0 18  82.00 82.00 82.00 83.27 83.62 83.65 83.53 83.34 82.86 82.00
 0 19  82.00 82.00 82.00 83.21 83.56 83.60 83.49 83.31 82.84 82.00
 0 20  82.00 82.00 82.00 83.22 83.54 83.56 83.45 83.28 82.82 82.00
 0 21  82.24 82.50 82.70 83.32 83.53 83.52 83.41 83.25 82.80 82.00
 0 22  82.33 82.82 83.09 83.39 83.48 83.45 83.35 83.20 82.78 82.00
 0 23  82.41 83.11 83.37 83.34 83.24 83.24 83.18 83.07 82.71 82.00
 0 24  82.27 83.16 83.26 82.66 81.60 82.42 82.62 82.71 82.54 82.00
 0 25  82.29 83.04 82.95 82.90 82.80 82.77 82.72 82.67 82.48 82.00
 0 26  82.65 82.74 81.40 82.30 82.38 82.06 81.60 81.98 82.18 82.00
 0 27  82.61 82.72 82.46 82.48 82.36 82.02 81.60 81.93 82.13 82.00
 0 28  82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00 82.00
OHEAD WILL BE SAVED ON UNIT 20 AT END OF TIME STEP  1, STRESS PERIOD  1
0


                    VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  1 IN STRESS PERIOD  1
                    ------------------------------------------------------------------------------

0                   CUMULATIVE VOLUMES      L**3                        RATES FOR THIS TIME STEP      L**3/T
                    ------------------                                  ------------------------

                         IN:                                                 IN:
```

STORAGE =	.00000
CONSTANT HEAD =	.30319E+06
RECHARGE =	.46579E+07
TOTAL IN =	.49611E+07

0 OUT:

STORAGE =	.00000
CONSTANT HEAD =	.49614E+07
RECHARGE =	.00000
TOTAL OUT =	.49614E+07
IN - OUT =	-219.50
PERCENT DISCREPANCY =	-.00

STORAGE =	.00000
CONSTANT HEAD =	830.64
RECHARGE =	12761.
TOTAL IN =	13592.

OUT:

STORAGE =	.00000
CONSTANT HEAD =	13593.
RECHARGE =	.00000
TOTAL OUT =	13593.
IN - OUT =	-.60059
PERCENT DISCREPANCY =	-.00

0

TIME SUMMARY AT END OF TIME STEP 1 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.315360E+08	525600.	8760.00	365.000	.999316
STRESS PERIOD TIME	.315360E+08	525600.	8760.00	365.000	.999316
TOTAL SIMULATION TIME	.315360E+08	525600.	8760.00	365.000	.999316

1

1 STRESS PERIOD NO. 2, LENGTH = 365.0000

NUMBER OF TIME STEPS = 1

MULTIPLIER FOR DELT = 1.000

INITIAL TIME STEP SIZE = 365.0000

0REUSING RECH FROM LAST STRESS PERIOD

0

1 ITERATIONS FOR TIME STEP 1 IN STRESS PERIOD 2

0MAXIMUM HEAD CHANGE FOR EACH ITERATION:

0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL

-.1067E-02 (1, 5, 25)

0

0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 1 CELL-BY-CELL FLOW TERM FLAG = 0

0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
1	0	1	0

1 HEAD IN LAYER 1 AT END OF TIME STEP 1 IN STRESS PERIOD 2

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	1	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00
0	2	82.00	82.82	83.10	83.27	83.30	83.20	82.75	83.01	82.65	82.52	82.44	82.40	82.36	82.32	82.28	82.19	81.96	81.39	81.81	81.40
0	3	82.00	83.26	83.74	84.03	84.13	83.99	83.00	83.74	82.94	82.72	82.62	82.55	82.49	82.44	82.37	82.22	81.80	80.20	81.58	80.20
0	4	82.00	83.44	84.01	84.39	84.56	84.47	83.85	84.26	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	5	82.00	83.58	84.22	84.68	84.91	84.89	84.52	84.73	85.00	85.00	82.19	79.44	77.89	77.08	76.68	76.63	77.11	77.94	78.93	79.70
0	6	82.00	83.67	84.33	84.95	85.30	85.38	85.20	85.22	85.12	84.58	82.07	79.05	76.69	74.00	75.18	76.16	76.97	77.90	78.92	79.72
0	7	82.00	83.58	84.05	85.06	85.66	85.90	85.89	85.71	85.18	84.22	81.86	78.72	76.34	74.00	74.78	75.77	76.74	77.82	78.89	79.72
0	8	82.00	82.96	81.50	84.43	85.49	85.92	86.07	85.85	84.80	84.06	81.82	78.67	76.18	74.00	74.66	75.61	76.60	77.71	78.80	79.63

0 9 82.00 83.11 83.17 83.90 84.89 85.26 85.48 85.65 85.10 84.05 81.80 78.71 76.33 74.00 74.70 75.57 76.51 77.60 78.69 79.49
0 10 82.00 82.74 82.63 81.40 83.73 83.60 83.60 84.97 84.74 83.87 81.75 78.71 76.33 74.00 74.75 75.60 76.49 77.56 78.59 79.32
