TECHNICAL MEMORANDUM
October 1987

# ONE FOOT DRAWDOWN ZONES OF INFLUENCE SURROUNDING MUNICIPAL WATER SUPPLY WELLFIELDS IN PALM BEACH COUNTY

A Technical Support Study for the Resource Control Department

DRE 238

by

Don G. J. Padgett

Hydrogeology Division
Resource Planning Department
South Florida Water Management District
West Palm Beach, Florida

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## PREFACE

On March 19, 1986, Richard A. Rogers, Director, Resource Control Department, South Florida Water Management District, sent a memorandum to Peter B. Rhoads, Director, Resource Planning Department, specifying information needs of Resource Control from Resource Planning. The first item on the memorandum list was a request for county maps of public water supply wellfields showing one-foot drawdown lines to be used in administering the revised Surface Water Management Basis of Review rules for water quality protection purposes.

The task of generating these maps was given to the Hydrogeology Division of Resource Planning.

This study presents the map series for Palm Beach County. The study was done by Don Padgett, Staff Hydrogeologist, under the direction of Rick Bower, Senior Hydrogeologist, and Sharon Trost, Director, Hydrogeology Division.

The next map series to be completed in this study will be Martin and St. Lucie Counties.

## EXECUTIVE SUMMARY

In response to requests from South Florida Water Management District's Resource Control Department, possible surface water impacts due to water withdrawals from large Palm Beach County public water supply wellfields were modeled using THEIS and THEIS 1 uniform-properties, analytical drawdown model programs. All active wells were modeled as pumping continuously for 100 days without recharge at rates determined by the permitted annual allocation. Aquifer parameters were taken from existing literature or derived from previously recorded hydrologic and hydrogeologic data. THEIS input data for individual public water supply permits were referenced on data summary sheets. One foot iso-drawdown lines were contoured on program output and mapped on U.S. Geological Survey quadrangles.

## METHODOLOGY

### Background

The project was begun by researching available in-house information on the hydrogeology of eastern Palm Beach County. This in-house data search led to a good regional picture of the aquifer system exploited by most producers of potable water.

All large water supply wellfields in Palm Beach County draw water exclusively from the Surficial Aquifer System. Current literature defines this aquifer system as being either an unconfined water table aquifer or a semi-unconfined aquifer hydraulically connected to the water table.

Geologically, the Surficial Aquifer System can be regionally described as unconsolidated sand and shell overlying a predominately limestone and sandstone section with variable amounts of secondary effective porosity development. The lithology of this system varies spatially due to rapid facies changes. Facies changes combined with varying amounts of limestone solutioning result in a wide range of aquifer performance capabilities.

Stratigraphic nomenclature of lithologic units of the Surficial Aquifer System are described by Land et al. (1973).

Based on the literature reviewed by the author, two assumptions were made in this investigation:

1. The use of a Theis non-equilibrium flow model to simulate extremely severe drawdown effects of wellfields in eastern Palm Beach County is reasonable.
2. A storativity (specific yield) value of 0.2 is a realistic approximation of the ultimate storage capabilities of Surficial aquifer sediments.

Once regional aquifer characteristics had been defined, wellfields to be modeled were selected. A list of Palm Beach County public water supply permits was generated from the Public Water Supply computer file. This list was cross-

checked against the Resource Control Department's county map of public water supply wellfields, then edited of all permits with allocations less than 365 million gallons per year (1 million gallons per day). Drawdowns of existing wellfields permitted for less than 365 MGY were assumed to have insignificant impacts on surface water in Palm Beach County.

After general locations of the edited permit list wellfields were plotted on a base map, pumping scenarios for each wellfield were constructed and modeled. As information was assembled to construct these scenarios, summary sheets for each public water supply permit were created. The completed summary sheets are listed in ascending permit number in Appendix I. These sheets provide simple and complete references to the data sources used and assumptions made in modeling individual wellfields.

Wellfield drawdowns were modeled using the THEIS uniform-properties analytical drawdown model program. The working equation for the program is the Theis non-equilibrium flow equation (Walton, 1970). This program was later modified to print well names on the output. This modified program, THEIS 1, is executed using the same commands and input data as THEIS (Appendix II).

Data Acquistion

Information for constructing pumping scenarios for the THEIS models came from five sources: permit files, consultant reports, SWIM (Salt Water Intrusion Monitoring) files, governmental agency investigations, and the operators or managers of the wellfields.

Permit files provided allocation amounts, well locations and in some cases aquifer descriptions. Florida State Plane coordinates for well locations were sometimes provided by the permittee and included in a permit review staff report. Permit file maps were the best source of well locations. Permit files often yielded references to aquifer parameters and their origins.

Consultant reports were good sources of aquifer descriptions and well locations. These reports were the primary sources of available Aquifer Performance Test (A.P.T.) interpretations; unfortunately, the raw test data was not always available. Consultant report references on permit summary sheets include a "C#" which refers to the indexing system of the South Florida Water Management District's consultant report files.

Salt Water Intrusion Monitoring (SWIM) files were occasionally consulted to verify well locations and pumping status. Pump test data were sometimes found in these files.

Governmental agency investigations and reports were very useful sources of aquifer parameter values, local geology descriptions, specific capacity measurements, and local hydrologic descriptions.

Occasionally, it was necessary to contact wellfield operators or managers to get confirmations or updates on the status of existing water supply systems.

The information search for pumping scenario data revealed that several wellfields were located in areas where A.P.T's had not been performed. In addition, several A.P.T.'s yielded questionable results due to pump test durations, piezometer geometries, partial penetration of the pumping wells, well locations relative to hydraulically connected surface water bodies or data interpretation methods.

In areas where aquifer parameters had not been evaluated, transmissivity values were estimated from specific capacities (Walton, 1970). In areas where specific capacity data were unavailable, transmissivity values were assumed equivalent to those in nearby wellfields located along the depositional strike.

Although some A.P.T. results were questionable, the reinterpretation of the raw field data is beyond the scope of this report. Therefore, in most areas where A.P.T. interpretations were available, the derived transmissivity values were used in modeling the local wellfield drawdowns.

## Model Construction

Once all well location and aquifer parameter information was collected, well locations were plotted on U.S.G.S. quadrangle sheets. Wells were then assigned model grid coordinates using a 1" = 2000' scale grid. This scale is compatible with quadrangle sheets so computer generated output can be transferred directly to final maps. In some cases, the small size of a wellfield required a increase in model grid scale to better reflect the shape of the cone of depression. In these cases, a large scale model was run in addition to the 1" = 2000' scale model and used as an interpretation guide.

In cases where the wellfield exceeded the size limitations of the computer program grid, the wellfield was modeled using two overlapping grids and identical aquifer parameters. Corresponding drawdown values on computer output were added and the resulting values contoured (Freeze and Cherry, 1979).

Pumping rates for individual wells were defined by the author. In most cases, these rates were equal to the average daily allocation (yearly allocation ÷ 365) divided by the number of pumping wells. In some cases, withdrawal rates of individual wells or wellfields were dictated by limiting conditions in the permit. Although pumpages from emergency fire flow wells were not included in this study, certain emergency standby wells were modeled as pumping. Special pumping scenarios are described on the wellfield summary sheets.

## Model Execution and Interpretation

Once all pertinent data for a wellfield had been collected, they were formatted and placed into a computer data file. Data files were then submitted to the THEIS program for batch mode analyses (Appendix III).

After a model had run, well coordinates were plotted on the computer output grid (Supplement) and compared to previously verified well locations on

quadrangle sheets. This cross-checking process exposed many errors in the permittee supplied Florida State Plane coordinates.

When all data had been checked for correctable error, a one foot drawdown line was contoured on computer output by linearly interpolating between data points. This contour method introduces a negligible amount of error when distance to drawdown ratios are large.

Once the one foot iso-drawdown line was contoured, it was traced onto a quadrangle sheet using corresponding well locations as overlay guides.

## SPECIAL CONSIDERATIONS

The ultimate goal of this study was to define areas of possible surface water impacts due to permitted withdrawals from existing municipal water supply wellfields. The results, presented in the form of one foot drawdown contour maps, are contingent on two types of data; aquifer parameters and possible pumping scenarios.

Aquifer parameters will not change significantly with time. Further testing in some areas may provide better estimations of the local hydraulic characteristics of the aquifer. These new discoveries should be incorporated into reevaluations of specific withdrawal impacts, and the one foot drawdown contours on the master quadrangle maps should be adjusted accordingly. For the most part, however, the aquifer parameter information presented in this study should remain contemporary.

In contrast, possible pumping scenarios of municipal water supply wellfields are almost certain to change with time. Permit modifications, wellfield expansion, well deterioration and rejuvenation, pump replacement, treatment facility expansion, well abandonment, and new wellfield development are all events that may occur in the evolution of a public water supply system. These types of changes will eventually make certain maps presented in this study obsolete.

The data, programs and procedures used to generate the drawdown contours have been carefully documented in this study to enable the reader to easily update or check the validity of individual wellfield maps. New aquifer parameter data acquired or new permit modifications made after September 1986 can be compared to individual Wellfield Summary Sheets and corresponding Theis program input data sheets. If necessary, a new Theis program can be run and the program output used to create a new map in the manner described in the Methodology section of this Memorandum.

Because of the temporal nature of the data used in this study, the maps presented here should not be used as legal evidence in impact disputes unless it can be shown that existing conditions are identical to the assumptions this author incorporated into the process of generating individual one foot drawdown contours.

During the modeling of certain wellfields, problems were encountered which could be best resolved using advanced A.P.T. data analysis techniques and/or more sophisticated modeling programs.

Several wellfields were hydraulically connected to large surface water bodies or canals. The THEIS model used in this study assumes no recharge to the aquifer. When modeled drawdown cones intersected the edges of large lakes, bays, or ocean bodies, drawdown contours were terminated at shorelines. No further attempt was made to represent the effect of relatively-infinite, constant head boundaries on drawdown cone geometrics.

Canals posed a more complex problem. Canal depths, their distance from wells, and their storage capacities could all significantly affect drawdown cone geometrics. The presence of canals was ignored in this study.

In Palm Beach County, transmissivities of the Surficial aquifer can change significantly over a short horizontal distance (Swayze and Miller, 1984). In some cases, the modeled cones of influence of adjacent wellfields would intersect. Although the transmissivities used to model these wellfield drawdowns were different, the "effects of combined drawdown" problem was resolved in this investigation by adding corresponding drawdown data values from overlapping wellfield data grids. This problem might have been better resolved using a two-dimensional finite difference model with spatially varying transmissivity values. However, detailed cumulative impact numerical modeling is beyond the scope of this study.

## FURTHER INVESTIGATIONS

Mary-Jo Shine, Staff Hydrogeologist in the Resource Planning Department, is currently investigating groundwater resources in Palm Beach County. In addition to providing guidance on estimating reasonable aquifer parameters in untested areas, Ms. Shine described the current and near-future actions the Hydrogeology Division is taking to complete a county wide groundwater resource evaluation study. As part of this study, Ms. Shine is working on a three-dimensional finite difference model to determine the effects of a shallow canal on the cone of depression created by a partially penetrating pumping well in a heterogeneous aquifer. This model will be calibrated with data acquired from a similarly constructed A.P.T. to be conducted in Palm Beach County early in 1987. New data acquired through this study will be very useful for individuals who wish to update or modify the results of this investigation.

Future evaluations of both new and existing data should include the analyses of partial penetration effects on A.P.T. results. Resource Planning hydrogeologists, Rick Bower, Mary-Jo Shine, and Keith Smith are currently refining and evaluating programs which use Streltsova or Neuman equations to generate type curves for partially penetrating pumping scenarios. These programs should be useful in critical evaluations of groundwater withdrawal impacts of specific wellfields.

## REFERENCES


Freeze, R. Allan and Cherry, John A., 1979. *Ground Water*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Land, Larry F., Rodis, Harry G., and Schneider, James J., 1973. *Appraisal of the Water Resources of Eastern Palm Beach County, Florida*, Report of Investigations No. 67, Florida Bureau of Geology, Tallahassee, Florida.

Swayze, Leo J. and Miller, Wesley L., 1984. *Hydrogeology of a Zone of Secondary Permeability in the Surficial Aquifer of Eastern Palm Beach County, Florida*, Water Resources Investigations Report 83-4249, U. S. Geological Survey, Tallahassee, Florida.

Walton, William C., 1970. *Groundwater Resource Evaluation*, McGraw-Hill Book Company, New York, 1970.

# APPENDIX I

# DATA SUMMARY SHEETS

# INDEX OF DATA SUMMARY SHEET
# PERMIT NUMBERS AND NAMES

| | |
|---|---|
| 50-00010-W | Town of Jupiter |
| 50-00036-W | Village of Palm Springs |
| 50-00046-W | Village of Tequesta |
| 50-00135-W | Palm Beach County Water Utilities (System #1) |
| | Water Treatment Plant #1 |
| | Water Treatment Plant #2 |
| | Water Treatment Plant #8 |
| 50-00177-W | City of Delray Beach |
| 50-00178-W | Century Utilities |
| 50-00234-W | Lake Worth Utilities |
| 50-00346-W | Town of Highland Beach |
| 50-00365-W | Seacoast Utilities |
| 50-00367-W | City of Boca Raton |
| 50-00401-W | Palm Beach County Water Utilities (System #9) |
| 50-00444-W | Village of Royal Palm Beach |
| 50-00460-W | City of Riviera Beach |
| 50-00464-W | Acme Improvement District |
| 50-00499-W | City of Boynton Beach |
| 50-00501-SW | Pratt and Whitney Aircraft |
| | Division of United Technologies |
| 50-00506-W | Town of Manalapan |
| 50-00511-W | Palm Beach County Water Utilities (System #3) |
| 50-00562-W | Meadowbrook Utilities |
| 50-00575-W | Town of Lantana |

## INDEX OF DATA SUMMARY SHEET FIGURES

## PALM BEACH COUNTY

PERMIT #: 50-00010-W

PERMIT NAME: Town of Jupiter

ALLOCATION: 3.3 Billion Gallons Per Year
(9.04 Million Gallons Per Day)

NUMBER OF WELLS: 24

MODELED DAILY PUMPAGE PER WELL: 376,712 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Jupiter, Rood

AQUIFER: Surficial
*T = 60,000 GPD/FT (Wells #1-14 and #19)
**T = 30,000 GPD/FT (Wells #15-18 and #20-24)
Sy = 0.20 (assumed for shallow unconfined aquifer)

REFERENCES:

*Unknown author, *Installation and Testing of Production Wells 12, 13, and 14, Town of Jupiter Water Systems, Jupiter, Florida*, Consultant Report, Palm Beach Co., C#119, June, 1979, Geraghty and Miller Inc., Palm Beach Gardens, Florida, p. 24.

**Unknown author, *Model Study to Estimate Yields and Impacts of the Jupiter Water System's Well-Field Expansion*, Consultant Report, Palm Beach Co., C-#169, February, 1985, Geraghty and Miller Inc., Palm Beach Gardens, Florida, p. 4.

COMMENTS:

*Transmissivity data were calculated from both continuous-drawdown and step drawdown tests on three production wells, using both Boulton and Hantush-Jacob analytical methods. The longest continuous pumping interval was 24 hours.

**Transmissivity values were derived from pump tests performed by Geraghty and Miller Inc., on several Jupiter wellfield wells. Data was modified by Geraghty and Miller, Inc. to allow for the partially-penetrating nature of the wells.

