

APPENDIX C

MODELING OF TRANSIENT GROUND-WATER FLOW DURING IRRIGATION

PART 1: Background discharge from study field prior to irrigation.
Initial water table heads measured 6/22/84.
Simulation period = 1 day.

PART 2: Ground-water discharge from study field during irrigation
period.
Water table heads at maximum, measured 6/28/82.
Simulation period = 3.6 days, total period of irrigation.

U. S. G. S.
FINITE-DIFFERENCE MODEL
FOR
SIMULATION OF GROUND-WATER FLOW

JANUARY, 1975

R. OSTBERG'S 56 ACRE ALFALFA FIELD, GREENFIELD BENCH

STATIC WATER LEVELS FROM 6-22-82, PRIOR TO IRR

SIMULATION OPTIONS: WATE

SIP CHEC

NUME HEAD

NUMBER OF ROWS = 10
NUMBER OF COLUMNS = 20
NUMBER OF WELLS FOR WHICH DRAWDOWN IS COMPUTED AT A SPECIFIED RADIUS = 0
MAXIMUM PERMITTED NUMBER OF ITERATIONS = 100

WORDS OF Y VECTOR USED = 4550

ON ALPHAMERIC MAP:

MULTIPLICATION FACTOR FOR X DIMENSION = 1.000000
MULTIPLICATION FACTOR FOR Y DIMENSION = 1.000000
MAP SCALE IN UNITS OF FEET
NUMBER OF FEET PER INCH = 500.0000
MULTIPLICATION FACTOR FOR DRAWDOWN = 10.00000
MULTIPLICATION FACTOR FOR HEAD = 10.00000

NUMBER OF PUMPING PERIODS = 1
TIME STEPS BETWEEN PRINTOUTS = 4

ERROR CRITERION FOR CLOSURE = 0.1000000E-01
STEADY STATE ERROR CRITERION = 0.1000000E-01

SPECIFIC STORAGE OF CONFINING BED = 0.0000000E+00
EVAPOTRANSPIRATION RATE = 0.0000000E+00
EFFECTIVE DEPTH OF ET = 1.000000

MULTIPLICATION FACTOR FOR TRANSMISSIVITY IN X DIRECTION = 1.000000
IN Y DIRECTION = 1.000000

[illegible]

STORAGE COEFFICIENT
MATRIX

1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000								
2	0.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	-1.000
	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	0.00000								
3	0.00000	-1.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.000
	0.00000	0.00000	0.00000	0.00000	-1.00000	0.00000								
4	0.00000	-1.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.000
	0.00000	0.00000	0.00000	0.00000	-1.00000	0.00000								
5	0.00000	0.00000	-1.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.000
	-1.00000	-1.00000	-1.00000	-1.00000	-1.00000	0.00000								
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-1.00000	-1.000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000								
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-1.00000	0.00000	0.000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000								
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-1.00000	-1.00000	-1.00000	0.00000	0.00000	0.000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000								
9	0.00000	0.00000	0.00000	0.00000	-1.00000	-1.00000	-1.00000	-1.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000								
10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000								

AQUIFER HYDRAULIC CONDUCTIVITY
MATRIX

1	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00
2	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00
3	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00
4	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00
5	0.000E+00 0.220E-03	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00
6	0.000E+00 0.220E-03	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00
7	0.000E+00 0.220E-03	0.000E+00 0.220E-03	0.000E+00 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00
8	0.000E+00 0.220E-03	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00
9	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00
10	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00

AQUIFER BASE ELEVATION = 0.0000000E+00

SPECIFIC YIELD = 0.1000000

DELX = 200.0000

DELY = 200.0000

SOLUTION BY THE STRONGLY IMPLICIT PROCEDURE

BETA= 1.00

10 ITERATION PARAMETERS: 0.0000000D+00 0.7320526D+00 0.9282042D+00 0.9807625D+00 0.9948454D+00 0.0000000D+00

0.7320526D+00 0.9282042D+00 0.9807625D+00 0.9948454D+00
PUMPING PERIOD NO. 1: 3000.00 DAYS

NUMBER OF TIME STEPS= 25

DELT IN HOURS = 6.000

MULTIPLIER FOR DELT = 1.000

0 WELLS

I J PUMPING RATE WELL RADIUS

! TIME STEP NUMBER = 4 !