0 11 82.00 81.86 81.94 81.40 83.49 83.60 83.60 84.66 84.06 83.63 81.75 78.76 76.37 74.00 74.78 75.72 76.65 77.65 78.54 79.15
0 12 82.00 80.76 81.26 81.90 83.45 83.90 84.14 84.55 83.30 83.51 81.81 78.88 76.45 74.00 74.86 75.91 76.85 77.74 78.51 79.04
0 13 82.00 78.50 80.26 81.90 83.36 84.01 84.37 84.51 83.30 83.50 81.92 79.11 76.64 74.00 75.05 76.25 77.13 77.83 78.49 78.96
0 14 82.00 80.12 78.50 81.61 83.19 83.99 84.43 84.47 83.75 83.56 82.11 79.56 77.18 74.00 75.71 76.87 77.51 77.92 78.44 *****
0 15 82.00 80.91 78.60 81.14 82.91 83.85 84.33 84.36 83.90 83.62 82.34 80.32 79.06 78.34 77.96 77.80 78.00 77.97 ***** 81.85
0 16 82.00 81.43 78.70 80.31 82.50 83.58 84.09 84.11 83.83 83.63 82.56 80.93 80.05 79.51 78.89 78.29 78.14 ***** 82.13 81.92
0 17 82.00 81.88 80.23 78.70 81.95 83.21 83.76 83.75 83.60 83.62 82.78 81.30 80.71 80.50 ***** ***** ***** 81.12 82.00 82.03
0 18 82.00 82.26 81.11 78.80 81.30 82.71 83.33 83.23 83.18 83.60 83.03 ***** ***** ***** 82.57 82.46 82.06 80.80 82.00 82.00
0 19 82.00 82.58 81.76 78.80 80.39 82.09 82.82 82.50 82.50 83.59 ***** 82.77 82.73 82.68 82.61 82.46 82.13 81.43 82.00 82.00
0 20 82.00 82.85 82.33 80.49 78.90 81.32 82.26 82.38 82.63 ***** 82.46 82.66 82.64 82.60 82.54 82.40 82.12 81.63 82.00 82.00
0 21 82.00 83.09 82.82 81.48 78.90 80.39 81.59 82.04 ***** 81.20 82.26 82.49 82.48 82.44 82.39 82.24 81.96 81.50 82.00 82.00
0 22 82.00 83.29 83.23 82.23 80.46 79.00 80.75 81.56 81.17 80.82 82.01 82.26 82.25 82.21 82.14 81.98 81.65 81.00 81.00 81.00
0 23 82.00 83.52 83.71 83.06 81.84 80.58 79.00 80.77 80.88 79.40 81.55 81.84 81.81 81.75 81.65 81.42 81.00 81.00 81.00 81.00
0 24 82.00 83.71 84.09 83.67 82.72 81.65 80.00 79.50 80.60 80.60 81.13 81.13 80.97 80.81 80.58 80.00 80.00 80.00 80.00 80.00
0 25 82.00 83.66 84.07 83.62 82.46 81.84 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00
0 26 82.00 83.26 83.67 82.98 80.00 81.77 81.34 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 82.00 81.99
0 27 82.00 82.00 83.03 82.90 82.21 82.34 82.07 81.38 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.00 80.91 80.70 82.10
0 28 82.00

1 HEAD IN LAYER 1 AT END OF TIME STEP 1 IN STRESS PERIOD 2

	21	22	23	24	25	26	27	28	29	30
0 1	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00
0 2	82.15	82.41	82.54	82.65	82.77	82.88	82.90	82.80	82.52	82.00
0 3	82.13	82.56	82.75	82.92	83.09	83.36	83.70	83.21	82.73	82.00
0 4	*****	*****	*****	*****	*****	*****	*****	83.12	82.75	82.00
0 5	80.39	80.85	81.14	81.25	81.29	81.31	*****	83.06	82.75	82.00
0 6	80.38	80.84	81.13	81.23	81.27	81.28	*****	83.05	82.76	82.00
0 7	80.34	80.80	81.07	81.15	81.17	81.16	*****	83.15	82.82	82.00
0 8	80.25	80.69	80.96	80.97	80.87	80.60	*****	83.90	83.12	82.00
0 9	80.10	80.57	80.87	80.98	81.00	81.00	*****	83.16	82.81	82.00
0 10	79.86	80.39	80.77	80.94	81.02	81.05	*****	83.02	82.72	82.00
0 11	79.53	80.21	80.66	*****	*****	*****	83.38	83.24	82.81	82.00
0 12	79.19	80.10	*****	84.16	84.11	83.92	83.66	83.39	82.87	82.00
0 13	78.70	*****	83.74	84.05	84.07	83.92	83.71	83.45	82.90	82.00
0 14	*****	82.00	83.53	83.93	84.01	83.89	83.70	83.46	82.91	82.00
0 15	80.30	82.00	83.32	83.80	83.92	83.84	83.67	83.44	82.91	82.00
0 16	80.30	82.00	83.06	83.64	83.82	83.78	83.63	83.41	82.90	82.00
0 17	82.00	82.00	82.66	83.46	83.72	83.71	83.58	83.38	82.88	82.00
0 18	82.00	82.00	82.00	83.27	83.62	83.65	83.53	83.34	82.86	82.00
0 19	82.00	82.00	82.00	83.21	83.56	83.60	83.49	83.31	82.84	82.00
0 20	82.00	82.00	82.00	83.22	83.54	83.56	83.45	83.28	82.82	82.00
0 21	82.24	82.50	82.70	83.32	83.53	83.52	83.41	83.25	82.80	82.00
0 22	82.33	82.82	83.09	83.39	83.48	83.45	83.35	83.20	82.78	82.00
0 23	82.41	83.11	83.37	83.34	83.24	83.24	83.18	83.07	82.71	82.00