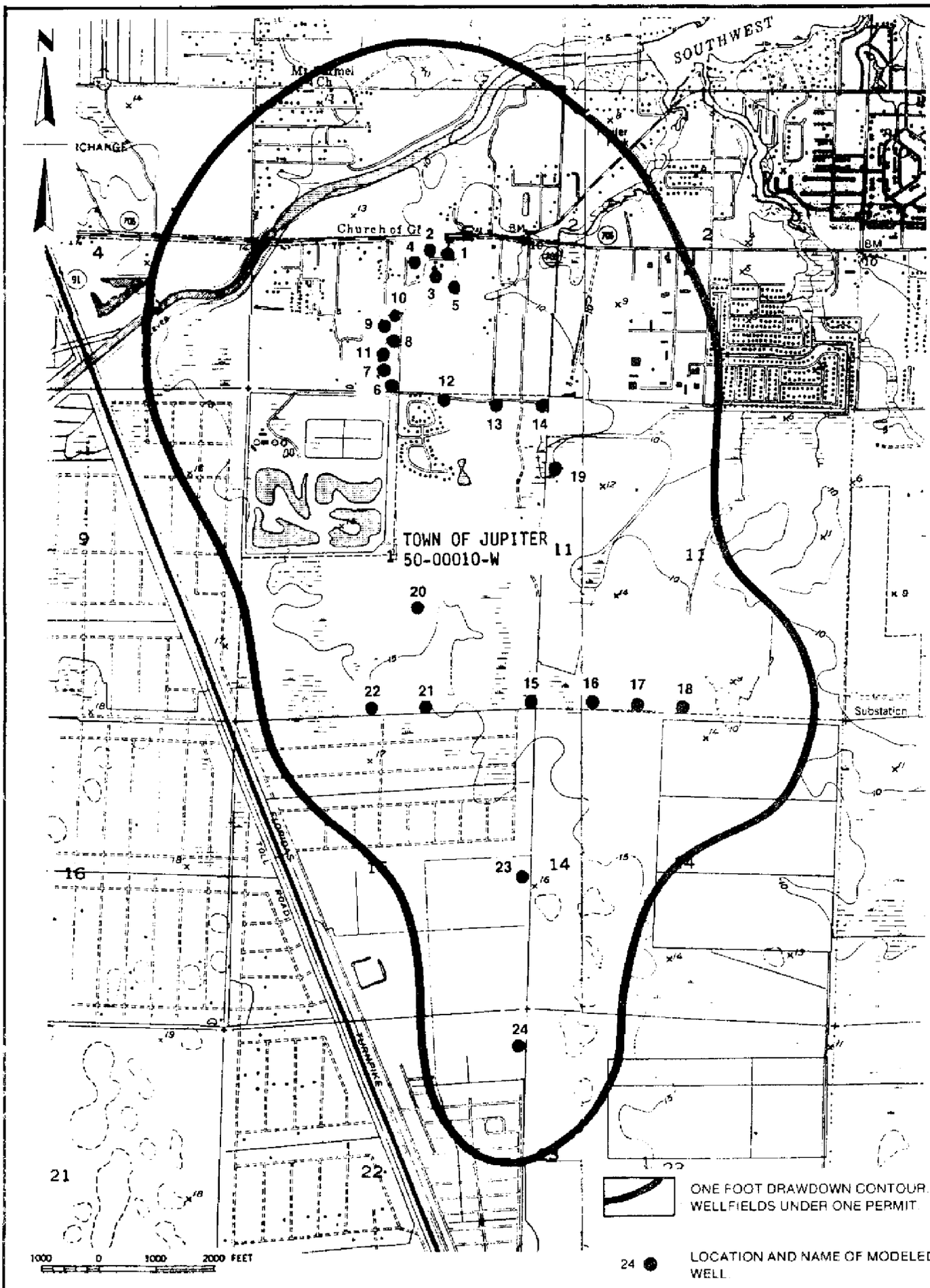


**Figure 1 ONE FOOT DRAWDOWN; TOWN OF JUPITER (Generated September, 1986)**

TOWN OF JUPITER
50-00010-W
SOUTHERN WELLFIELD

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 30000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.70 | 13.00 | 376712.00 | WELL 15 |
| 14.00 | 13.00 | 376712.00 | WELL 16 |
| 14.80 | 13.00 | 376712.00 | WELL 17 |
| 15.80 | 13.00 | 376712.00 | WELL 18 |
| 10.70 | 15.00 | 376712.00 | WELL 20 |
| 11.40 | 13.00 | 376712.00 | WELL 21 |
| 10.10 | 13.00 | 376712.00 | WELL 22 |
| 12.70 | 6.80 | 376712.00 | WELL 24 |
| 12.70 | 9.50 | 376712.00 | WELL 23 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

Theis grid coordinates (10,15) of the Southern wellfield correlate to Theis grid coordinates (11,7) of the Northern wellfield.

TOWN OF JUPITER
50-00010-W
NORTHERN WELLFIELD

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 60000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.95 | 13.00 | 376712.00 | WELL 1 |
| 11.60 | 13.00 | 376712.00 | WELL 2 |
| 11.85 | 12.70 | 376712.00 | WELL 3 |
| 11.50 | 12.80 | 376712.00 | WELL 4 |
| 12.10 | 12.60 | 376712.00 | WELL 5 |
| 11.10 | 10.50 | 376712.00 | WELL 6 |
| 11.00 | 10.80 | 376712.00 | WELL 7 |
| 11.10 | 11.20 | 376712.00 | WELL 8 |
| 11.00 | 11.50 | 376712.00 | WELL 9 |
| 11.10 | 11.70 | 376712.00 | WELL 10 |
| 10.95 | 11.00 | 376712.00 | WELL 11 |
| 12.00 | 10.40 | 376712.00 | WELL 12 |
| 13.05 | 10.40 | 376712.00 | WELL 13 |
| 13.90 | 10.40 | 376712.00 | WELL 14 |
| 14.15 | 9.20 | 376712.00 | WELL 19 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00036-W

PERMIT NAME: Village of Palm Springs

ALLOCATION: 1.606 Billion Gallons Per Year
(4.4 Million Gallons Per Day)

NUMBER OF WELLS: 10 (Not including 4 wells of the uncompleted Forest Hill Water Treatment Plant)

MODELED DAILY PUMPAGE PER WELL:
Main Wellfields #1, #2 & #3 - 440,000 Gallons Per Day Per Well
Forest Hill Wellfield - 314,286 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Palm Beach, Palm Beach Farms

AQUIFER: Surficial (Main Wellfield #3 and Forest Hill Plant Wellfield-Turnpike)
*T = 44,000 GPD/FT. (Main Wellfields #1 and #2)
**T = 260,000 GPD/FT. (Main Wellfield #3)
***T = 1,250,000 GPD/FT (Forest Hill Plant Wellfield)
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
**Unknown Author, *Well Test Report, Village of Palm Springs, Project No. 501-75-03(II),* Consultant Report (1974?), Black, Crow & Eidsness, Inc., Gainesville, FL., p. 18, as found in Permit File #50-00036-W.

***Gary E. Eichler, Hydrogeologist, *Evaluation of Wellfield Facilities for the Village of Palm Springs, Palm Beach County, Florida,* Consultant Report, Palm Beach Co., C#135, June 1983, CH2M Hill, Gainesville, Florida, p. 9-1.

COMMENTS:
*The transmissivity value used to model the drawdown in Main Wellfields #1 and #2 was estimated from specific capacities of wells in those fields.

The transmissivity value used to model the drawdown in Main Wellfield #3 was derived analytically from data collected during a continuous-drawdown, 6 hour pump test performed on Well #10. Both drawdown and recovery data from the pumped well and the nearest observation well were analyzed using semilog data plots and Jacob's modified Theis non-equilibrium formula. Well #10 is located less than 50' from LWDD Canal No. 8.

The transmissivity value used to model the drawdown in the Forest Hill Plant Wellfield was derived analytically from data collected during a 48 hour APT conducted April 13 to April 15, 1983, on Well #5. Both drawdown and recovery data from observation wells #1, #2, and #3 were plotted on semilog and log-log

paper and analyzed using the Jacob and the Jacob-Hantush methods. Drawdown data from Well #5 and Observation Well #4 were analyzed using a semilog plot and the Jacob method. Well #5 is approximately 600 feet from a canal.

The Forest Hill Water Treatment Plant is still under construction and is expected to be completed and go on line October, 1987 along with Wells #1-#3 and #5. When the wellfield becomes operational, the Modeled Daily Pumpage Per Well value of 314,286 million gallons per day per well should be representative of pumpage rates, assuming equal withdrawal rates throughout the Village of Palm Springs wellfield system. When the Forest Hill Plant Wellfield is modeled at this 100 day withdrawal rate and a transmissivity of 1.25 MGPD/FT, no 1 foot drawdown in the Surficial Aquifer System is observed.

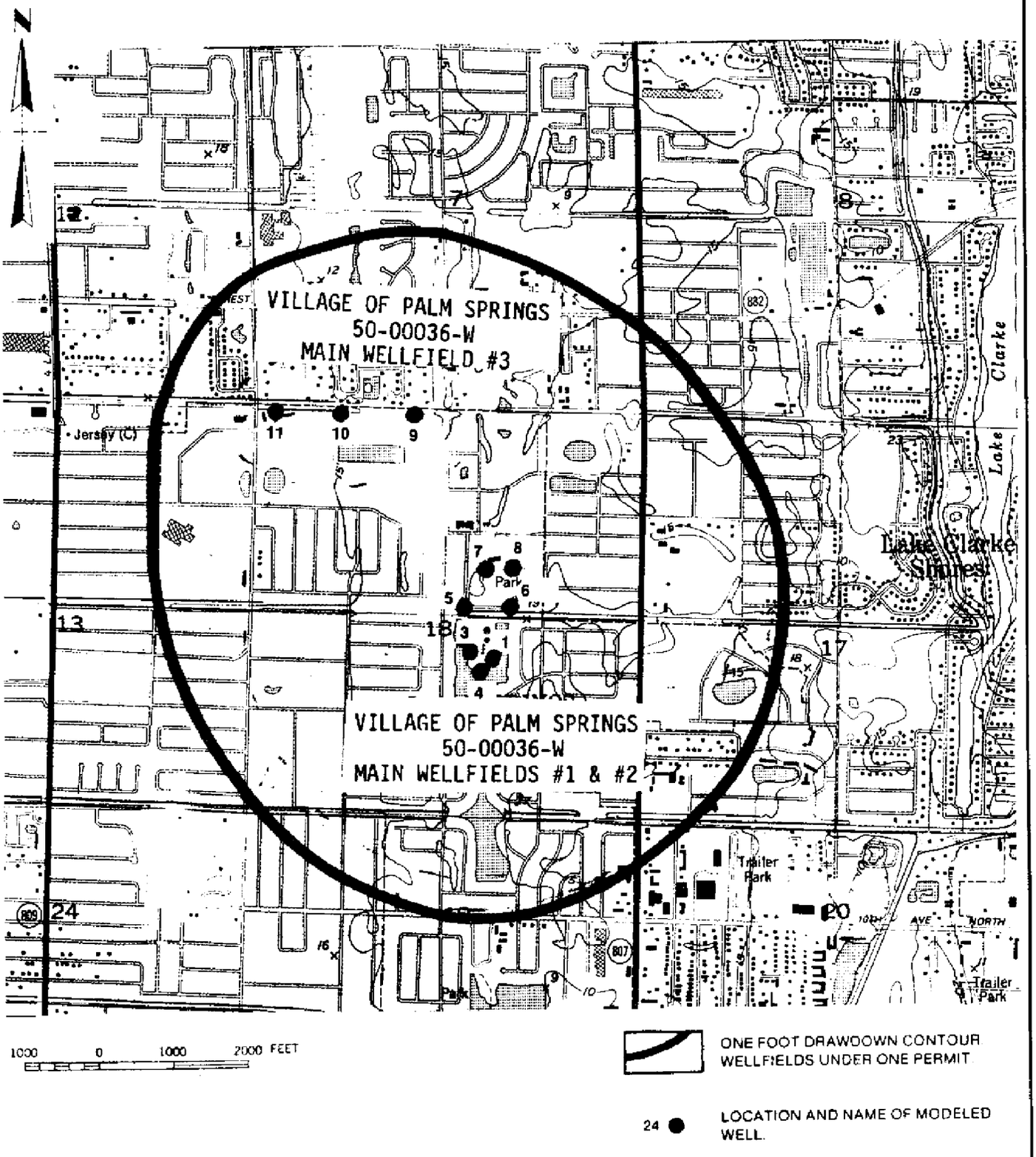


**Figure 2 ONE FOOT DRAWDOWN; VILLAGE OF PALM SPRINGS**
**(Generated September, 1986)**

VILLAGE OF PALM SPRINGS
50-00036-W
MAIN WELLFIELD #1 & #2

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 44000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.10 | 11.80 | 440000.00 | WELL 1 |
| 11.80 | 11.90 | 440000.00 | WELL 3 |
| 11.90 | 11.60 | 440000.00 | WELL 4 |
| 11.70 | 12.50 | 440000.00 | WELL 5 |
| 12.35 | 12.50 | 440000.00 | WELL 6 |
| 12.00 | 13.00 | 440000.00 | WELL 7 |
| 12.35 | 13.00 | 440000.00 | WELL 8 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

VILLAGE OF PALM SPRINGS
50-00036-W
MAIN WELLFIELD #3

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 260000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.00 | 15.00 | 440000.00 | WELL 9 |
| 10.00 | 15.00 | 440000.00 | WELL 10 |
| 9.10 | 15.00 | 440000.00 | WELL 11 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

VILLAGE OF PALM SPRINGS
50-00036-W
FORREST HILL WELLFIELD

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 1250000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.50 | 12.00 | 314286.00 | WELL 1 |
| 14.00 | 12.00 | 314286.00 | WELL 2 |
| 14.00 | 14.50 | 314286.00 | WELL 3 |
| 14.00 | 11.50 | 314286.00 | WELL 5 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00046-W

PERMIT NAME: Village of Tequesta

ALLOCATION: 584 Million Gallons Per Year
(1.6 Million Gallons Per Day)

NUMBER OF WELLS: 15

MODELED DAILY PUMPAGE PER WELL: 106,667 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Jupiter

AQUIFER: Surficial
*T = 237,000 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Unknown author, *Evaluation of the Potential for Raw Water Supply Development for the Village of Tequesta*, Consultant Report, Palm Beach Co., C#103B, December, 1982, Gee and Jenson, Inc., West Palm Beach, Florida, p. 35.

COMMENTS:
Pump tests run by Gee and Jenson, Inc. yielded a wide range of transmissivity values. This was due in part to the varying degrees of aquifer penetration in both the pumping and the observation wells. The lowest calculated transmissivity value was used in this model in order to simulate the most severe local drawdown.