SIZE OF TIME STEP IN SECONDS= 21600.00

TOTAL SIMULATION TIME IN SECONDS= 86400.00
 MINUTES= 1440.00
 HOURS= 24.00
 DAYS= 1.00
 YEARS= 0.00

DURATION OF CURRENT PUMPING PERIOD IN DAYS= 1.00
 YEARS= 0.00

CUMULATIVE MASS BALANCE:

L**3

SOURCES:

STORAGE = 1752.40
 RECHARGE = 0.00
 CONSTANT FLUX = 0.00
 CONSTANT HEAD = 568.46
 LEAKAGE = 0.00
 TOTAL SOURCES = 2320.85

DISCHARGES:

EVAPOTRANSPIRATION = 0.00
 CONSTANT HEAD = 2320.85
 QUANTITY PUMPED = 0.00
 LEAKAGE = 0.00
 TOTAL DISCHARGE = 2320.85
 DISCHARGE-SOURCES = 0.00
 PER CENT DIFFERENCE = 0.00

RATES FOR THIS TIME STEP:

L**3/T

STORAGE = 0.0201
 RECHARGE = 0.0000
 CONSTANT FLUX = 0.0000
 PUMPING = 0.0000
 EVAPOTRANSPIRATION = 0.0000
 CONSTANT HEAD:
 IN = 0.0067
 OUT = -0.0267
 LEAKAGE:
 FROM PREVIOUS PUMPING PERIOD = 0.0000
 TOTAL = 0.0000
 SUM OF RATES = 0.0000

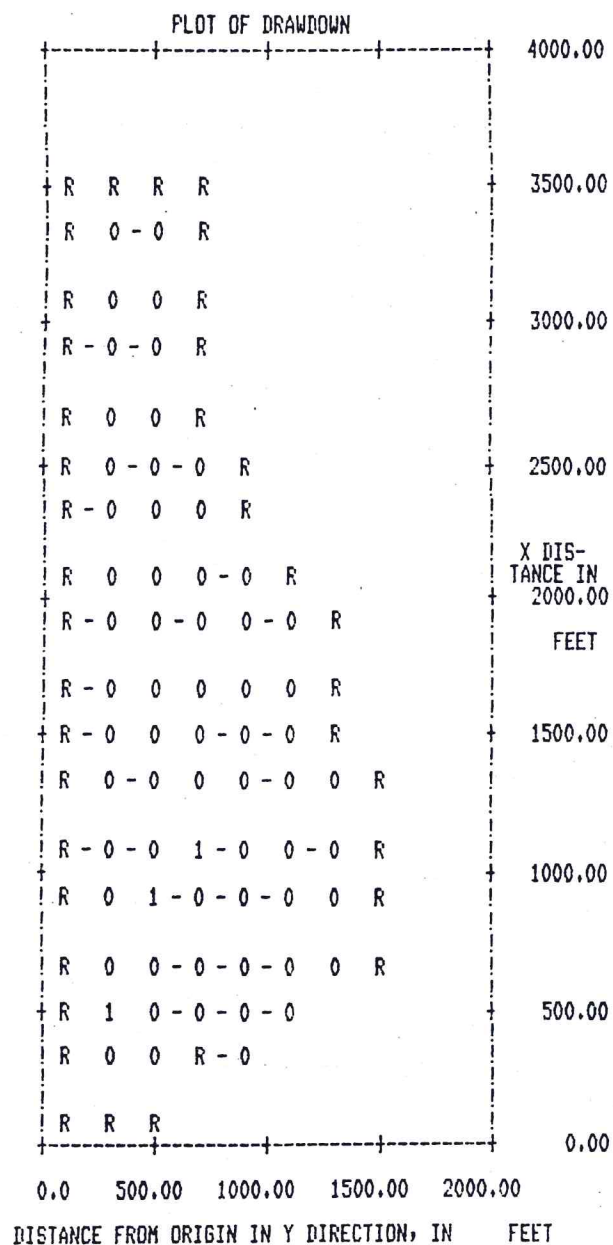
MAXIMUM HEAD CHANGE FOR EACH ITERATION:

0.0280 0.0000

MAXIMUM CHANGE IN HEAD FOR THIS TIME STEP = 0.028

TIME STEP : 1 2 3 4

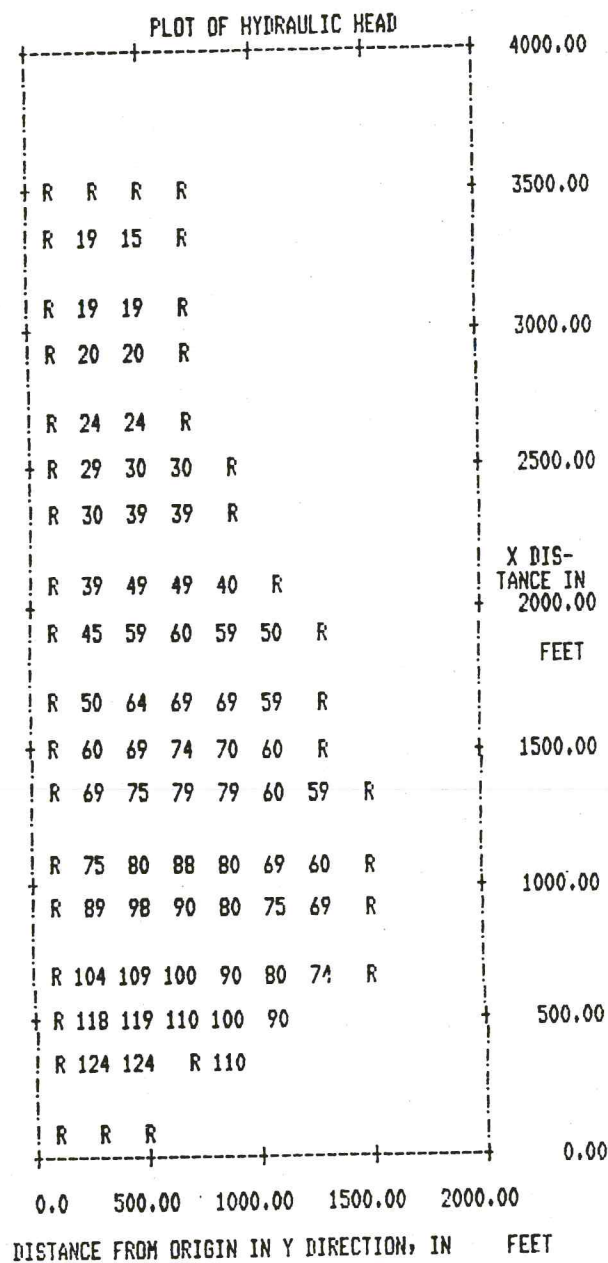
ITERATIONS: 1 1 1 1



EXPLANATION

R = CONSTANT HEAD BOUNDARY
 *** = VALUE EXCEEDED 3 FIGURES
 MULTIPLICATION FACTOR = 10.000

R = CONSTANT HEAD BOUNDARY
*** = VALUE EXCEEDED 3 FIGURES
MULTIPLICATION FACTOR = 10.000



EXPLANATION

R = CONSTANT HEAD BOUNDARY
*** = VALUE EXCEEDED 3 FIGURES
MULTIPLICATION FACTOR = 10,000

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[illegible]

Abstract

[illegible]

U. S. G. S.
FINITE-DIFFERENCE MODEL
FOR
SIMULATION OF GROUND-WATER FLOW
JANUARY, 1975

R. OSTBERG'S 56 ACRE ALFALFA FIELD, GREENFIELD BENCH

STATIC WATER LEVELS FROM 6-78-82, AFTER IRR

SIMULATION OPTIONS: WATE

SIF CHEC

NUME HEAD

NUMBER OF ROWS = 10
NUMBER OF COLUMNS = 20
NUMBER OF WELLS FOR WHICH DRAWDOWN IS COMPUTED AT A SPECIFIED RADIUS = 0
MAXIMUM PERMITTED NUMBER OF ITERATIONS = 100
WORDS OF Y VECTOR USED = 4550