0 24	82.27	83.16	83.26	82.66	81.60	82.42	82.62	82.71	82.54	82.00
0 25	82.29	83.04	82.95	82.90	82.80	82.77	82.72	82.67	82.48	82.00
0 26	82.65	82.74	81.40	82.30	82.38	82.06	81.60	81.98	82.18	82.00
0 27	82.61	82.72	82.46	82.48	82.36	82.02	81.60	81.93	82.13	82.00
0 28	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00

OHEAD WILL BE SAVED ON UNIT 20 AT END OF TIME STEP 1, STRESS PERIOD 2

0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 1 IN STRESS PERIOD 2

0 CUMULATIVE VOLUMES L**3 RATES FOR THIS TIME STEP L**3/T

IN:		IN:	
STORAGE =	.00000	STORAGE =	.00000
CONSTANT HEAD =	.60638E+06	CONSTANT HEAD =	830.66
RECHARGE =	.93159E+07	RECHARGE =	12761.
TOTAL IN =	.99223E+07	TOTAL IN =	13592.
OUT:		OUT:	
STORAGE =	.00000	STORAGE =	.00000
CONSTANT HEAD =	.99227E+07	CONSTANT HEAD =	13593.
RECHARGE =	.00000	RECHARGE =	.00000
TOTAL OUT =	.99227E+07	TOTAL OUT =	13593.
IN - OUT =	-400.00	IN - OUT =	-.49609
PERCENT DISCREPANCY =	-.00	PERCENT DISCREPANCY =	-.00

TIME SUMMARY AT END OF TIME STEP 1 IN STRESS PERIOD 2

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	.315360E+08	525600.	8760.00	365.000	.999316
STRESS PERIOD TIME	.315360E+08	525600.	8760.00	365.000	.999316
TOTAL SIMULATION TIME	.630720E+08	.105120E+07	17520.0	730.000	1.99863

NEVERS & ASSOCIATES, INC.
ENGINEERING CONSULTANTS

DATE: May 17, 1993

TO: Mr. Steve Dutch, P.E.
Wade-Trim
4919 Memorial Highway
Suite 200
Tampa, FL 33639

RE: Response to DER's Letter
Dated April 15, 1993
Hydrogeologic Evaluation of
Hardee County Landfill
Wachula, Florida

Dear Mr. Dutch:

In accordance with your request, we have reviewed DER's letter dated April 15, 1993 regarding the information submitted for the above referenced site. We are providing herein the additional information requested.

ITEM NO. 1: For our field permeability testing, we conducted falling head permeability tests in several of the piezometers installed for our study. The testing was conducted by filling the piezometer with water and measuring the rate of fall down to the static water level. The piezometer was recharged for 10 minutes prior to conducting the testing. The data obtained from the testing as well as the permeability calculations are included in Appendix A.

ITEM NO. 2: The groundwater flow map prepared for our study was a generalized interpretation of the groundwater flow based on field data, site conditions, surrounding influences, and the results of our

groundwater modeling. It is important to note that anything more than a generalized contour map is almost impossible to develop considering the numerous influences to groundwater that exist at this site. In addition to the landfill and the leachate collection system influences, there are also the influences of spray irrigation to the south of the landfill, the ditch which runs along the southern portion of the site and the large wetland area located to the east of the landfill. Given all of the influences (both natural and man-made), it is impossible to generate a groundwater contour map for this site from field data alone. We feel that the map prepared was representative of the general groundwater flow conditions at the site. While the piezometers measured around the inside perimeter of the landfill indicated that leachate levels are below that of the surrounding groundwater outside the landfill, it is conceivable, as the model has suggested, that some mounding is occurring within the landfill. Leachate is being produced continuously by the landfill and that is why a collection system is needed.

ITEM NO. 4: The modflow data requested has been provided on a computer diskette enclosed. The input data was obtained from field data collected during our study as well as previous studies performed by others.