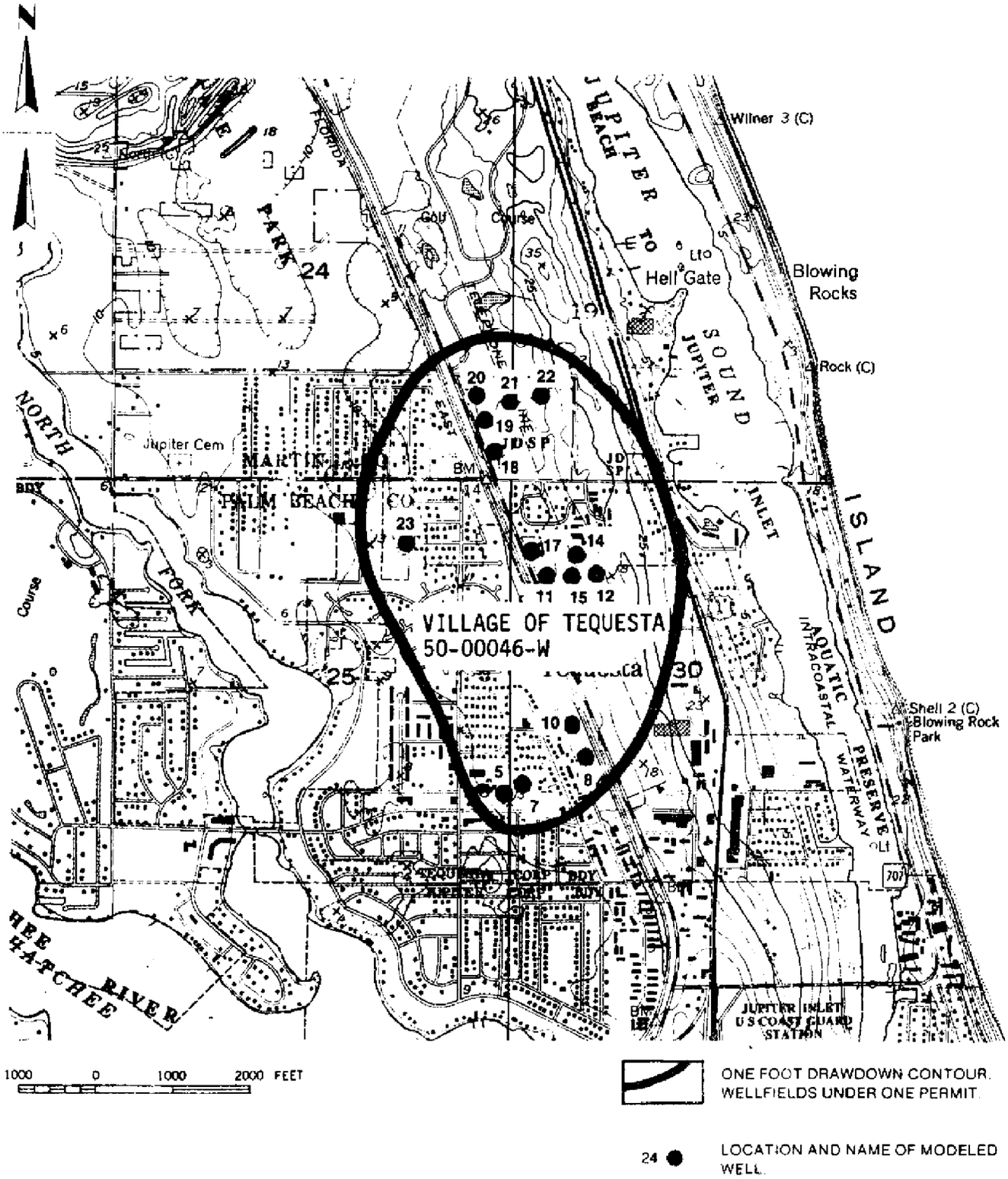


**Figure 3 ONE FOOT DRAWDOWN; VILLAGE OF TEQUESTA (Generated September, 1986)**

VILLAGE OF TEQUESTA
50-00046-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 237000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.70 | 9.80 | 106667.00 | WELL 5 |
| 13.50 | 10.70 | 106667.00 | WELL 10 |
| 13.20 | 12.70 | 106667.00 | WELL 11 |
| 13.85 | 12.70 | 106667.00 | WELL 12 |
| 13.60 | 12.95 | 106667.00 | WELL 14 |
| 13.55 | 12.70 | 106667.00 | WELL 15 |
| 13.00 | 13.00 | 106667.00 | WELL 17 |
| 12.50 | 14.25 | 106667.00 | WELL 18 |
| 12.40 | 14.65 | 106667.00 | WELL 19 |
| 12.30 | 15.00 | 106667.00 | WELL 20 |
| 12.70 | 14.95 | 106667.00 | WELL 21 |
| 13.10 | 15.00 | 106667.00 | WELL 22 |
| 12.90 | 9.90 | 106667.00 | WELL 7R |
| 11.35 | 13.10 | 106667.00 | WELL 23 |
| 13.75 | 10.30 | 106667.00 | WELL 8R |

## PALM BEACH COUNTY

PERMIT #: 50-00135-W

PERMIT NAME: Palm Beach County Water Utilities, (System #1); (Water Treatment Plant #1)

ALLOCATION: 1 Million Gallons Per Day, Average

NUMBER OF WELLS: 12

MODELED DAILY PUMPAGE PER WELL: 83,333 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Palm Beach

AQUIFER: Surficial
*T = 35,000 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Larry F. Land, Hydrogeologist, U. S. Geological Survey, in a written communication to Mr. Charles Cashman, Director of the Palm Beach County Utilities, June 12, 1974, as found in *Engineering Report for Central and Southern Florida Flood Control District, Well Permit Application No. 23893, Palm Beach County, Florida, Water System No. 1,* Consultant Report, Palm Beach County, C#11, 1975, Barker, Osha & Anderson, Inc., and Russell & Axon, Inc., Appendix D.

COMMENTS:
In 1974, Mr. Bill Scott of the U. S. Geological Survey conducted a 23 hour continuous-drawdown pump test on well #3. The drawdown data were analyzed using the Hantush leaky aquifer, modified Jacob and steady-state methods. Mr. Scott considered the transmissivity value derived using the Hantush method, 35,000 GPD/FT, to be the best representation of the local aquifer transmissivity.

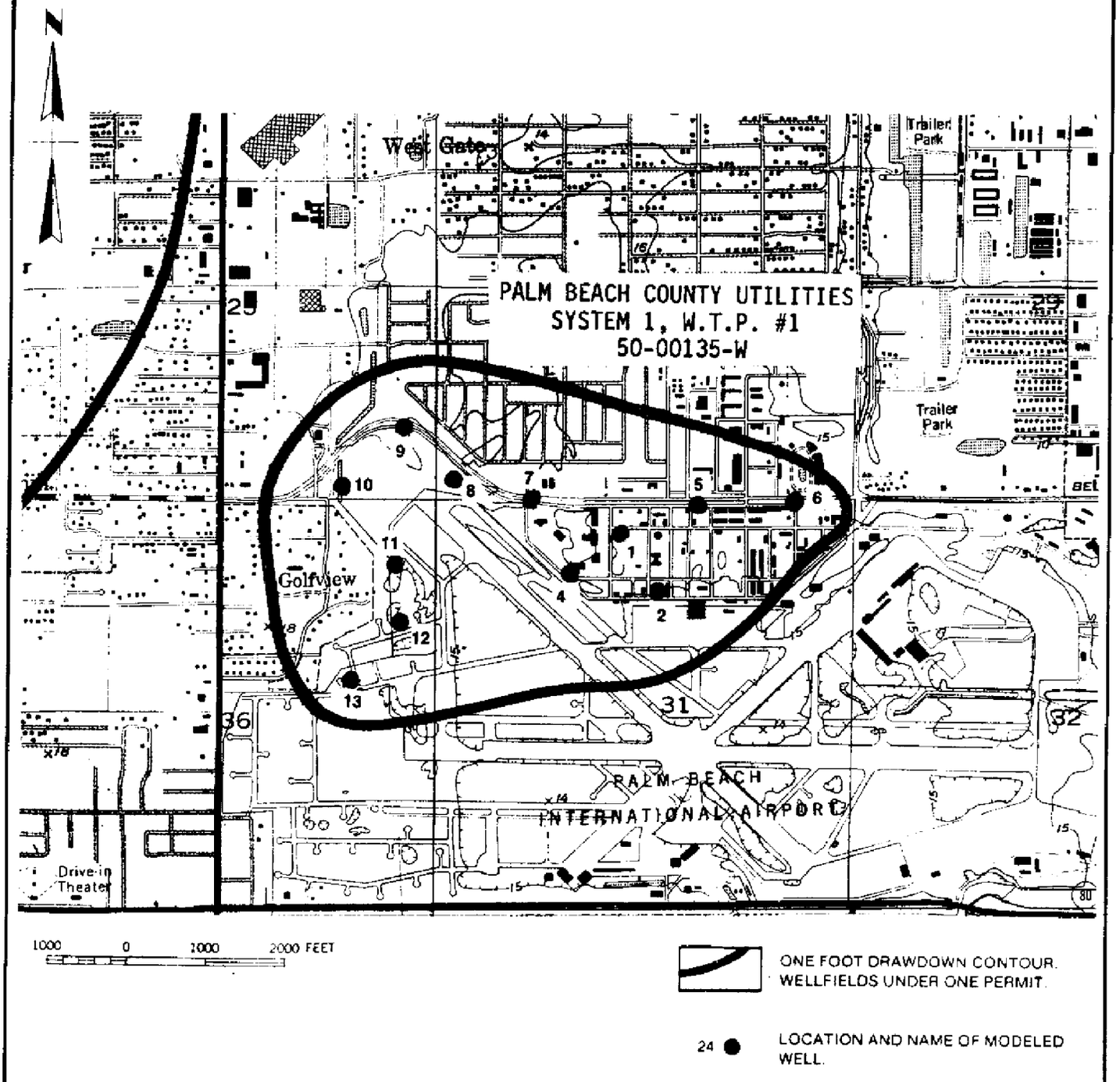


**Figure 4: ONE FOOT DRAWDOWN; PALM BEACH COUNTY WATER UTILITIES (SYSTEM #1) WATER TREATMENT PLANT #1 (Generated September, 1986)**

PALM BEACH COUNTY UTILITIES
SYSTEM 1, W.T.P. #1
50-00135-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 35000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 13.60 | 12.50 | 83333.00 | WELL 1 |
| 14.10 | 11.80 | 83333.00 | WELL 2 |
| 13.00 | 12.00 | 83333.00 | WELL 4 |
| 14.60 | 12.90 | 83333.00 | WELL 5 |
| 15.80 | 12.90 | 83333.00 | WELL 6 |
| 12.50 | 12.95 | 83333.00 | WELL 7 |
| 11.50 | 13.20 | 83333.00 | WELL 8 |
| 10.90 | 13.90 | 83333.00 | WELL 9 |
| 10.10 | 13.10 | 83333.00 | WELL 10 |
| 10.75 | 12.15 | 83333.00 | WELL 11 |
| 10.80 | 11.40 | 83333.00 | WELL 12 |
| 10.20 | 10.60 | 83333.00 | WELL 13 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00135-W

PERMIT NAME: Palm Beach County Water Utilities, (System # 1); (Water Treatment Plant #2)

ALLOCATION: 5.0 Million Gallons Per Day, Average

NUMBER OF WELLS: 12

MODELED DAILY PUMPAGE PER WELL: 416,667 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Palm Beach Farms

AQUIFER: Surficial (Turnpike)
*T = 660,000 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*D. Allman, Hydrogeologist, South Florida Water Management District, personal observations and analyses of 12 hour continuous-drawdown pump test performed on well #1 on August 17, 1974, as found in Permit File #50-00584-W (old System #2), South Florida Water Management District, West Palm Beach, FL.

COMMENTS:
Transmissivity values were derived numerically by D. Allman using the image well method of recharge boundary simulation as described in William C. Walton, *Groundwater Resource Evaluation*, (New York, McGraw-Hill, Inc., 1970), pp. 163-167. This method takes into account the locations of the pumping well, piezometers, and nearby canal. However, existing conditions which violate the assumptions of the method include an unconfined aquifer, fluctuating canal levels, a partially penetrating canal and nonsteady state conditions. These unconsidered variables make the calculated aquifer parameter values questionable. At the time this model was run, more reliable aquifer parameter values were not available for this area.

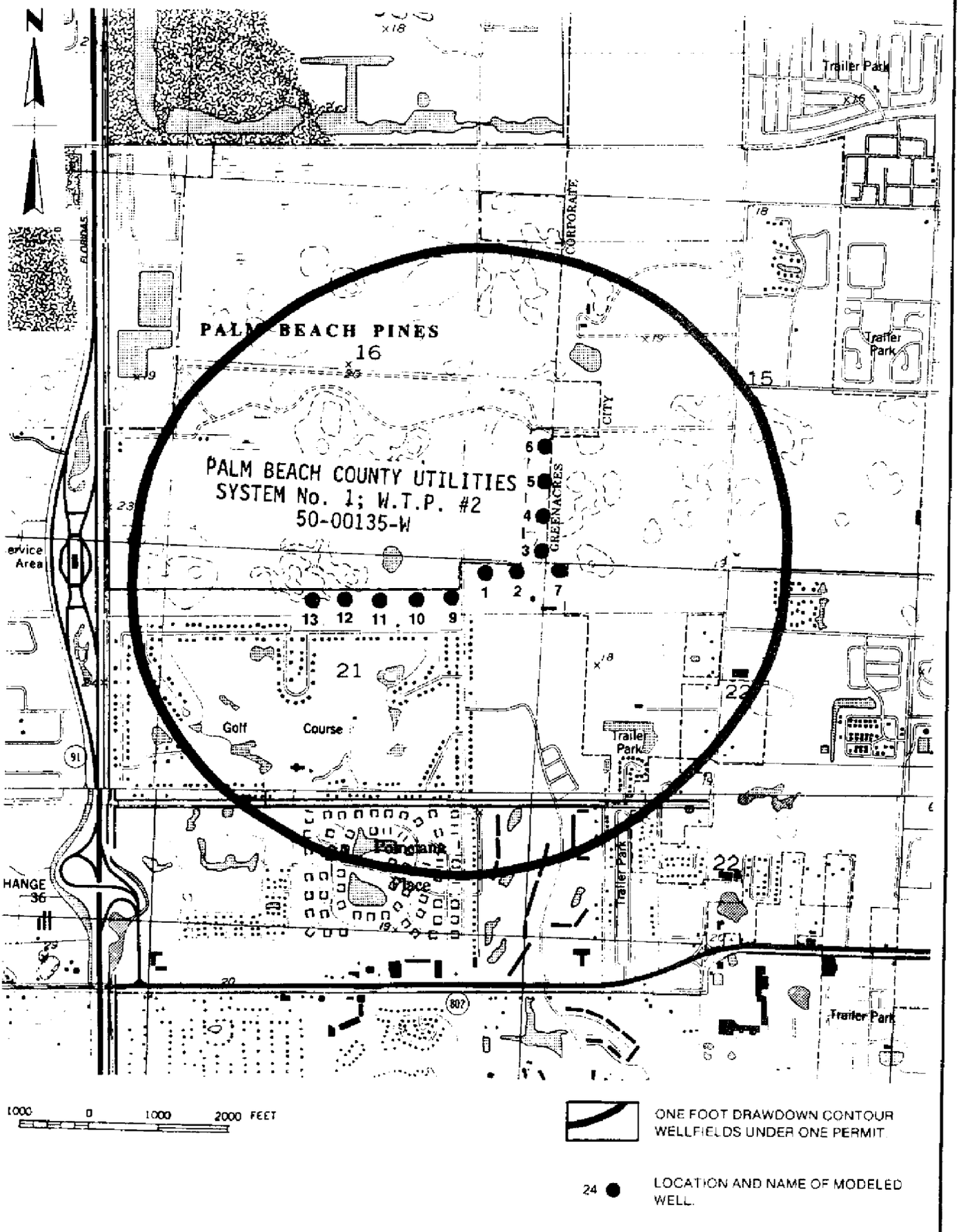


**Figure 5 ONE FOOT DRAWDOWN; PALM BEACH COUNTY WATER UTILITIES (SYSTEM #1) WATER TREATMENT PLANT #2 (Generated September, 1986)**

PALM BEACH COUNTY UTILITIES
SYSTEM 1,W.T.P. #2
50-00135-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 660000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.50 | 12.40 | 416667.00 | WELL 1 |
| 12.95 | 12.40 | 416667.00 | WELL 2 |
| 13.30 | 12.70 | 416667.00 | WELL 3 |
| 13.30 | 13.20 | 416667.00 | WELL 4 |
| 13.35 | 13.70 | 416667.00 | WELL 5 |
| 13.35 | 14.20 | 416667.00 | WELL 6 |
| 13.55 | 12.40 | 416667.00 | WELL 7 |
| 12.00 | 12.00 | 416667.00 | WELL 9 |
| 11.50 | 12.00 | 416667.00 | WELL 10 |
| 10.90 | 12.00 | 416667.00 | WELL 11 |
| 10.45 | 12.00 | 416667.00 | WELL 12 |
| 9.95 | 12.00 | 416667.00 | WELL 13 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00135-W

PERMIT NAME: Palm Beach County Water Utilities, (System #1); (Water Treatment Plant #8)

ALLOCATION: 9 Million Gallons Per Day, Average

NUMBER OF WELLS: 9

MODELED DAILY PUMPAGE PER WELL: 1 Million Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Palm Beach Farms

AQUIFER: Surficial (Turnpike)
*T = 1.4 MGPD/FT
Sy = 0.2 (assumed for a shallow, unconfined aquifer)

REFERENCES:
*Unknown Author, *Program Implementation Central Regional Water Works Facilities, Phase 1, Aquifer Performance Evaluation,* Consultant Report, Palm Beach County, C#19, 1979, Barker, Osha & Anderson, and Russell & Axon, Palm Beach County, Florida, Section III, Theis graph for Observation Well #3.