ON ALPHAMERIC MAP:

MULTIPLICATION FACTOR FOR X DIMENSION = 1.000000
MULTIPLICATION FACTOR FOR Y DIMENSION = 1.000000
MAP SCALE IN UNITS OF FEET
NUMBER OF FEET PER INCH = 500.0000
MULTIPLICATION FACTOR FOR DRAWDOWN = 10.00000
MULTIPLICATION FACTOR FOR HEAD = 10.00000

NUMBER OF PUMPING PERIODS = 1
TIME STEPS BETWEEN PRINTOUTS = 4

ERROR CRITERION FOR CLOSURE = 0.1000000E-01
STEADY STATE ERROR CRITERION = 0.5000000E-02

SPECIFIC STORAGE OF CONFINING BED = 0.0000000E+00
EVAPOTRANSPIRATION RATE = 0.0000000E+00
EFFECTIVE DEPTH OF ET = 1.000000

MULTIPLICATION FACTOR FOR TRANSMISSIVITY IN X DIRECTION = 1.000000
IN Y DIRECTION = 1.000000

[illegible]

[illegible]

AQUIFER HYDRAULIC CONDUCTIVITY
MATRIX

1	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00
2	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00
3	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00
4	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00
5	0.000E+00 0.220E-03	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00
6	0.000E+00 0.220E-03	0.000E+00 0.220E-03	0.220E-03 0.220E-03	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00
7	0.000E+00 0.220E-03	0.000E+00 0.220E-03	0.000E+00 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00
8	0.000E+00 0.220E-03	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00
9	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.220E-03 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00
10	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00	0.000E+00 0.000E+00

AQUIFER BASE ELEVATION = 0.000000E+00

SPECIFIC YIELD = 0.1000000

DELX = 200.0000

DELY = 200.0000

SOLUTION BY THE STRONGLY IMPLICIT PROCEDURE

BETA= 1.00

10 ITERATION PARAMETERS: 0.0000000D+00 0.7320526D+00 0.9282042D+00 0.9807625D+00 0.9948454D+00 0.0000000D+00

0.7320526D+00 0.9282042D+00 0.9807625D+00 0.9948454D+00
PUMPING PERIOD NO. 1: 3.60 DAYS

NUMBER OF TIME STEPS= 15

DELT IN HOURS = 5.760

MULTIPLIER FOR DELT = 1.000
0 WELLS

I J PUMPING RATE WELL RADIUS

! TIME STEP NUMBER = 15 !

SIZE OF TIME STEP IN SECONDS= 20736.00

TOTAL SIMULATION TIME IN SECONDS= 311040.00
 MINUTES= 5184.00
 HOURS= 86.40
 DAYS= 3.60
 YEARS= 0.01

DURATION OF CURRENT PUMPING PERIOD IN DAYS= 3.60
 YEARS= 0.01

CUMULATIVE MASS BALANCE:

L**3

SOURCES:

STORAGE = 49843.98
 RECHARGE = 0.00
 CONSTANT FLUX = 0.00
 CONSTANT HEAD = 0.00
 LEAKAGE = 0.00
 TOTAL SOURCES = 49843.98

DISCHARGES:

EVAPOTRANSPIRATION = 0.00
 CONSTANT HEAD = 49843.98
 QUANTITY PUMPED = 0.00
 LEAKAGE = 0.00
 TOTAL DISCHARGE = 49843.98
 DISCHARGE-SOURCES = 0.00
 PER CENT DIFFERENCE = 0.00

RATES FOR THIS TIME STEP:

L**3/T

STORAGE = 0.1494
 RECHARGE = 0.0000
 CONSTANT FLUX = 0.0000
 PUMPING = 0.0000
 EVAPOTRANSPIRATION = 0.0000
 CONSTANT HEAD:
 IN = 0.0000
 OUT = -0.1494
 LEAKAGE:
 FROM PREVIOUS PUMPING PERIOD = 0.0000
 TOTAL = 0.0000
 SUM OF RATES = 0.0000

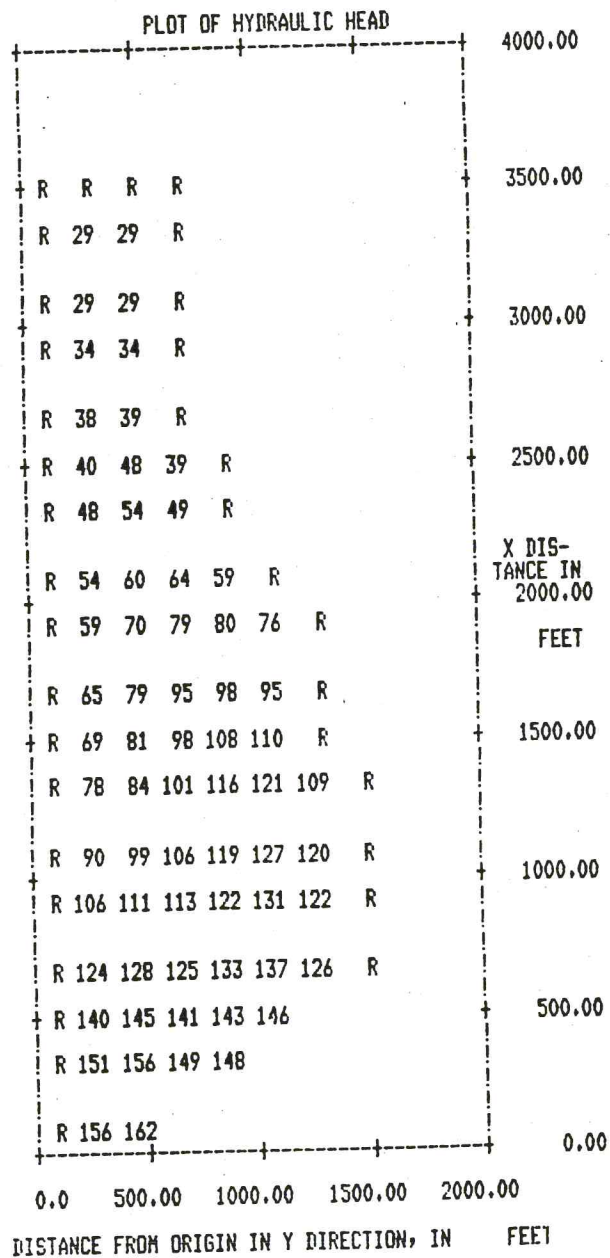
MAXIMUM HEAD CHANGE FOR EACH ITERATION:

0.0599 0.0001

MAXIMUM CHANGE IN HEAD FOR THIS TIME STEP = 0.060

TIME STEP : 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

ITERATIONS: 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1



EXPLANATION

R = CONSTANT HEAD BOUNDARY
 *** = VALUE EXCEEDED 3 FIGURES
 MULTIPLICATION FACTOR = 10.000

1000

[illegible]

DRAWDOWN

1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.87	0.87	0.91	0.57	0.37	-0.02	0.13	0.00	0.00	0.04	0.10	0.10	-0.05	0.11	0.06	0.02	0.10	0.00	0.00
4	0.00	0.26	0.39	0.42	0.13	-0.13	0.09	-0.46	-0.15	0.03	-0.02	-0.04	0.08	0.16	0.05	0.06	0.03	0.10	0.00	0.00
5	0.00	0.00	0.03	-0.10	-0.53	-0.31	-0.16	-0.11	0.11	0.46	0.04	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.11	0.12	0.15	-0.27	0.07	0.35	0.11	0.16	-0.02	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.32	0.22	0.36	0.29	0.36	0.97	0.48	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.83	0.71	0.99	1.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

FORTRAN STOP

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