None of the cells in the model went dry during simulation. The cells indicated with **** in the

output were designated as no-flow nodes to simulate the liner as an impervious boundary.

ITEM NO. ~~4~~ 5: As requested, a Water Quality and Leachate Monitoring Plan has been developed and is included in Appendix B.

We trust the supplemental information provided herein is sufficient for FDER to complete their evaluation of the permit application. If you have any questions, please do not hesitate to contact me.

Sincerely,

MEVERS & ASSOCIATES, INC.

David A. Mevers, P.E.
President

Attachments: Appendices A & B

agency.ltr.wadetrim.ltr

APPENDIX A

SLUG TEST DATA AND CALCULATIONS

SLUG TEST DATA SHEET

PROJECT NO.: DATE: 3/11/93

PROJECT NAME: HARDEE COUNTY WELL NO.: P-11

PROJECT LOCATION: WAUCHULA, FL TECHNICIAN: GB

WELL DATA

RADIUS OF BOREHOLE (r): 4"
RADIUS OF WELL CASING (R): 1.5"
LENGTH OF WELL SCREEN (L): 15'
INITIAL WATER LEVEL(H_o): 4.82

SLUG TEST FIELD DATA

VOLUME OF WATER REMOVED: _____ GAL

TYPE OF TEST: SLUG-IN V
SLUG-OUT _____

TRIAL 1		TRIAL 2	
Time	Head	Time	Head
0	6.90	0	6.90
27	6.40	28	6.40
56	5.90	58	5.90
89	5.40	91	5.40
130	4.82	133	4.82

CALCULATIONS

$K = r^2/2L\Delta t \times Ln\ (L/R) \times Ln\ (H_1/H_2)$

TRIAL 1			TRIAL 2		
Δt(s)	H_1/H_2	K(ft/s)	Δt(s)	H_1/H_2	K(ft/s)
27	1.08	5.05×10^{-5}	28	1.08	4.87×10^{-5}
56	1.17	4.97×10^{-5}	58	1.17	4.80×10^{-5}
89	1.28	4.92×10^{-5}	91	1.28	4.81×10^{-5}
130	1.43	4.88×10^{-5}	133	1.43	4.77×10^{-5}

Ave. K = 4.3 (Ft/Day) Ave. K = 4.2 (Ft/Day)

MEVERS & ASSOCIATES, INC.

Engineering Consultants

SLUG TEST DATA SHEET

PROJECT NO.: DATE: 3/11/93

PROJECT NAME: HARDEE COUNTY WELL NO.: P-6

PROJECT LOCATION: WAUCHULA, FL TECHNICIAN: GB

WELL DATA

RADIUS OF BOREHOLE (r): 4"
RADIUS OF WELL CASING (R): 1.5"
LENGTH OF WELL SCREEN (L): 15'
INITIAL WATER LEVEL(H_0): 0.98

SLUG TEST FIELD DATA

VOLUME OF WATER REMOVED: _____ GAL

TYPE OF TEST: SLUG-IN V
SLUG-OUT _____

TRIAL 1		TRIAL 2	
Time	Head	Time	Head
0	3.48	0	3.48
57	2.98	61	2.98
122	2.48	130	2.48
195	1.98	203	1.98
293	1.48	305	1.48

CALCULATIONS

$K = r^2/2L\Delta t \times Ln\ (L/R) \times Ln\ (H_1/H_2)$

TRIAL 1			TRIAL 2		
Δt(s)	H_1/H_2	K(ft/s)	Δt(s)	H_1/H_2	K(ft/s)
57	1.17	4.88×10^{-5}	61	1.17	4.56×10^{-5}
122	1.40	4.89×10^{-5}	136	1.40	4.59×10^{-5}
195	1.76	5.14×10^{-5}	203	1.76	4.99×10^{-5}
293	2.35	5.17×10^{-5}	305	2.35	4.97×10^{-5}

Ave. K = 4.3 (Ft/Day) Ave. K = 4.1 (Ft/Day)

MEVERS & ASSOCIATES, INC.

Engineering Consultants

SLUG TEST DATA SHEET

PROJECT NO.: DATE: 3/11/93

PROJECT NAME: HARDEE COUNTY LANDFILL WELL NO.: P-3

PROJECT LOCATION: WACHULA, FLORIDA TECHNICIAN: GB

WELL DATA

RADIUS OF BOREHOLE (r): 4"
RADIUS OF WELL CASING (R): 1.5"
LENGTH OF WELL SCREEN (L): 15'
INITIAL WATER LEVEL(H_0): 1.66

SLUG TEST FIELD DATA

~~VOLUME OF WATER~~ REMOVED: ____ GAL

TYPE OF TEST: SLUG-IN ✓
SLUG-OUT ____

TRIAL 1		TRIAL 2	
Time	Head	Time	Head
0	4.11	0	4.11
57	3.11	59	3.11
132	2.11	135	2.11
205	1.66	208	1.66

CALCULATIONS

$K = r^2/2L\Delta t \times Ln\ (L/R) \times Ln\ (H_1/H_2)$

TRIAL 1			TRIAL 2		
Δt(s)	H_1/H_2	K(ft/s)	Δt(s)	H_1/H_2	K(ft/s)
57	1.32	8.69×10^{-5}	59	1.32	8.39×10^{-5}
132	1.95	8.97×10^{-5}	135	1.95	8.77×10^{-5}
205	2.48	7.86×10^{-5}	208	2.48	7.74×10^{-5}

Ave. K = 7.3 (Ft/Day) Ave. K = 7.2 (Ft/Day)

MEVERS & ASSOCIATES, INC.