COMMENTS:
The transmissivity value used in this model was derived using the Theis graphical method (log-log graph) to analyze data gathered from observation well #3 during a 72 hour, continuous-drawdown pump test performed on Water Treatment Plant #8's production well #10. Transmissivity values were also derived from residual-drawdown, time-drawdown, and distance-drawdown graphical analyses. These values ranged from 1.8 MGPD/FT to 3.8 MGPD/FT and were the highest derived values of transmissivity for the Surficial Aquifer System in Palm Beach County.

The test production well was located 50 feet from canal L-2.

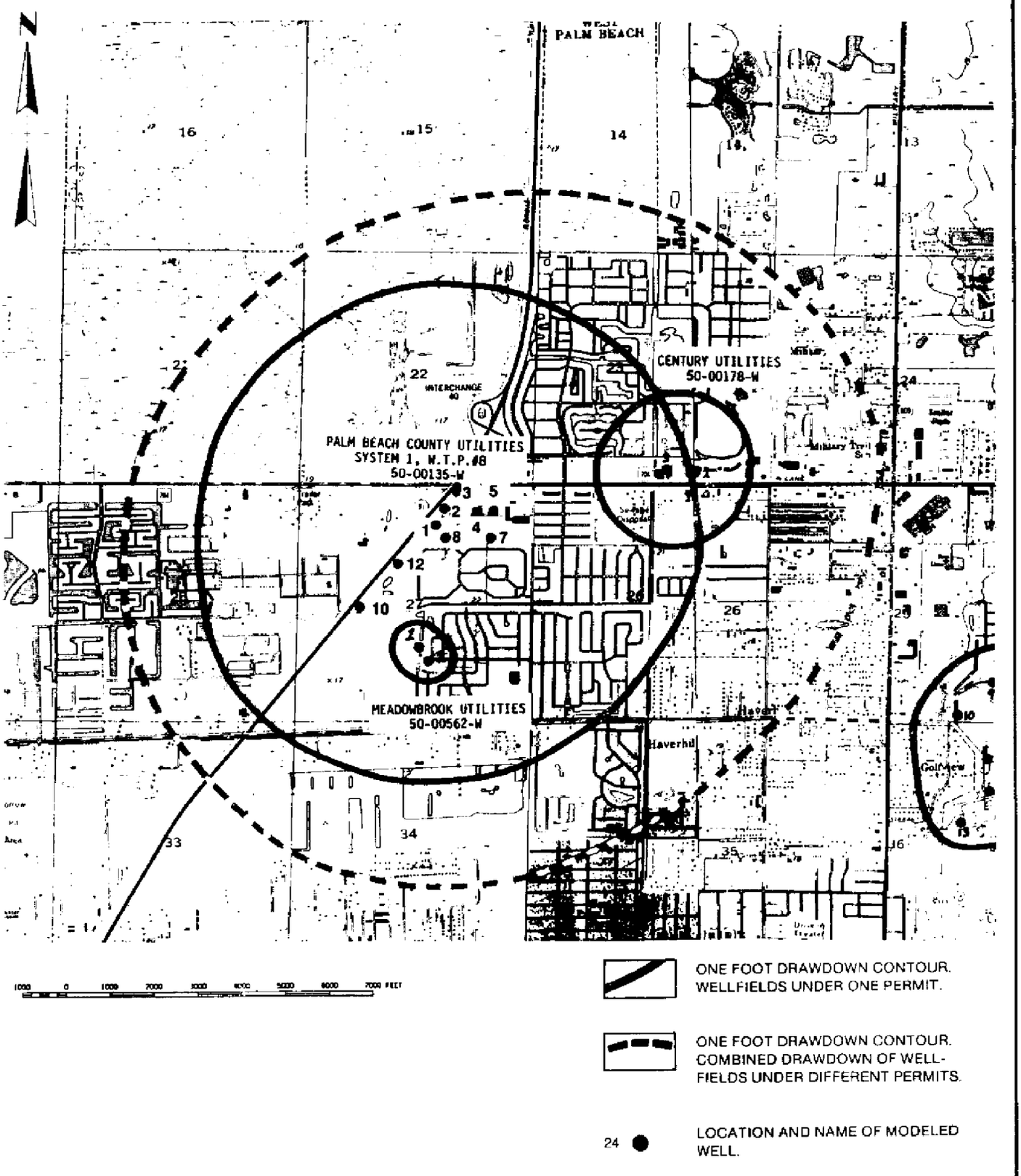


**Figure 6 ONE FOOT DRAWDOWN; PALM BEACH COUNTY WATER UTILITIES (SYSTEM #1) WATER TREATMENT PLANT #8 (Generated September, 1986)**

PALM BEACH COUNTY UTILITIES
SYSTEM 1, W.T.P. #8
50-00135-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 1.400000

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.75 | 11.85 | 1000000.00 | PBC WELL 1 |
| 11.94 | 12.30 | 1000000.00 | PBC WELL 2 |
| 12.24 | 12.68 | 1000000.00 | PBC WELL 3 |
| 12.67 | 12.18 | 1000000.00 | PBC WELL 4 |
| 13.00 | 12.18 | 1000000.00 | PBC WELL 5 |
| 13.00 | 11.60 | 1000000.00 | PBC WELL 7 |
| 12.00 | 11.60 | 1000000.00 | PBC WELL 8 |
| 10.00 | 10.00 | 1000000.00 | PBC WELL 10 |
| 10.80 | 10.93 | 1000000.00 | PBC WELL 12 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

Well locations for System 1, Water Treatment Plant #8 wells; Century Utilities wells; and Meadowbrook Utilities wells were all assigned grid coordinates on the same Theis grid.

## PALM BEACH COUNTY

PERMIT #: 50-00177-W

PERMIT NAME: City of Delray Beach

ALLOCATION: 5.6 Billion Gallons Per year
(15.3 Million Gallons Per Day)

NUMBER OF WELLS: 24

MODELED DAILY PUMPAGE PER WELL:
Eastern Wellfield, 322,222 Gallons Per Day Per Well
Western Wellfield, 1.59 Million Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Delray Beach

AQUIFER: Surficial (Biscayne)
*T = 145,000 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Unknown author, Jacob method using semilog plots of piezometer data from continuous-drawdown pump tests of wells 1W, 2W, 3W, and 4W, as found in SWIM file data sheets for City of Delray Beach, 1980, South Florida Water Management District.

COMMENTS:
The Eastern Wellfield is restricted by limiting condition #26 of Water Use Permit #50-00177-W to producing a maximum of 5.8 million gallons per day (5.8 MGPD/18 wells = 322,222 GPD/well), due to salt water encroachment from the east. In order to account for the balance of the allocated average daily production, the Western Wellfield was modeled as operating near maximum pumping capacity.

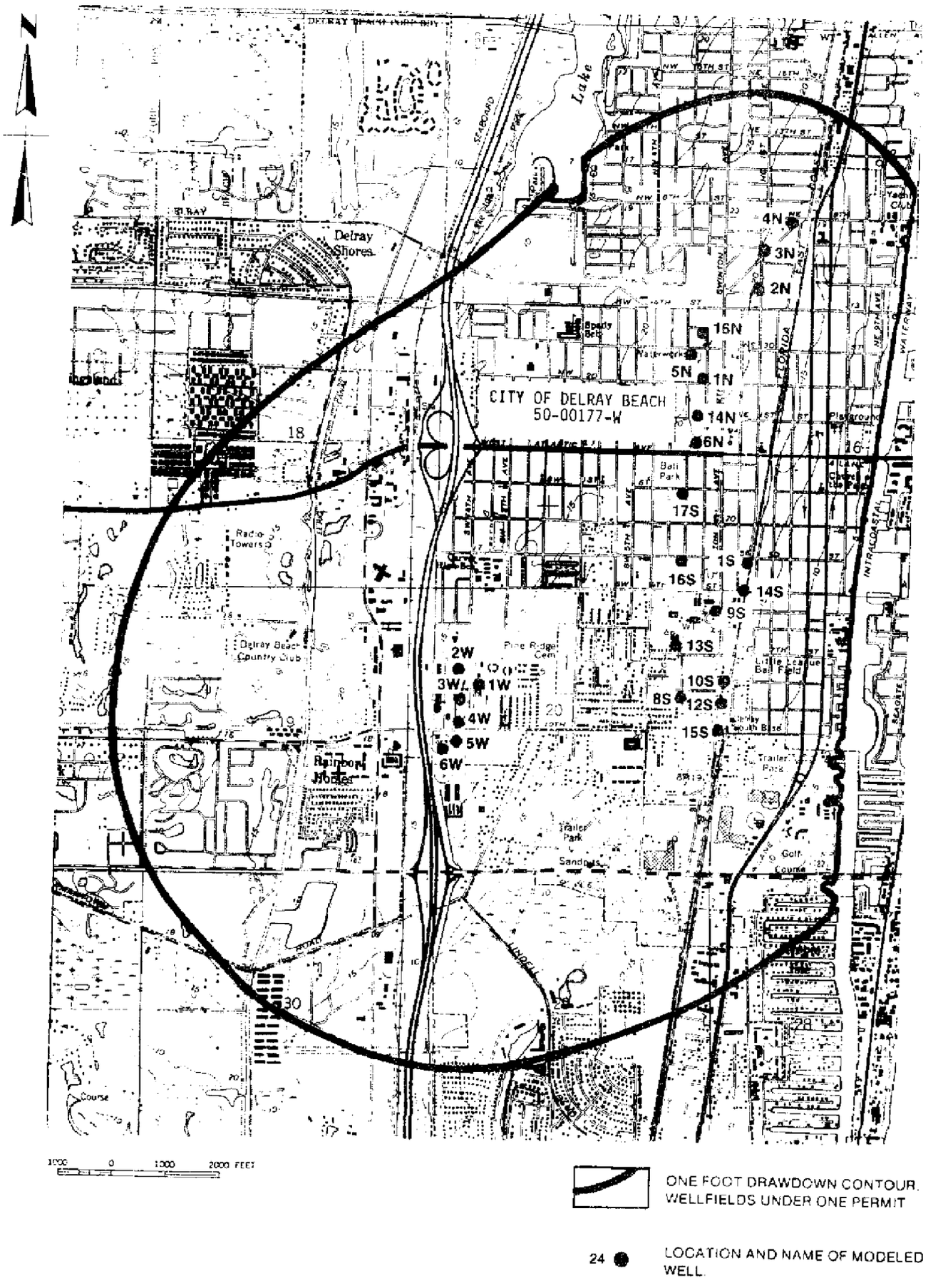


**Figure 7 ONE FOOT DRAWDOWN; CITY OF DELRAY BEACH (Generated September, 1986)**

CITY OF DELRAY BEACH
50-00177-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 145000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.25 | 9.60 | 1590000.00 | WELL 1 |
| 10.85 | 9.90 | 1590000.00 | WELL 2 |
| 10.85 | 9.40 | 1590000.00 | WELL 3 |
| 10.85 | 8.90 | 1590000.00 | WELL 4 |
| 10.85 | 8.50 | 1590000.00 | WELL 5 |
| 10.60 | 8.30 | 1590000.00 | WELL 6 |
| 15.75 | 8.80 | 322222.00 | WELL 15S |
| 15.80 | 9.30 | 322222.00 | WELL 12S |
| 15.05 | 9.40 | 322222.00 | WELL 8S |
| 15.90 | 9.70 | 322222.00 | WELL 10S |
| 14.95 | 10.40 | 322222.00 | WELL 13S |
| 15.65 | 11.05 | 322222.00 | WELL 9S |
| 16.20 | 11.40 | 322222.00 | WELL 14S |
| 15.00 | 12.00 | 322222.00 | WELL 16S |
| 16.25 | 11.95 | 322222.00 | WELL 1S |

WELL DESCRIPTIONS
(CONTINUED)

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 15.00 | 13.30 | 322222.00 | WELL 17S |
| 15.25 | 14.25 | 322222.00 | WELL 6N |
| 15.30 | 14.75 | 322222.00 | WELL 17N |
| 15.35 | 15.40 | 322222.00 | WELL 1-AN |
| 15.05 | 15.95 | 322222.00 | WELL 5N |
| 15.35 | 16.30 | 322222.00 | WELL 16N |
| 16.40 | 17.15 | 322222.00 | WELL 2N |
| 16.45 | 17.85 | 322222.00 | WELL 3N |
| 17.00 | 18.40 | 322222.00 | WELL 4N |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00178-W

PERMIT NAME: Century Utilities

ALLOCATION: 594 Million Gallons Per Year
(1.627 Million Gallons Per Day)

NUMBER OF WELLS: 3

MODELED DAILY PUMPAGE PER WELL: 542,466 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Palm Beach Farms, Palm Beach

AQUIFER: Surficial (Turnpike)
T = 400,000 GPD/FT.
Sy = 0.2 (assumed for shallow, unconfined aquifer)

COMMENTS:
Transmissivity and storativity values were assumed for a surficial, unconfined aquifer with a high percentage of secondary effective porosity development.

The closest APT was performed on well #10 of Palm Beach County Utilities Water Treatment Plant #8. This well is located 75,000 feet to the southwest of Century Utilities Production Well #1. The APT performed on Well #10 yielded transmissivity values ranging from 1.4 MGPD/ FT to 3.8 MGPD/FT (see Wellfield Summary Sheet for Permit #50-00135-W). As these transmissivity values were the highest determined for the Surficial Aquifer System in Palm Beach County, a more conservative transmissivity value of 400,000 GPD/FT was used to model the drawdown of Century Utilities Wellfield.

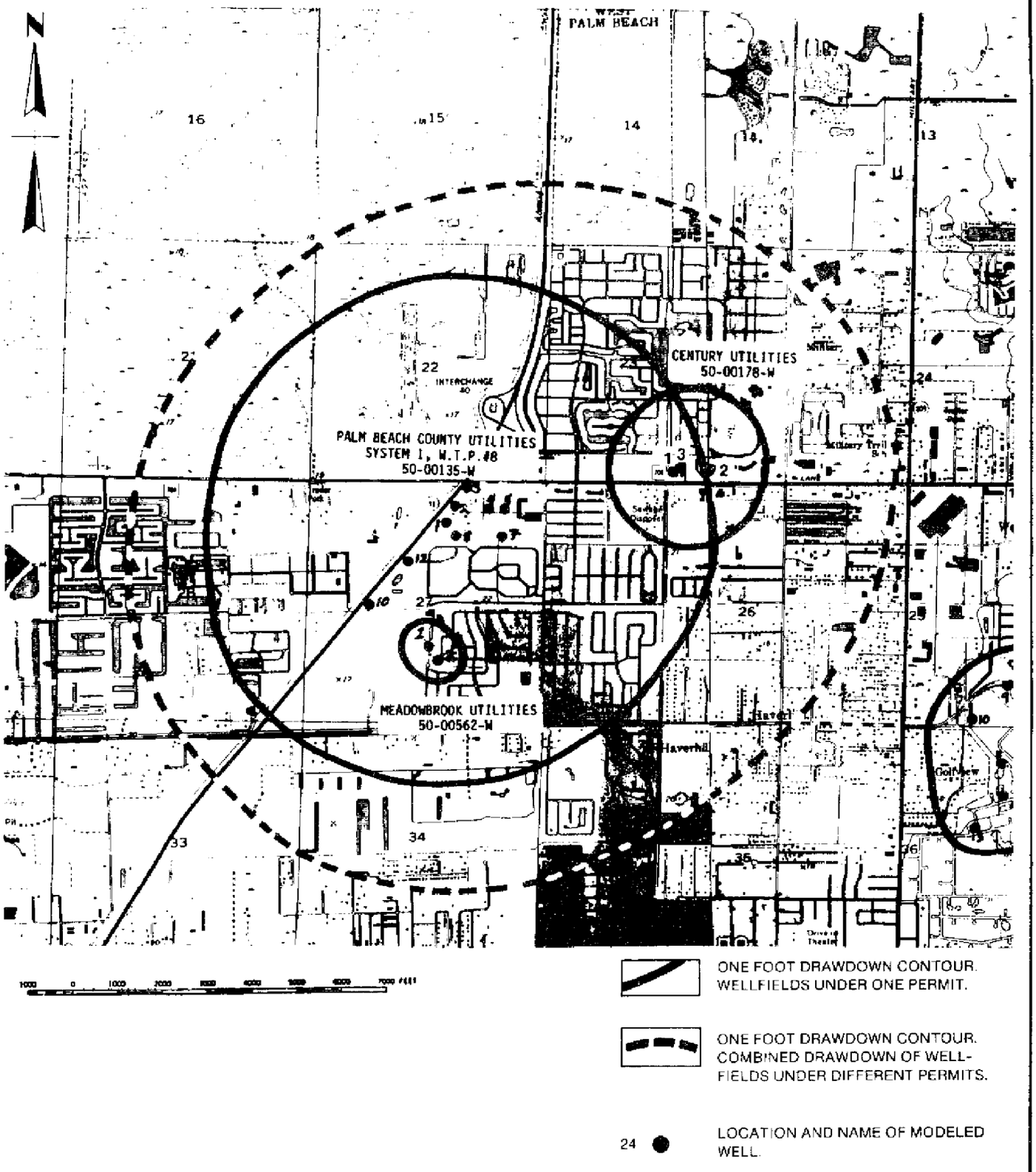


**Figure 8 ONE FOOT DRAWDOWN; CENTURY UTILITIES (Generated September, 1986)**

CENTURY UTILITIES
50-00178-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 400000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 16.75 | 13.10 | 542466.00 | WELL 1 |
| 17.60 | 13.20 | 542466.00 | WELL 2 |
| 16.90 | 13.20 | 542466.00 | WELL 3 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00234-W

PERMIT NAME: Lake Worth Utilities

ALLOCATION: 2.85 Billion Gallons Per Year
(7.8 Million Gallons Per Day)

NUMBER OF WELLS: 14

MODELED DAILY PUMPAGE PER WELL: 557,000 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Lake Worth

AQUIFER: Surficial
*T = 58,000 GPD/FT
SY = 0.2 (Assumed for shallow, unconfined aquifer)

REFERENCES:
*David V. Maddy, Hydrogeologist, U. S. Geological Survey, in a written communication to Cliff C. Blaisdell, Jr., Director of Lake Worth Utilities Authority, May, 1976, as found in Permit File #50-00234-W.

COMMENTS:
The transmissivity value used was derived by Mr. David V. Maddy, Hydrogeologist, USGS, from data taken during a 24 hour continuous-drawdown pump test performed on production well #12 on April 20, 1976. Well #12 was located very near the shore of Lake Osborne.

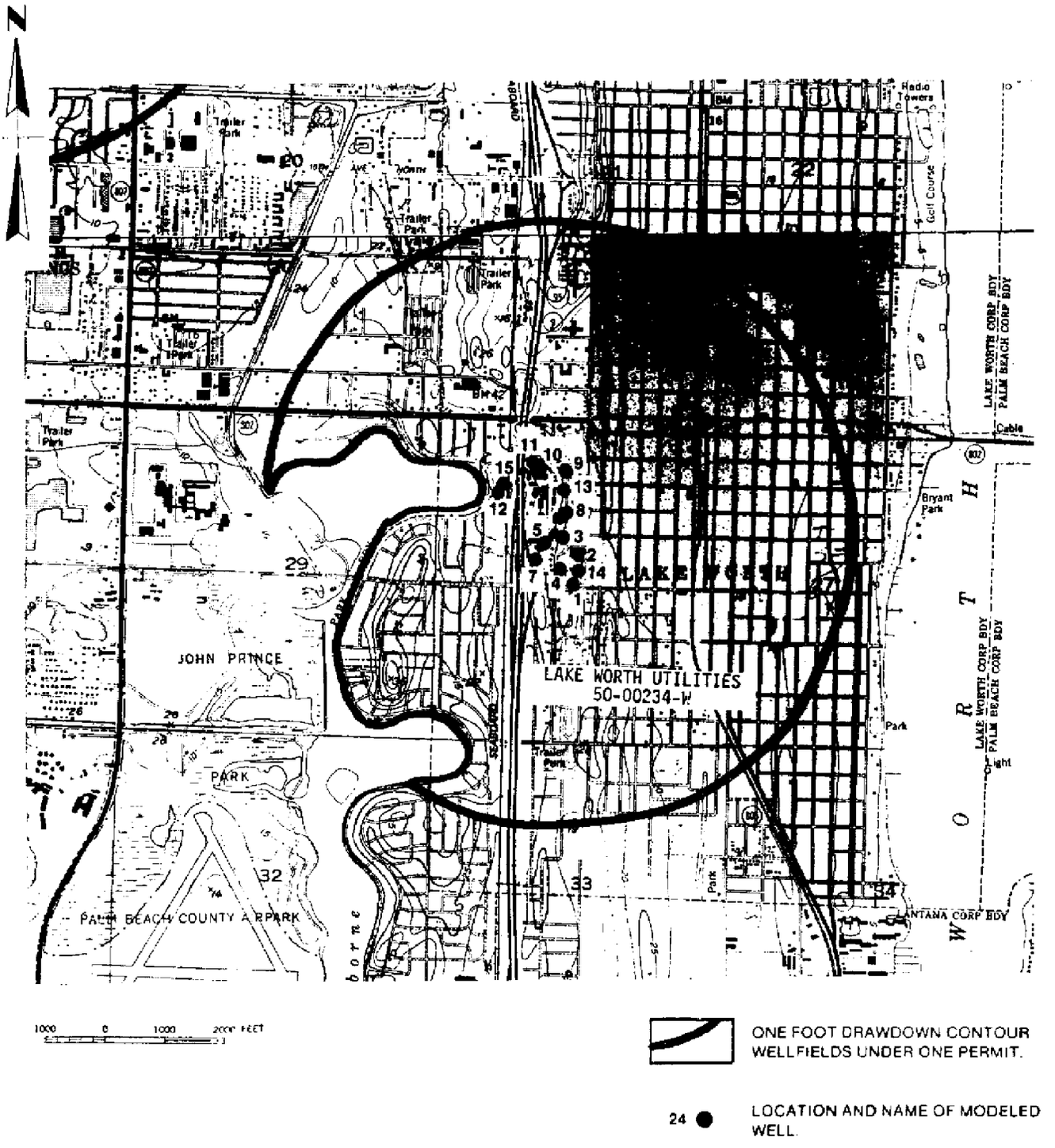


**Figure 9 ONE FOOT DRAWDOWN; LAKE WORTH UTILITIES**
**(Generated September, 1986)**

LAKE WORTH UTILITIES
50-00234-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 58000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 13.00 | 11.00 | 557000.00 | WELL 1 |
| 13.08 | 11.58 | 557000.00 | WELL 2 |
| 12.80 | 11.90 | 557000.00 | WELL 3 |
| 12.72 | 11.30 | 557000.00 | WELL 4 |
| 12.48 | 11.72 | 557000.00 | WELL 5 |
| 12.30 | 11.44 | 557000.00 | WELL 7 |
| 12.78 | 12.30 | 557000.00 | WELL 8 |
| 12.74 | 13.05 | 557000.00 | WELL 9 |
| 12.25 | 13.02 | 557000.00 | WELL 10 |
| 12.18 | 13.08 | 557000.00 | WELL 11 |
| 11.62 | 12.71 | 557000.00 | WELL 12 |
| 12.77 | 12.70 | 557000.00 | WELL 13 |
| 13.07 | 11.28 | 557000.00 | WELL 14 |
| 11.76 | 12.84 | 557000.00 | WELL 15 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00346-W

PERMIT NAME: Town of Highland Beach

ALLOCATION: 508 Million Gallons Per Year
(1.39 Million Gallons Per Day)

NUMBER OF WELLS: 3

MODELED DAILY PUMPAGE PER WELL: 463,333 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Delray Beach

AQUIFER: Surficial (Biscayne)
*T = 131,480 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Unknown author, *Aquifer Performance Test at Town of Highland Beach, Florida, October 19-21, 1978,* Consultant Report, Palm Beach Co., C#85, November, 1985, Ross, Saarinen, Bolton & Wilder, a Camp Dresser & McKee Firm, Ft. Lauderdale, Florida, p. 31.

COMMENTS:
Transmissivity values were derived from both continuous-rate drawdown and well recovery tests on well #4. The resulting data were analyzed using the Boulton analytical method for an unconfined surficial aquifer.

Well #4 was a partially penetrating well.

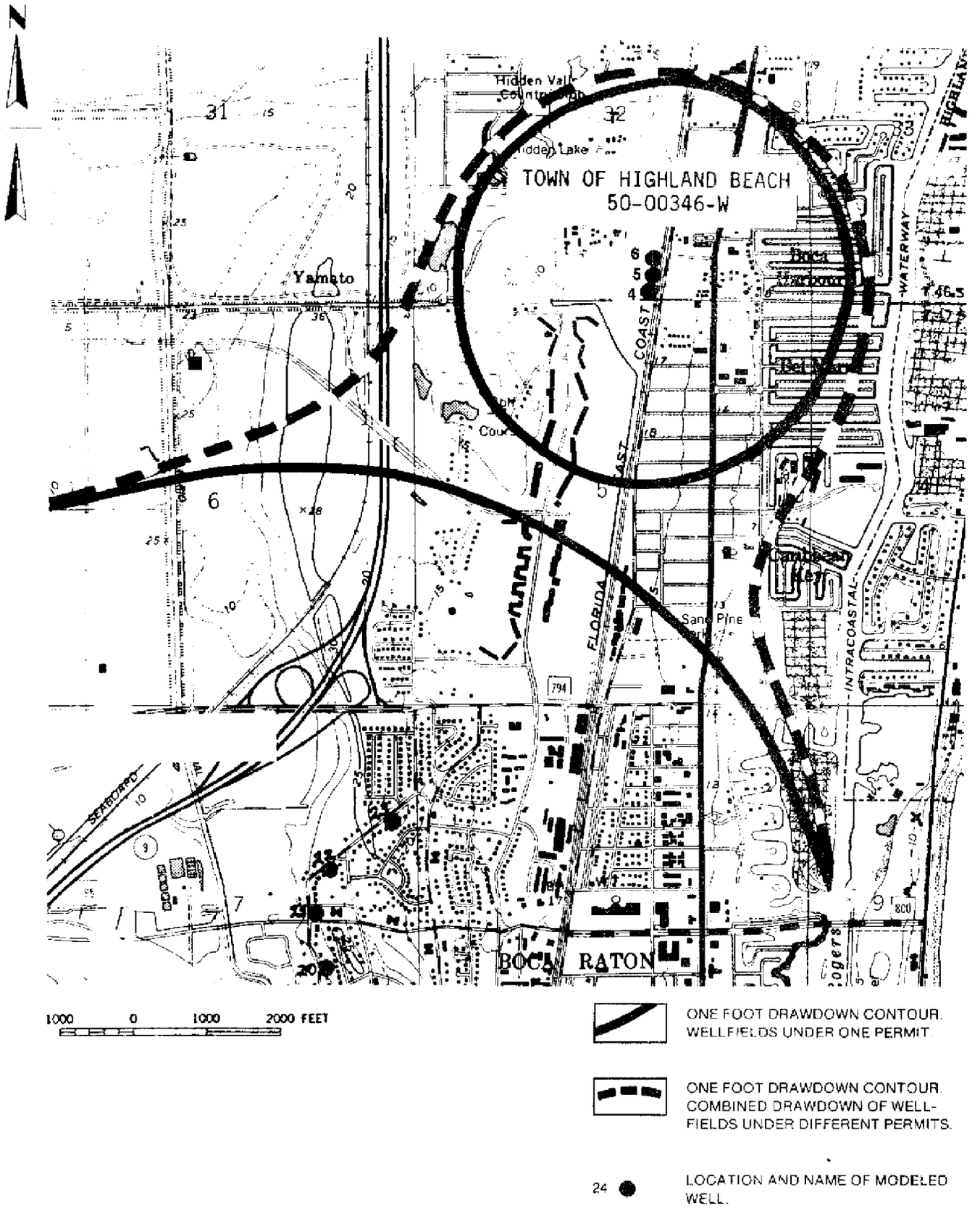


**Figure 10 ONE FOOT DRAWDOWN; TOWN OF HIGHLAND BEACH (Generated September, 1986)**

TOWN OF HIGHLAND BEACH
50-00346-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 131480.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.75 | 12.10 | 463333.00 | WELL 6 |
| 12.75 | 11.85 | 463333.00 | WELL 5 |
| 12.75 | 11.60 | 463333.00 | WELL 4 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

Theis grid coordinates (13,12) of the Highland Beach grid correlate to Theis grid coordinates (18,39) of the Boca Raton eastern grid.

## PALM BEACH COUNTY

PERMIT #: 50-00365-W

PERMIT NAME: Seacoast Utilities

ALLOCATION: 7.059 Billion Gallons Per Year
(19.34 Million Gallons Per Day)

NUMBER OF WELLS: 36 (excluding 4 Cabanna Colony Wellfield emergency fire flow wells)

MODELED DAILY PUMPAGE PER WELL:
Hood Road Wellfield - 946,154 Gallons Per Day Per Well
Palm Beach Gardens Wellfield - 420,000 Gallons Per Day Per Well
North Palm Beach Wellfield - 563,375 Gallons Per Day Per Well
Old Dixie Wellfield, standby - 332,556 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Riviera Beach, Delta

AQUIFER: Surficial (Turnpike)
*T = 440,000 GPD/FT (Hood Road Wellfield, cavity riddled section)
**T = 160,000 GPD/FT (Palm Beach Gardens Wellfield)
***T = 46,910 GPD/FT (North Palm Beach and Old Dixie wellfields)
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Unknown author, *Aquifer Test at Hood Road Well 1, Seacoast Utilities, Inc., Palm Beach County, Florida,* Consultant Report, Palm Beach Co., C#13, August 1979, Geraghty & Miller, Inc., Palm Beach Gardens, FL, p. 3.