Engineering Consultants

SLUG TEST DATA SHEET

PROJECT NO.: DATE: 3/11/93

PROJECT NAME: HARDEE COUNTY LANDFILL WELL NO.: P-8

PROJECT LOCATION: WAUCHULA, FLORIDA TECHNICIAN: GB

WELL DATA

RADIUS OF BOREHOLE (r): 4"
RADIUS OF WELL CASING (R): 1.5"
LENGTH OF WELL SCREEN (L): 15'
INITIAL WATER LEVEL (H_0): 1.21

SLUG TEST FIELD DATA

~~VOLUME OF WATER~~ REMOVED: ____ GAL

TYPE OF TEST: SLUG-IN ✓
SLUG-OUT ____

TRIAL 1		TRIAL 2	
Time	Head	Time	Head
0	3.30	0	3.30
50	2.80	53	2.80
105	2.30	107	2.30
167	1.80	172	1.80
223	1.21	231	1.21

CALCULATIONS

$K = r^2/2L\Delta t \times Ln\ (L/R) \times Ln\ (H_1/H_2)$

TRIAL 1			TRIAL 2		
Δt(s)	H_1/H_2	K(ft/s)	Δt(s)	H_1/H_2	K(ft/s)
50	1.18	5.87×10^{-5}	53	1.18	5.54×10^{-5}
105	1.43	6.09×10^{-5}	107	1.43	5.93×10^{-5}
167	1.83	6.92×10^{-5}	172	1.83	6.23×10^{-5}
223	2.09	5.86×10^{-5}	231	2.09	5.66×10^{-5}

Ave. K = 5.2 (Ft/Day) Ave. K = 5.1 (Ft/Day)

MEVERS & ASSOCIATES, INC.

Engineering Consultants

SLUG TEST DATA SHEET

PROJECT NO.: DATE: 3/11/93

PROJECT NAME: HARDEE COUNTY WELL NO.: P-7

PROJECT LOCATION: WAUCHULA, FLORIDA TECHNICIAN: GB

WELL DATA

RADIUS OF BOREHOLE (r): 4"
RADIUS OF WELL CASING (R): 1.5"
LENGTH OF WELL SCREEN (L): 15'
INITIAL WATER LEVEL (H_o): 0.48

SLUG TEST FIELD DATA

~~VOLUME OF WATER~~ REMOVED: ____ GAL

TYPE OF TEST: SLUG-IN ✓
SLUG-OUT ____

TRIAL 1		TRIAL 2	
Time	Head	Time	Head
0	2.68	0	2.68
63	2.18	67	2.18
138	1.68	143	1.68
226	1.18	231	1.18
451	0.48	469	0.48

CALCULATIONS

$K = r^2/2L\Delta t \times \text{Ln}\ (L/R) \times \text{Ln}\ (H_1/H_2)$

TRIAL 1			TRIAL 2		
Δt(s)	H_1/H_2	K(ft/s)	Δt(s)	H_1/H_2	K(ft/s)
63	1.23	5.83×10^{-5}	67	1.23	5.48×10^{-5}
138	1.60	6.04×10^{-5}	143	1.60	5.83×10^{-5}
226	2.27	6.43×10^{-5}	231	2.27	6.29×10^{-5}
451	5.58	6.76×10^{-5}	469	5.58	6.50×10^{-5}

Ave. K = 5.4 (Ft/Day) Ave. K = 5.2 (Ft/Day)

MEVERS & ASSOCIATES, INC.
Engineering Consultants

APPENDIX B

WATER QUALITY AND LEACHATE MONITORING PLAN

WATER QUALITY AND

LEACHATE MONITORING PLAN

HARDEE COUNTY LANDFILL

WACHULA, FLORIDA

PREPARED FOR:

HARDEE COUNTY
DEPARTMENT OF SOLID WASTE
WACHULA, FLORIDA

AND

WADE-TRIM, INC.
4919 MEMORIAL HIGHWAY
SUITE 200
TAMPA, FLORIDA

TABLE OF CONTENTS

1.0 PROJECT DESCRIPTION

The Hardee County Landfill Facility is located east of Wachula, Florida in Section 35 of Township 33 South, Range 25 east. The landfill is currently being used for Class I materials as well as construction debris and waste tires.