COMMENTS:
*The transmissivity value used to model the Hood Road Wellfield drawdown was derived by Geraghty & Miller, Inc. from a 48 hour, continuous-drawdown pump test they performed on Hood Road Well #1. Data from the pumped well and four observation wells were analyzed by matching log-log data plots to Cooper type curves and subsequently deriving the aquifer parameters using both the Cooper and the Hantush and Jacob numerical methods.

**The transmissivity value used to model the Palm Beach Gardens Wellfield drawdown was assumed to be the same as the Riviera Beach Western Wellfield.

***The transmissivity value used to model the North Palm Beach Wellfield and the Old Dixie Wellfield drawdowns was estimated from specific capacity data from unspecified wells in the North Palm Beach Wellfield.

The Old Dixie Wellfield is used as a standby wellfield. The daily pumpage per well value used to model its drawdown was derived by dividing the difference between the maximum and average daily allocation of the North Palm Beach Wellfield by the number of wells in the Old Dixie Wellfield.

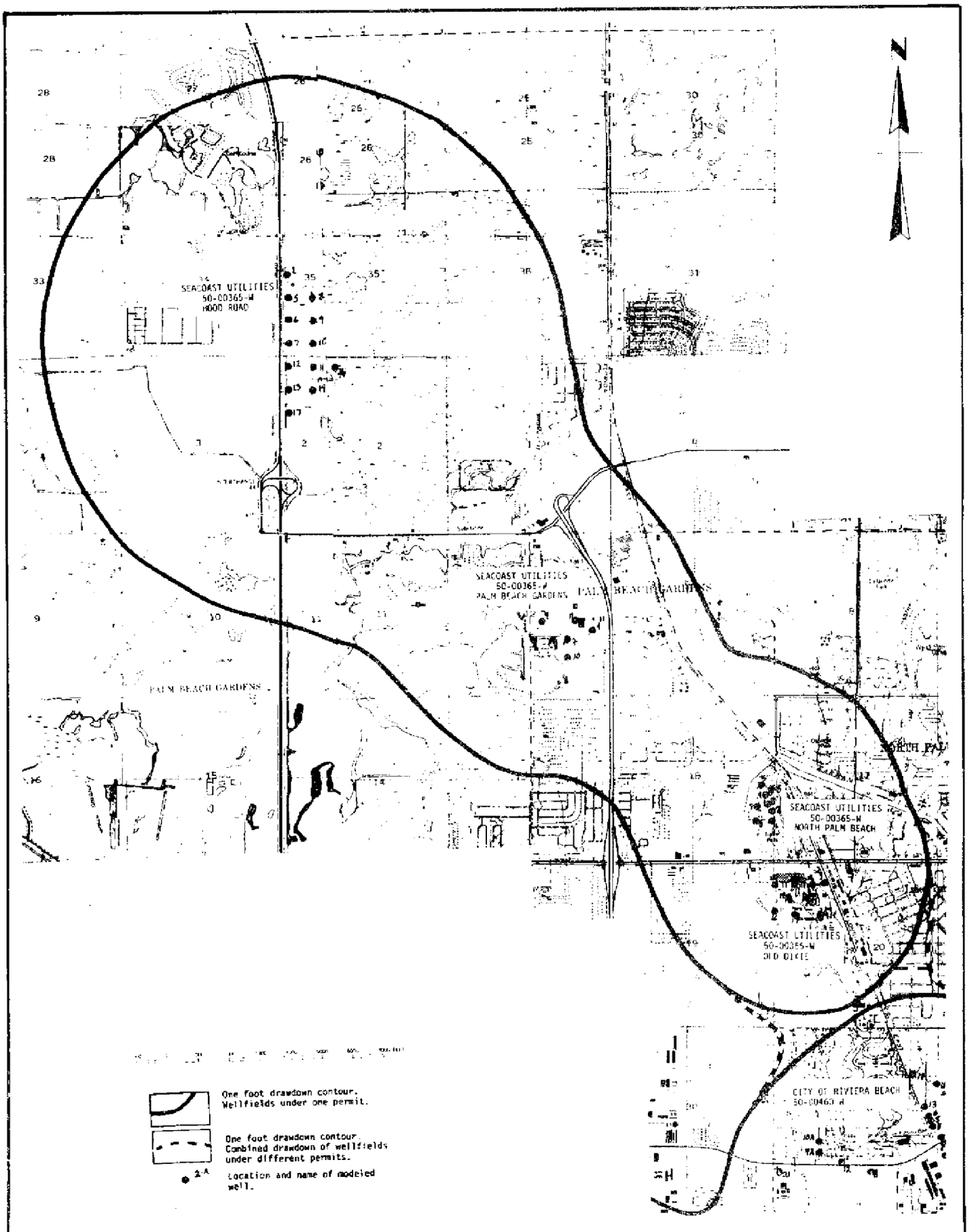


**Figure 11 ONE FOOT DRAWDOWN; SEACOAST UTILITIES (Generated September, 1986)**

SEACOAST UTILITIES
50-00365-W
HOOD ROAD WELLFIELD

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 440000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 9.20 | 18.25 | 946154.00 | WELL HR1 |
| 9.20 | 17.50 | 946154.00 | WELL HR5 |
| 9.20 | 16.75 | 946154.00 | WELL HR6 |
| 9.20 | 16.00 | 946154.00 | WELL HR7 |
| 10.00 | 17.50 | 946154.00 | WELL HR8 |
| 10.00 | 16.75 | 946154.00 | WELL HR9 |
| 10.00 | 16.00 | 946154.00 | WELL HR10 |
| 10.00 | 15.25 | 946154.00 | WELL HR11 |
| 9.20 | 15.25 | 946154.00 | WELL HR12 |
| 9.20 | 14.50 | 946154.00 | WELL HR13 |
| 10.00 | 14.50 | 946154.00 | WELL HR14 |
| 10.75 | 15.25 | 946154.00 | WELL HR16 |
| 9.20 | 13.75 | 946154.00 | WELL HR17 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--
--ROUNDED UP ON 5 AND DOWN ON 4--

Theis grid coordinates (10,16) of the Hood Road wellfield grid correlate to Theis grid coordinates (4,22) of the Palm Beach Gardens wellfield grid.

SEACOAST UTILITIES
50-00365-W
PALM BEACH GARDENS WELLFIELD

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 160000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.90 | 12.60 | 420000.00 | WELL PBG4 |
| 11.60 | 12.30 | 420000.00 | WELL PBG6 |
| 12.00 | 12.30 | 420000.00 | WELL PBG7 |
| 10.95 | 12.30 | 420000.00 | WELL PBG8 |
| 11.20 | 12.90 | 420000.00 | WELL PBG9 |
| 12.00 | 11.70 | 420000.00 | WELL PBG10 |
| 12.30 | 12.90 | 420000.00 | WELL PBG11 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

Theis grid coordinates (4,22) of the Palm Beach Gardens wellfield grid correlate to Theis grid coordinates (10,-16) of the Hood Road wellfield grid and to Theis grid coordinates (8,17) of the North palm Beach and Old Dixie wellfields grid.

SEACOAST UTILITIES
50-00365-W
NORTH PALM BEACH & OLD DIXIE WELLFIELDS

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 46910.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.60 | 13.30 | 563375.00 | WELL NPB1 |
| 12.60 | 13.70 | 563375.00 | WELL NPB2 |
| 12.40 | 13.90 | 563375.00 | WELL NPB3 |
| 12.30 | 14.20 | 563375.00 | WELL NPB4 |
| 12.20 | 14.50 | 563375.00 | WELL NPB5 |
| 12.00 | 13.30 | 563375.00 | WELL NPB6 |
| 12.10 | 13.85 | 563375.00 | WELL NPB7 |
| 12.60 | 14.35 | 563375.00 | WELL NPB8 |
| 14.20 | 11.30 | 332556.00 | WELL OD9 |
| 13.80 | 11.30 | 332556.00 | WELL OD10 |
| 14.10 | 10.30 | 332556.00 | WELL OD11 |
| 13.60 | 10.90 | 332556.00 | WELL OD12 |
| 13.30 | 11.30 | 332556.00 | WELL OD13 |
| 13.10 | 10.90 | 332556.00 | WELL OD14 |
| 12.60 | 11.30 | 332556.00 | WELL OD15 |

WELL DESCRIPTIONS
(CONTINUED)

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.60 | 10.45 | 332556.00 | WELL OD16 |
| 13.25 | 10.30 | 332556.00 | WELL OD17 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

Theis grid coordinates (8,17) of the North Palm Beach and Old Dixie wellfields grid correlate to Theis grid coordinates (14,10) of the Palm Beach Gardens wellfield grid.

## PALM BEACH COUNTY

PERMIT #: 50-00367-W

PERMIT NAME: City of Boca Raton

ALLOCATION: 14.2 Billion Gallons Per Year
(38.9 Million Gallons Per Day)

NUMBER OF WELLS: 49

MODELED DAILY PUMPAGE PER WELL:
South Eastern Wellfield (Wells #1-#9, Well #24); 333,333 Gallons Per Day Per Well
All other wells; 897,500 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Boca Raton, Delray Beach, West Dixie Bend, University Park

AQUIFER: Surficial (Biscayne)
*T = 201,428 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Unknown author, *Aquifer Performance Test Analysis, City of Boca Raton,* Consultant Report, Palm Beach Co., C#105, August, 1981, Camp, Dresser and McKee Inc., Fort Lauderdale, Florida, p. 35.

COMMENTS:
Withdrawal from the South Eastern Wellfield is limited to 3.0 million gallons per day due to its influence on salt water encroachment.

Transmissivity values were derived from pump tests performed in the North Western Wellfield. The longest continual drawdown test was 48 hours. Attempts were made by the consultant to incorporate the effects of nearby canals into the Aquifer Performance Test analyses.

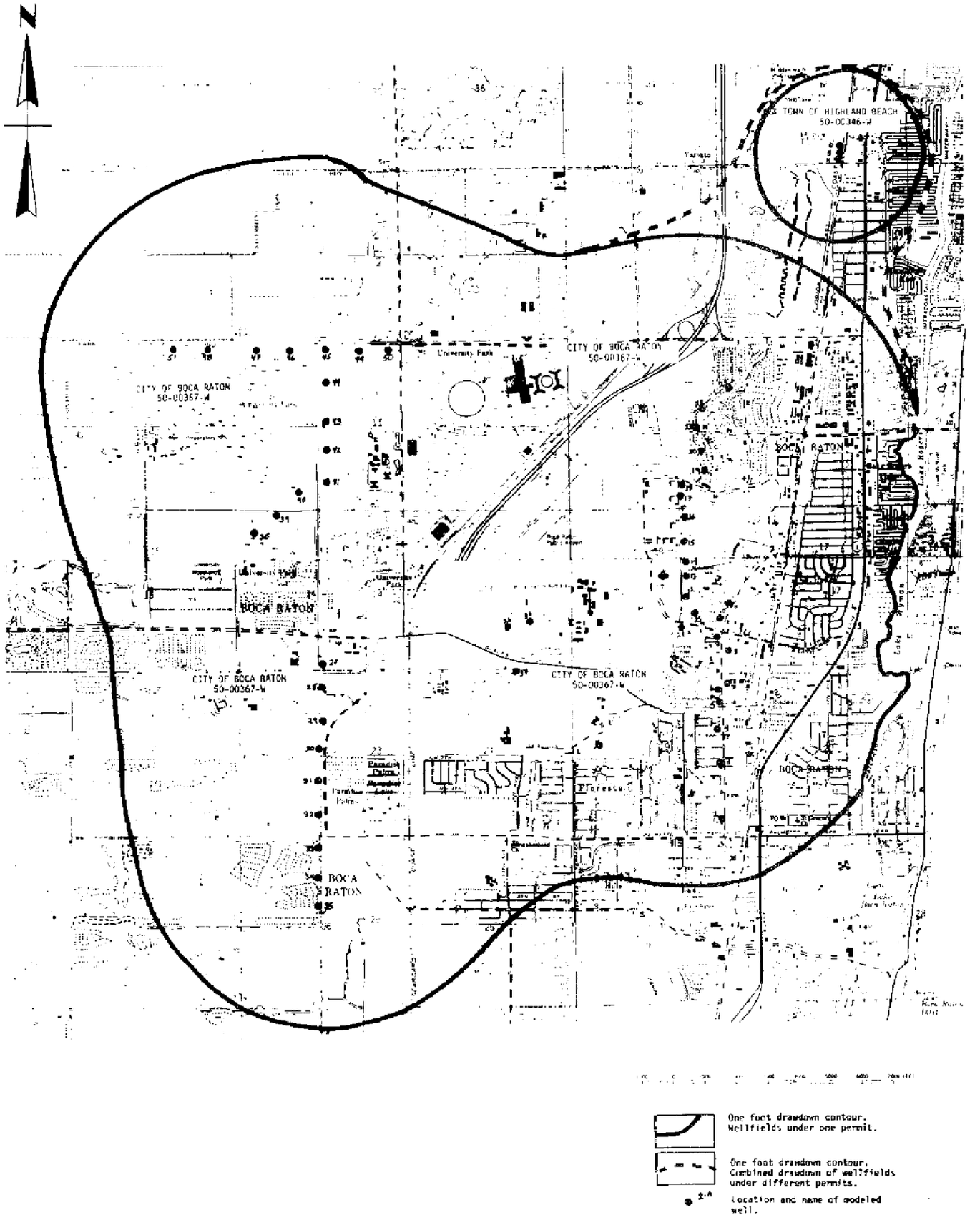


**Figure 12 ONE FOOT DRAWDOWN; CITY OF BOCA RATON (Generated September, 1986)**

CITY OF BOCA RATON
50-00367-W
EASTERN GRID

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 201428.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 13.80 | 17.82 | 333333.00 | WELL 1 |
| 13.10 | 19.55 | 333333.00 | WELL 3 |
| 13.05 | 20.60 | 333333.00 | WELL 4 |
| 13.15 | 21.50 | 333333.00 | WELL 5 |
| 13.15 | 21.90 | 333333.00 | WELL 6 |
| 13.45 | 22.07 | 333333.00 | WELL 7 |
| 13.45 | 23.15 | 333333.00 | WELL 8 |
| 13.10 | 23.60 | 333333.00 | WELL 9 |
| 12.00 | 23.95 | 333333.00 | WELL 24 |
| 13.20 | 24.25 | 897500.00 | WELL 10 |
| 13.50 | 24.65 | 897500.00 | WELL 11 |
| 12.20 | 25.00 | 897500.00 | WELL 12 |
| 12.20 | 25.65 | 897500.00 | WELL 13 |
| 12.20 | 26.15 | 897500.00 | WELL 14 |
| 12.20 | 26.80 | 897500.00 | WELL 15 |

Theis grid coordinates (10,25) of the eastern grid correlate to Theis grid coordinates (22,25) of the western grid.

CITY OF BOCA RATON
50-00367-W
EASTERN GRID

WELL DESCRIPTIONS
(CONTINUED)

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.20 | 27.55 | 897500.00 | WELL 16 |
| 12.10 | 28.25 | 897500.00 | WELL 17 |
| 12.20 | 28.60 | 897500.00 | WELL 18 |
| 12.90 | 28.90 | 897500.00 | WELL 19 |
| 12.85 | 29.60 | 897500.00 | WELL 20 |
| 12.70 | 30.35 | 897500.00 | WELL 21 |
| 12.95 | 30.95 | 897500.00 | WELL 22 |
| 13.85 | 31.55 | 897500.00 | WELL 23 |
| 12.40 | 24.40 | 897500.00 | WELL 24 |
| 6.50 | 24.20 | 897500.00 | WELL 26 |
| 7.20 | 24.30 | 897500.00 | WELL 36 |
| 6.75 | 22.70 | 897500.00 | WELL 37 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

Theis grid coordinates (10,25) of the eastern grid correlate to Theis grid coordinates (22,25) of the western grid.

CITY OF BOCA RATON
50-00367-W
WESTERN GRID

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 201428.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.70 | 23.00 | 897500.00 | WELL 27 |
| 12.70 | 22.25 | 897500.00 | WELL 28 |
| 12.65 | 21.20 | 897500.00 | WELL 29 |
| 12.55 | 20.25 | 897500.00 | WELL 30 |
| 12.45 | 19.25 | 897500.00 | WELL 31 |
| 12.45 | 18.15 | 897500.00 | WELL 32 |
| 12.45 | 17.10 | 897500.00 | WELL 33 |
| 12.45 | 16.20 | 897500.00 | WELL 34 |
| 12.45 | 15.29 | 897500.00 | WELL 35 |
| 11.30 | 27.90 | 897500.00 | WELL 38 |
| 10.55 | 27.35 | 897500.00 | WELL 39 |
| 12.00 | 28.60 | 897500.00 | WELL 40 |
| 12.90 | 28.90 | 897500.00 | WELL 41 |
| 12.85 | 29.90 | 897500.00 | WELL 42 |
| 12.85 | 30.90 | 897500.00 | WELL 43 |

Theis grid coordinates (22,25) of the western grid correlate to Theis grid coordinates (10,25) of the eastern grid.

WELL DESCRIPTIONS
(CONTINUED)

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.85 | 32.05 | 897500.00 | WELL 44 |
| 12.85 | 33.05 | 897500.00 | WELL 45 |
| 11.75 | 33.05 | 897500.00 | WELL 46 |
| 10.65 | 33.05 | 897500.00 | WELL 47 |
| 9.15 | 33.05 | 897500.00 | WELL 48 |
| 13.95 | 33.05 | 897500.00 | WELL 49 |
| 14.95 | 33.05 | 897500.00 | WELL 50 |
| 8.10 | 33.05 | 897500.00 | WELL 51 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

Theis grid coordinates (22,25) of the western grid correlate to Theis grid coordinates (10,25) of the eastern grid.

## PALM BEACH COUNTY

PERMIT #: 50-00401-W

PERMIT NAME: Palm Beach County Water Utilities, (System #9)

ALLOCATION: 3.22 Billion Gallons Per Year
(8.822 Million Gallons Per Day)

NUMBER OF WELLS: 15

MODELED DAILY PUMPAGE PER WELL: 588,129 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: West Dixie Bend

AQUIFER: Surficial (Biscayne)
*T = 144,495 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

COMMENTS:
*The transmissivity value used in this model was estimated from the specific capacities of wells #1-#8.

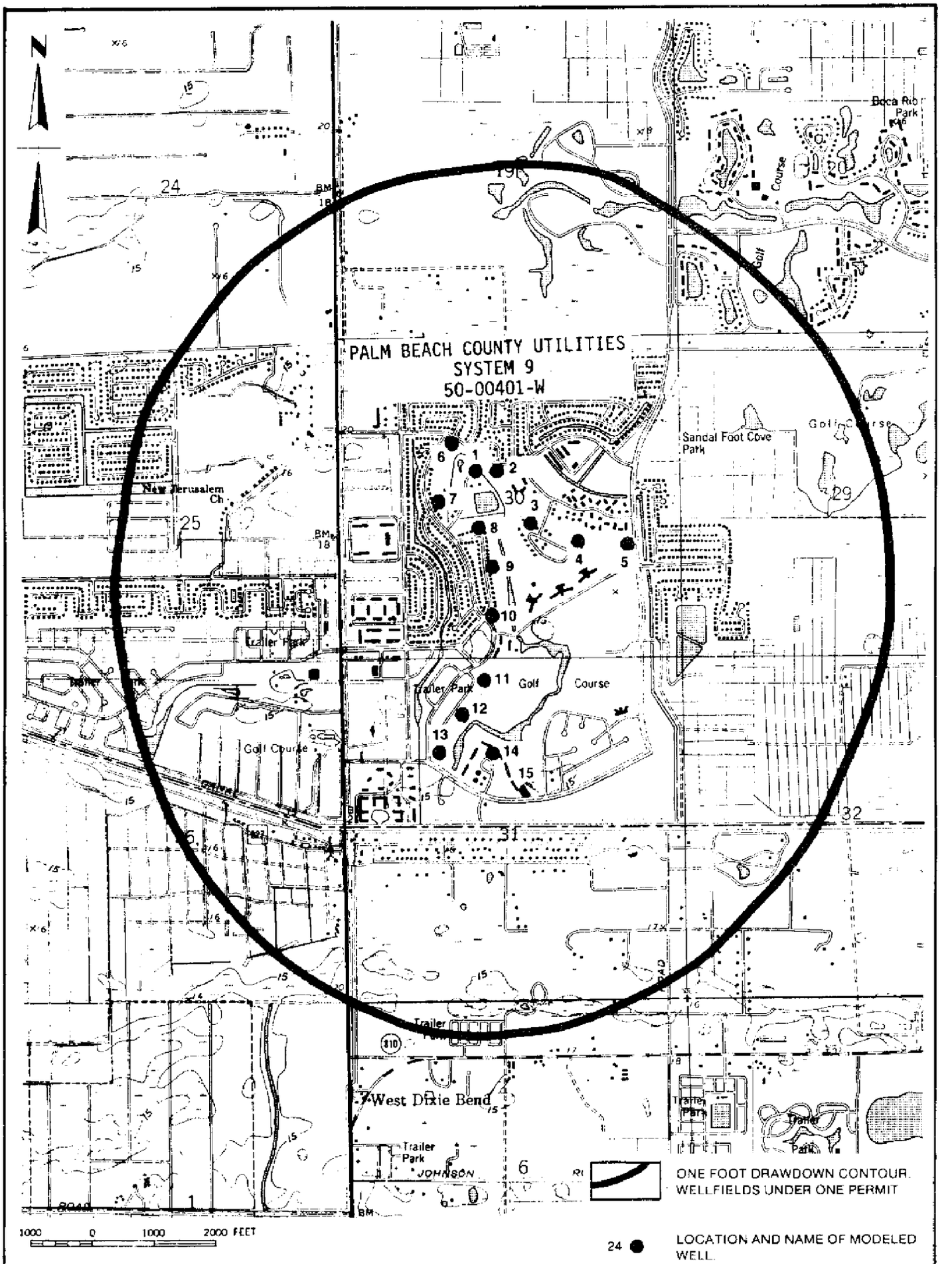


**Figure 13 ONE FOOT DRAWDOWN; PALM BEACH COUNTY WATER UTILITIES (SYSTEM #9) (Generated September, 1986)**

PALM BEACH COUNTY UTILITIES
SYSTEM 9
50-00401-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 144495.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.75 | 14.50 | 588129.00 | WELL 1 |
| 12.10 | 14.50 | 588129.00 | WELL 2 |
| 12.60 | 13.70 | 588129.00 | WELL 3 |
| 13.40 | 13.40 | 588129.00 | WELL 4 |
| 14.20 | 13.30 | 588129.00 | WELL 5 |
| 11.40 | 15.00 | 588129.00 | WELL 6 |
| 11.10 | 14.10 | 588129.00 | WELL 7 |
| 11.80 | 13.60 | 588129.00 | WELL 8 |
| 12.00 | 13.00 | 588129.00 | WELL 9 |
| 12.00 | 12.20 | 588129.00 | WELL 10 |
| 11.85 | 11.15 | 588129.00 | WELL 11 |
| 11.50 | 10.60 | 588129.00 | WELL 12 |
| 11.10 | 10.00 | 588129.00 | WELL 13 |
| 12.00 | 10.00 | 588129.00 | WELL 14 |
| 12.50 | 9.30 | 588129.00 | WELL 15 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00444-W

PERMIT NAME: Village of Royal Palm Beach

ALLOCATION: 849 Million Gallons Per Year
(2.326 Million Gallons Per Day)

NUMBER OF WELLS: 7

MODELED DAILY PUMPAGE PER WELL: 332,290 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Palm Beach Farms

AQUIFER: Surficial
T = 34,000 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

COMMENTS:
The Theis model was run using seven pumping-wells. As of July, 1986, wells #6 and #7 were drilled and completed but were not connected to the utilities system. This Theis model reflects conditions that could occur once these wells become operative.

Aquifer parameters were assumed to be similar to those of the Acme Improvement District Southern Wellfield.

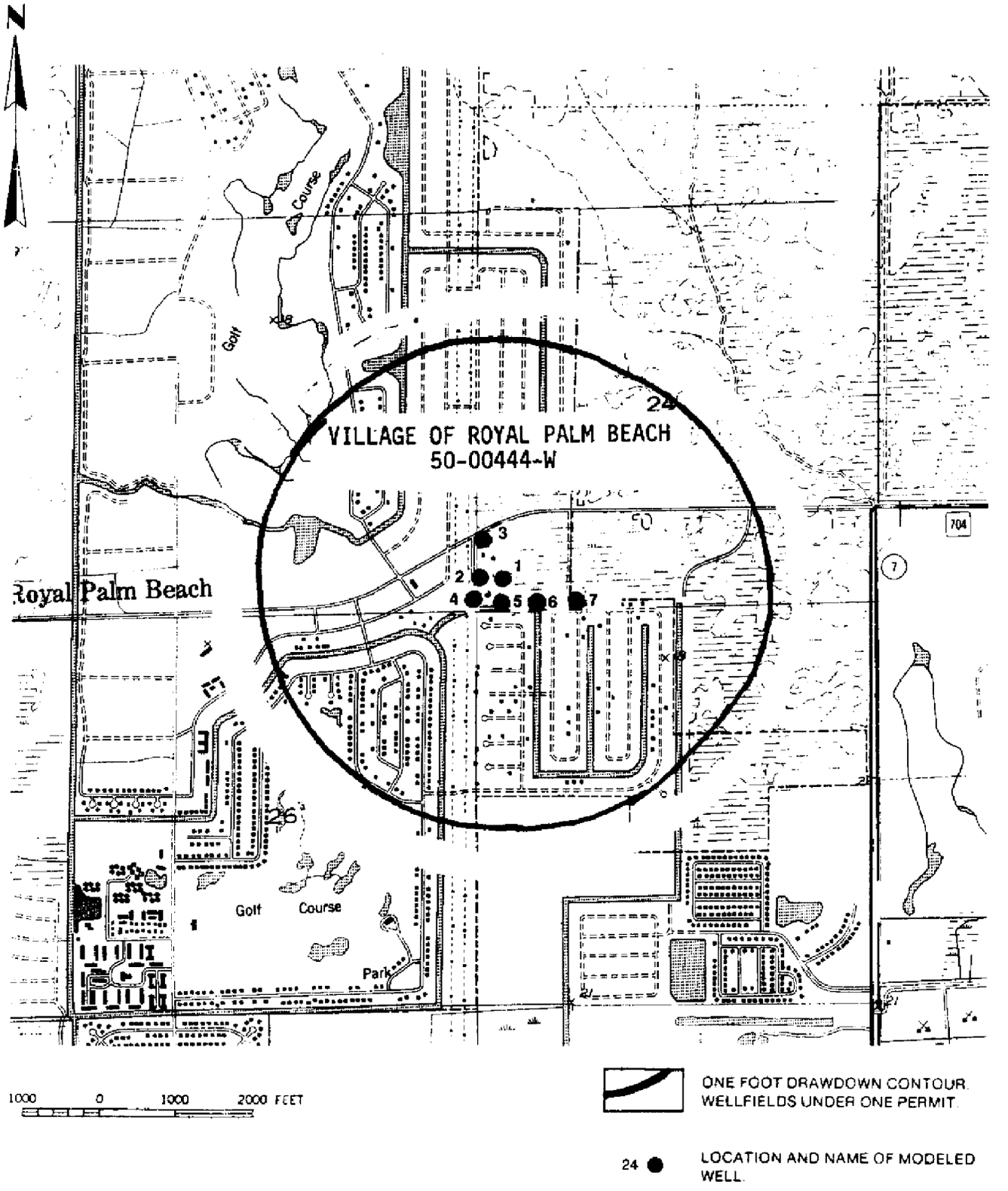


**Figure 14: ONE FOOT DRAWDOWN; VILLAGE OF ROYAL PALM BEACH (Generated September, 1986)**

VILLAGE OF ROYAL PALM BEACH
50-00444-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 34000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 13.00 | 13.00 | 332290.00 | WELL 1 |
| 12.60 | 13.00 | 332290.00 | WELL 2 |
| 12.60 | 13.50 | 332290.00 | WELL 3 |
| 12.60 | 12.60 | 332290.00 | WELL 4 |
| 13.00 | 12.70 | 332290.00 | WELL 5 |
| 13.50 | 12.70 | 332290.00 | WELL 6 |
| 14.00 | 12.70 | 332290.00 | WELL 7 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00460-W

PERMIT NAME: City of Riviera Beach

ALLOCATION: 3.25 Billion Gallons Per Year
(8.9 Million Gallons Per Day)

NUMBER OF WELLS: 24

MODELED DAILY PUMPAGE PER WELL:
Eastern Wellfield; 210,844 Gallons Per Day
Western Wellfield; Maximum Capacity
(see data-input sheets)

U.S.G.S. QUADRANGLE: Riviera Beach

AQUIFER: Surficial (Turnpike)
*T = 84,300 GPD/FT (Eastern Wellfield)
**T = 160,000 GPD/FT (Western Wellfield, "cavity riddled section")
Sy = 0.2 (assumed for a shallow, unconfined aquifer)

REFERENCES:
*Unknown author, *Report and Analyses, Wellfield Exploration Program in the Turnpike Aquifer for the City of Riviera Beach, Florida*, Consultant Report, Palm Beach Co., C#7, April, 1979, Barker Osha and Anderson Inc., North Palm Beach, Florida, p.43.

**L.F. Land, *Ground-Water Resources of the Riviera Beach Area, Palm Beach County, Florida*, U. S. G. S. Water Resources Investigation 77-47, Palm Beach Co., C#1, September, 1977, U. S. Geological Survey, Tallahassee, Florida, p. 16.

COMMENTS:
Wells in the Western Wellfield were modeled as pumping at maximum capacity to represent the further development of this field. Salt water encroachment in the east has made the Western Wellfield development a desirable objective to the City of Riviera Beach. Average pumping rates in the Eastern Wellfield were assigned based on the balance of the annual allocation not withdrawn by the Western Wellfield.