The landfill is constructed with plastic PVC sidewall liners tied to a natural clay base on the west, north and east sides of the landfill. A dewatering ditch is located along the south side of the landfill area. This configuration serves to effectively isolate the landfill from any surrounding groundwater influences and therefore any leachate generated results from existing groundwater within the landfill and from infiltration of rainwater falling on the landfill surface. A general site plan for the Hardee County Landfill is shown in Figure 1.

2.0 WATER QUALITY AND LEACHATE MONITORING NETWORK

Water quality and leachate monitoring will be handled via a network of eight (8) monitoring wells and one (1) leachate collection point. In addition, water level monitoring over the site will be completed in the series of piezometers installed on-site. The locations of the monitoring wells and piezometers are indicated in the attached site plan. Leachate sampling will be conducted at the south end of the dewatering ditch.

3.0 WATER QUALITY AND LEACHATE MONITORING PARAMETERS

As outlined in Chapter 17-701.510 (8)(a) the following parameters will be measured in the field in each monitoring well:

-Static water level prior to purging
-Specific conductivity
-pH
-Dissolved oxygen
-Turbidity
-Temperature
-Colors and sheens

As part of the initial conditions for renewal of the landfill permit, the following parameters will be analyzed for each well as outlined in Chapter 17-701.510(8)(a):

-Ammonium (NH4)
-Arsenic
-Bicarbonate
-Cadmium
-Chlorides
-Chromium
-Iron
-Lead
-Mercury
-Nitrate
-Sodium
-Total Dissolved Solids (TDS)
-Total organic carbon (TOC)
-EPA 601 & 602 analyses

As outlined in Chapter 17-701.510 (8)(c) the following parameters will be measured in the field at the leachate sampling location prior to sample collection:

-Specific conductivity
-pH
-Dissolved oxygen
-Colors, sheens

original permit
max measured for
WCS only

- Lad

The initial sampling and analysis of leachate will consist of the following parameters as outlined in Chapter 17-701.510(8)(c):

- -Ammonium (NH4)
- -Arsenic
- -Bicarbonate
- -Cadmium
- -Chlorides
- -Chromium
- -Iron
- -Lead
- -Mercury
- -Nitrate
- -Sodium
- -Total Dissolved Solids (TDS)
- -Total Organic Carbon (TOC)
- -EPA 601 & 602 Analyses
- -40 CFR Part 258, Appendix II parameters

4.0 SAMPLING METHODS

All sampling shall be conducted following the protocols outlined in the Comprehensive Quality Assurance Plan (CompQAP) approved by the State for the company or laboratory conducting the sampling.

5.0 MONITORING FREQUENCY

After the initial round of sampling, all indicator parameters for monitoring wells, surface water and leachate monitoring locations shall be sampled and analyzed on a quarterly basis. In addition, leachate samples shall be analyzed for those parameters listed in 80 CFR Part 258, Appendix II, on an annual basis.

No surface H_2O sampling sites?

6.0 WATER QUALITY MONITORING REPORTING

The landfill owner or operator shall report all water quality monitoring results to the Department of Environmental Regulation (DER) on a quarterly basis. The operator of the landfill shall notify the DER at least 14 days before the sampling is scheduled to occur so that the DER may collect split samples.

Quarterly reporting periods shall be established in the facility permit. The report shall include at least the following:

1. The facility name and identification number, sample collection dates, and analysis dates;

GW form
17-1.106(2)

2. All analytical results, including all peaks even if below maximum contamination levels;

3. Identification number and designation of all surface water and ground water monitoring points;

4. Applicable water quality standards;

5. Quality assurance, quality control notations;

6. Method detection limits;

.01 –
type in
17-701.510(9a)8

7. STORET code numbers for all parameters;

8. Water levels recorded prior to evaluating wells or sample collection. Elevation reference shall include the top of the well casing and land surface at each well site at a precision of plus or minus 0.1 foot (NGVD);

9. An updated ground water table contour map, with contours at no greater than one-foot intervals, which indicates ground water elevations and flow direction; and

10. A summary or trend analysis of any water quality standards or criteria that are exceeded, including elevations of parameters above background levels.

At the end of each year of data collection, with the year beginning with the date the landfill permit was issued, a technical report, prepared, signed and sealed by a professional geologist or professional engineer with experience in hydrogeologic investigations, shall be submitted to the DER. The report shall summarize and interpret the water quality data and water level measurements collected during the past two years. The report shall contain, at a minimum, the following:

1. Tabular and graphical displays of the data, including hydrographies for all monitor wells;
2. Trend analyses;
3. Comparisons among shallow, middle, and deep zone wells.
4. Comparisons between upgradient and downgradient wells;
5. Correlations between related parameters such as total dissolved solids and specific conductance;
6. Discussion of erratic and/or poorly correlated data; and
7. A summary ground water table contour map and an interpretation of the quarterly ground water contour maps.

All field and laboratory records specified in Rules 17-160.600-.630, F.A.C., shall be made available to the Department and be retained for the design period of the landfill.

7.0 ASSESSMENT MONITORING AND CORRECTION ACTION

(A) Assessment monitoring. If indicator parameters are detected in detection wells in concentrations which are significantly above background water quality, or which are at levels above the DER's water quality standards or criteria specified in Chapter 17-520, F.A.C., the permittee shall resample the wells within 15 days after the sampling data is received, to confirm the data. If the data is confirmed, the permittee shall notify the DER in writing within 14 days of this finding. Upon notification by the DER, the permittee shall initiate assessment monitoring as follows:

1. Routine monitoring of all monitoring wells, surface water monitoring locations and leachate sampling locations shall continue according to the requirements of section 3.0 of this plan.

2. Within 90 days of initiating assessment monitoring and annually thereafter, the permittee shall sample and analyze a representative sample of the background wells and all affected detection wells for the parameters listed in 40 CFR Part 258, Appendix II of this section. Any new parameters detected and confirmed in the affected downgradient wells shall be added to the routine ground water monitoring parameter lists required in section 3.0 of this plan.

3. Within 90 days of initiating assessment monitoring, the permittee shall install and sample compliance monitoring wells at the compliance line of the zone of discharge and downgradient from the affected detection monitoring wells. These wells shall be installed according to the requirements of Chapter 17-701.510 (3)(a), and samples shall be analyzed for the parameters listed in section 3.0 of this plan and also 40 CFR Part 258, Appendix II.

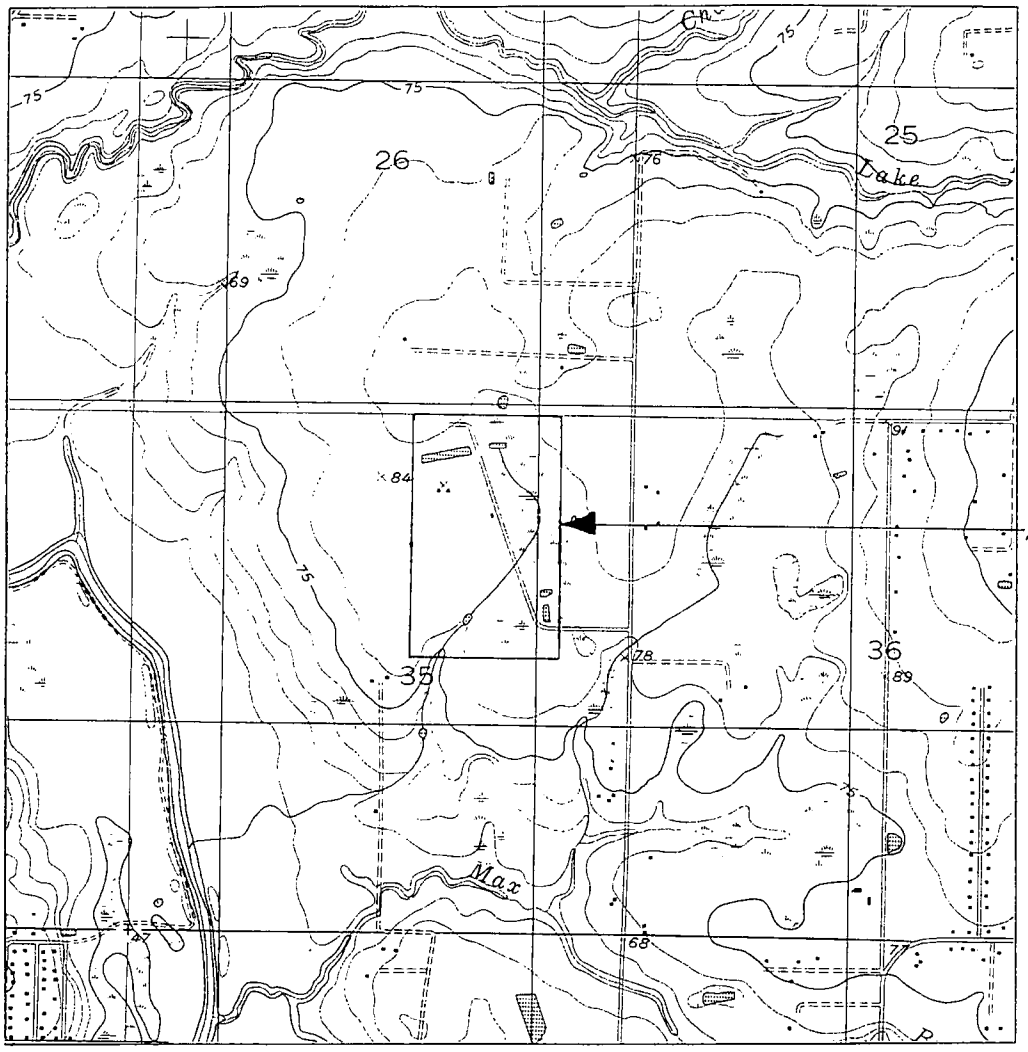
4. Within 180 days of initiating assessment monitoring, the permittee shall submit a contamination assessment plan to the DER. This plan shall be designed to delineate the extent and cause of the contamination, to predict the likelihood that DER water quality standards will be violated outside the zone of discharge, and to evaluate methods to prevent any such violations. Upon approval by the DER, the permittee shall implement this plan and submit a contamination assessment report in accordance with the plan. All reasonable efforts shall be made by the permittee to prevent further degradation of water quality from the landfill activities.

5. If for two (2) consecutive sampling events the concentrations of all indicator parameters and the parameters listed in 40 CFR Part 258, Appendix II are at or below background values, the permittee, upon approval by the DER, may discontinue assessment monitoring and return to the routine monitoring requirements in Section 3.0 of this plan.

B. Corrective actions.

1. If the contamination assessment report indicates that water quality standards are likely to be violated outside the zone of discharge, the permittee shall, within 90 days, submit a remedial action plan to the DER. Upon approval, the permittee shall initiate corrective actions to prevent such violations.

2. If any contaminants are detected and confirmed in compliance wells in concentrations which exceed both background levels and DER water quality standards or criteria, are detected and confirmed in detection wells in concentrations which are above DER water quality minimum criteria, the permittee shall notify the Department within 14 days of this finding and shall initiate corrective actions. Assessment monitoring shall continue according to the requirements of this section.



USGS QUAD MAP

Scale: 1" = 2000'

REFERENCE: USGS Quadrangle Map of
Wauchula, Florida
Prepared in 1954–55
Photorevised in 1987

Project No.: 93–H–103	HYDROGEOLOGIC EVALUATION	MEVERS & ASSOCIATES, INC.
Date: March 1993	HARDEE COUNTY LANDFILL	Engineering Consultants
Plate 1	WAUCHULA, FLORIDA	

GRID FOR HARDEE COUNTY SPRAYFIELD MODEL

SCALE: 1" = 100'

MONITORING WELL 7O
83.92
79.30

MONITORING WELL 3O
82.77

PA-9

PA 8

END OF LINER

LINER EXTENSION 80.57

⊕P 1
84.94
84.37

SPRAY FIELD

⊕P 5
84.77
80.89

⊕P 8
81.45
78.09

⊕P 2
79.606
78.69

⊕P 7
81.36
78.64

83.57/80.10
MONITORING WELL 6O

75'R

⊕P 3
82.27
79.96

PUMP STATION

DEWATERING DITCH

77.11
78.06
⊕P 9

MAINTENANCE BUILDING

MONITORING WELL 2
80.78
77.86

CONTROL STRUCTURE

⊕P 6
78.66
82.46

DITCH

LINER

83

82

82

78

80

84

MEYERS & ASSOCIATES, INC.
ENGINEERING CONSULTANTS

2310 Tall Pines Drive – Suite 210
Largo, Florida 34641

~~STEVE DUTCH~~

~~WADE TRIM~~

COMPUTER DISC
FOR MODELS

Revised
2-12-
Submitted

Media Insert

Dep Box Number: *DWM-SWD-SW-201*

Pride Box Number: *DEPS-S11 B1762*

PreIndex ID Number: *1552150*

	→	Slides
	→	CD/ DVD Disk
1	→	Floppy Disk
	→	Negatives
	→	

Notes:

MUDFLOW FILES
FOR HARDEE COUNTY SPRAYFIELD

MODEL

NORTH

Scale: 1" = 100'

Legend
- Power Auger Location
- Piezometer Location
- Monitoring Well Location

MONITORING WELL 7
MONITORING WELL 3
MONITORING WELL 5
MONITORING WELL 6
MONITORING WELL 1
MONITORING WELL 2
MONITORING WELL 4
PA 9
PA 8
PA 7
PA 6
PA 2
PA 1
PA 3
PA 4
PA 5
P 1
P 2
P 3
P 4
P 5
P 6
P 7
P 8
P 9
P 10
CONSTRUCTION DEBRIS AREA
SPRAY FIELD
POND
COVER MATERIAL AREA
RECYCLE CENTER
POND
POND W.L. 78.7
DRAINAGE DITCH
PERIMETER SWALE
PUMP STATION
MAINTENANCE BUILDING
CONTROL STRUCTURE
POND W.L. 81.9
W.S. EL. = +80.0
W.S. EL. = +78.0
WOODED DETENTION AREA
BARBED WIRE FENCE
DITCH

Project No.: 93-H-103	HYDROGEOLOGIC EVALUATION	MEVERS & ASSOCIATES, INC.
Date: March 1993	HARDEE COUNTY LANDFILL	Engineering Consultants
Plate 4	WAUCHULA, FLORIDA	