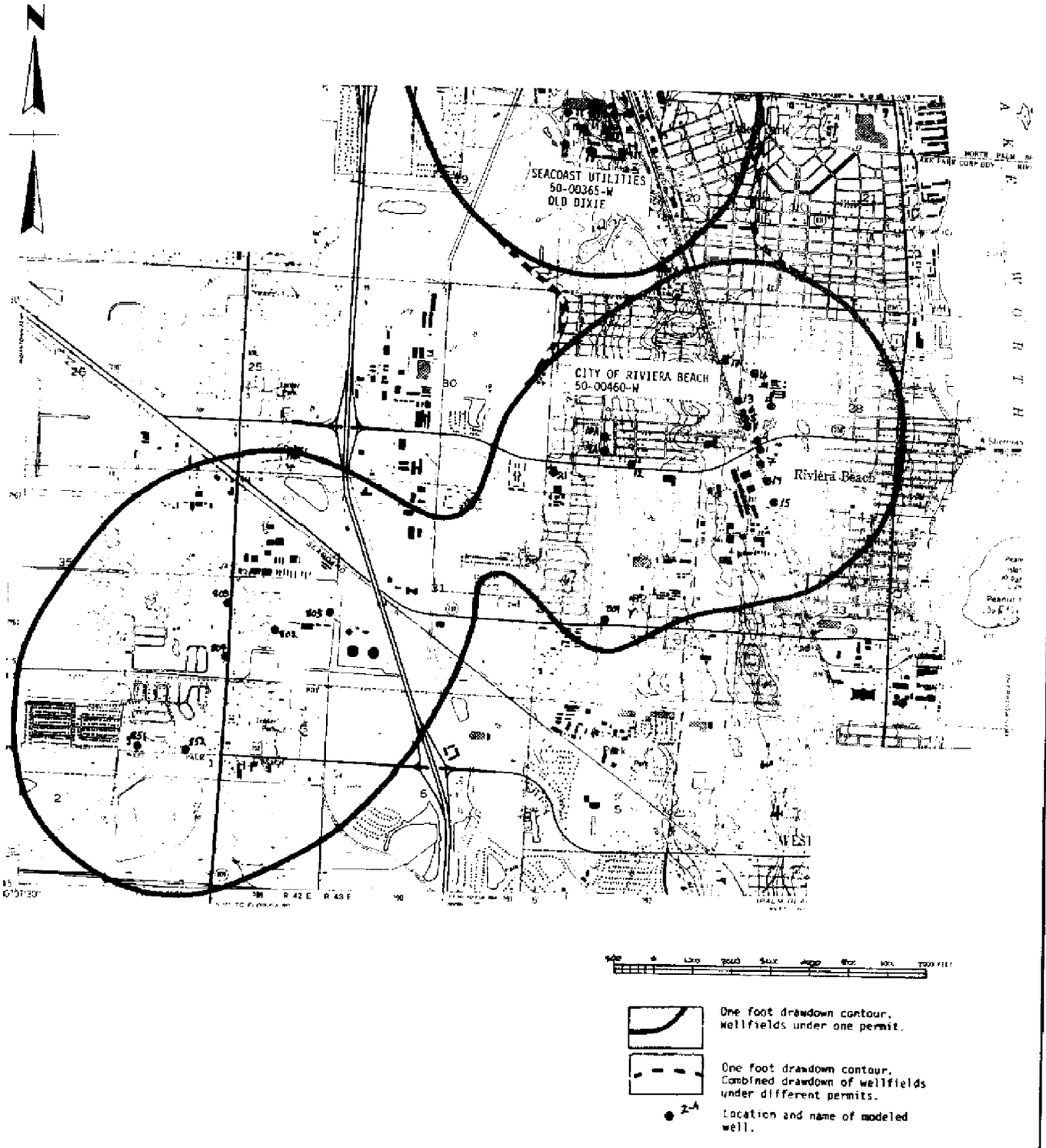


**Figure 15 ONE FOOT DRAWDOWN; CITY OF RIVIERA BEACH (Generated September, 1986)**

CITY OF RIVIERA BEACH
50-00460-W
EASTERN WELLFIELD

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 84300.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 14.03 | 11.32 | 210844.00 | WELL 1 |
| 13.93 | 11.48 | 210844.00 | WELL 2 |
| 13.79 | 11.87 | 210844.00 | WELL 4 |
| 13.67 | 12.03 | 210844.00 | WELL 5 |
| 13.58 | 12.27 | 210844.00 | WELL 6 |
| 14.21 | 10.91 | 210844.00 | WELL 7 |
| 10.09 | 11.15 | 210844.00 | WELL 9A |
| 10.10 | 11.57 | 210844.00 | WELL 10A |
| 12.62 | 11.47 | 210844.00 | WELL 11 |
| 10.78 | 10.84 | 210844.00 | WELL 12 |
| 13.43 | 12.61 | 210844.00 | WELL 13 |
| 14.36 | 10.55 | 210844.00 | WELL 14 |
| 14.52 | 10.00 | 210844.00 | WELL 15 |
| 13.91 | 13.41 | 210844.00 | WELL 16 |
| 13.00 | 13.60 | 210844.00 | WELL 17 |

Theis grid coordinates (3,3) of the Eastern Wellfield grid correlate to Theis grid coordinates (14,11) of the Western Wellfield grid.

CITY OF RIVIERA BEACH
50-00460-W
EASTERN WELLFIELD

WELL DESCRIPTIONS
(CONTINUED)

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 14.05 | 12.57 | 210844.00 | WELL 18 |
| 8.86 | 10.57 | 210844.00 | WELL 21 |
| 10.22 | 6.80 | 210844.00 | WELL 801 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

Theis grid coordinates (3,3) of the Eastern Wellfield grid correlate to Theis grid coordinates (14,11) of the Western Wellfield grid.

CITY OF RIVIERA BEACH
50-00460-W
WESTERN WELLFIELD

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 16000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.63 | 14.23 | 864000.00 | WELL 802 |
| 11.43 | 14.83 | 792000.00 | WELL 803 |
| 11.36 | 13.57 | 712800.00 | WELL 804 |
| 13.98 | 14.68 | 720000.00 | WELL 805 |
| 9.20 | 11.09 | 1008000.00 | WELL 851 |
| 10.22 | 11.07 | 1008000.00 | WELL 852 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00464-W

PERMIT NAME: Acme Improvement District

ALLOCATION: 910 Million Gallons Per Year
(2.49 Million Gallons Per Day)

NUMBER OF WELLS: 15

MODELED DAILY PUMPAGE PER WELL:
North and Eastern Wellfields, Maximum Capacity
Southern Wellfield, 830,000 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Green Acres City, Palm Beach Farms

AQUIFER: Surficial
*T = 11,500 GPD/FT - North and Eastern wellfields
Sy = 0.2 (assumed for shallow, unconfined aquifer)
**T = 34,000 GPD/FT - Southern Wellfield
**Sy = 0.1

REFERENCES:
*Unknown author, *Summary Report for Acme Improvement District Test Well Program #79-44,* Palm Beach Co., C#29, October 1979, Gee and Jenson, West Palm Beach, Florida.

**Unknown author, *Part II, Supplemental Engineering Report, Water Development, Section 25, for Acme Improvement District,* Consultant Report, Palm Beach Co., C#120, November, 1980, Gee and Jenson, West Palm Beach, Florida, p. 13.

COMMENTS:
The maximum withdrawal capacity of the North and Eastern wellfields is less than the average day allocation. These wellfields were modeled as operating at maximum capacity. The Southern Wellfield was modeled as producing the total average daily allocation of water in order to represent the further development of this wellfield in the future. Salt water intrusion in the North and Eastern wellfields has made further development of the Southern Wellfield necessary.

Transmissivity and storativity values used in modeling drawdowns in the Southern Wellfield were derived from calibrating pump test data with water table declines observed during operation of the southern wellfield. The pump test data were taken during a continuous-rate, 72 hour drawdown test performed on well #18. The pumped well and the piezometers were located less than 150 ft. from a canal.

ACME IMPROVEMENT DISTRICT
50-00464-W
NORTHERN AND EASTERN
WELLFIELDS

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 11500.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 9.25 | 12.95 | 134400.00 | Well 1 |
| 9.65 | 13.10 | 134400.00 | Well 2 |
| 10.00 | 13.10 | 134400.00 | WELL 3 |
| 9.90 | 12.70 | 134400.00 | WELL 4 |
| 9.60 | 12.50 | 134400.00 | WELL 5 |
| 9.30 | 12.70 | 134400.00 | WELL 6 |
| 14.00 | 13.00 | 129600.00 | WELL 7 |
| 14.00 | 12.50 | 360000.00 | WELL 8 |
| 14.00 | 12.10 | 180000.00 | WELL 9 |
| 14.00 | 11.30 | 108000.00 | WELL 11 |
| 14.00 | 10.30 | 129600.00 | WELL 13 |
| 14.00 | 9.30 | 180000.00 | WELL 15 |
| 14.00 | 8.30 | 360000.00 | WELL 17 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

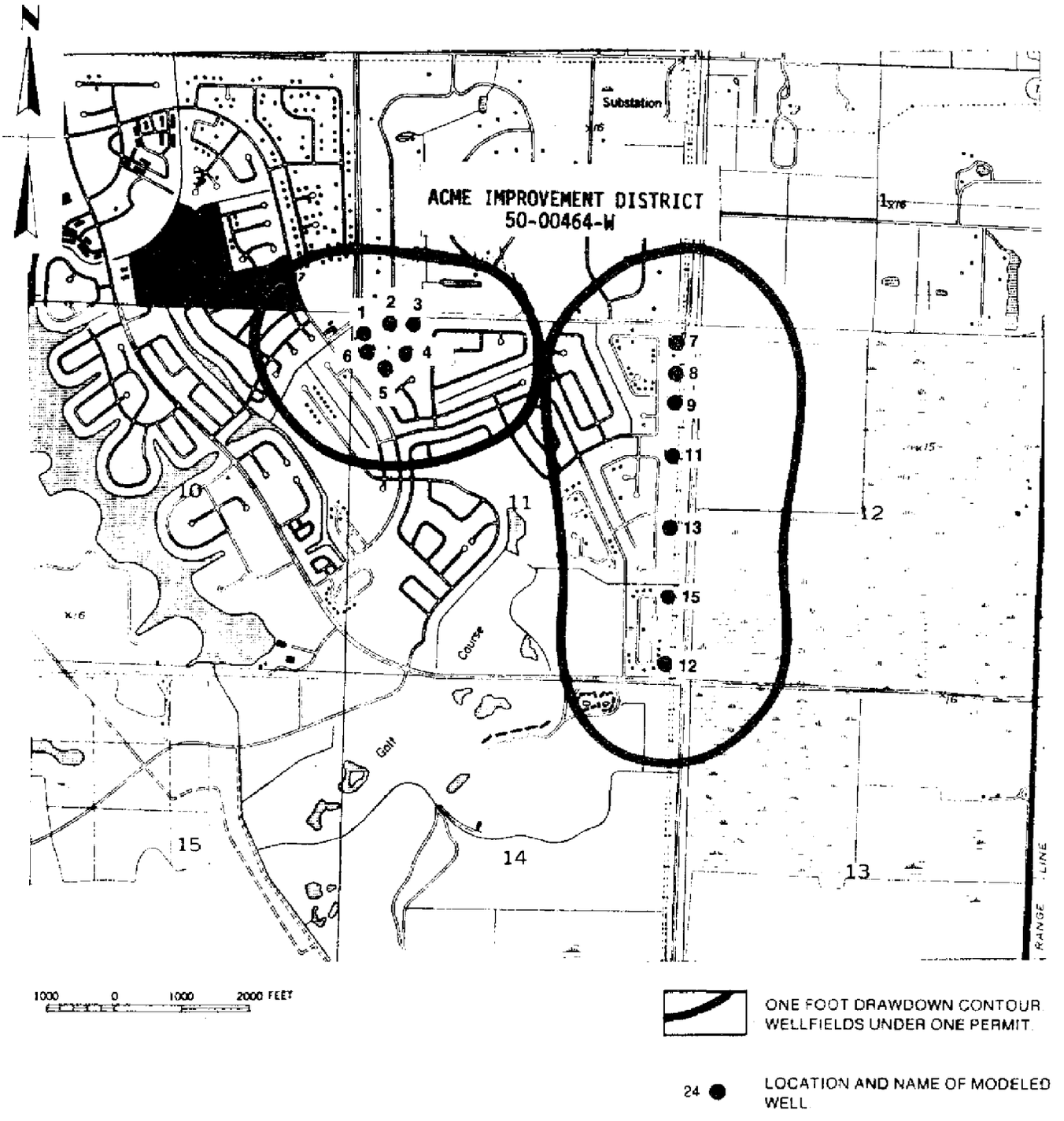


**Figure 16-A: ONE FOOT DRAWDOWN; ACME IMPROVEMENT DISTRICT (Generated September, 1986)**

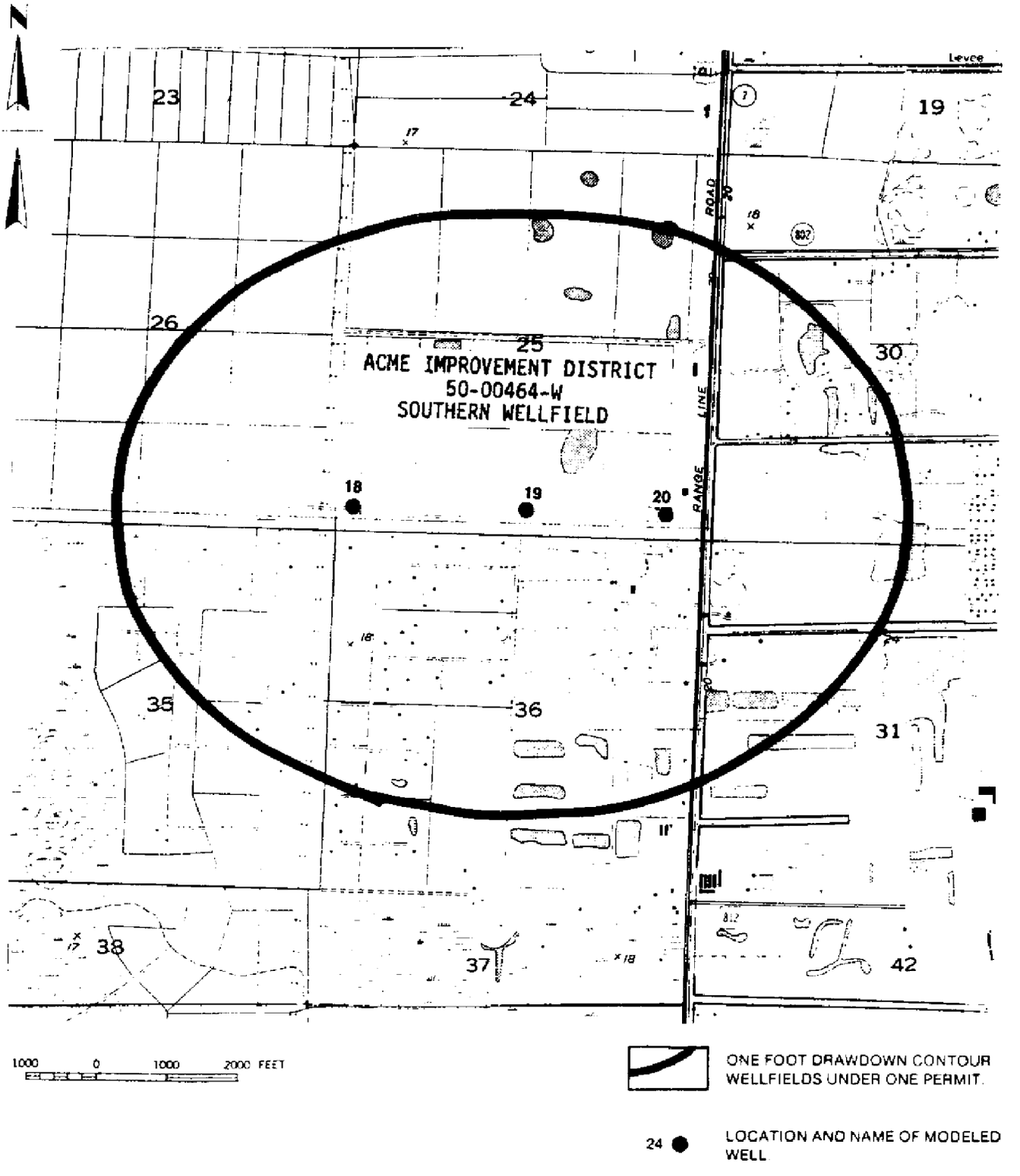


**Figure 16-B ONE FOOT DRAWDOWN; ACME IMPROVEMENT DISTRICT, SOUTHERN WELLFIELD (Generated September, 1986)**

ACME IMPROVEMENT DISTRICT
50-00464-W
SOUTHERN WELLFIELD

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 34000.

STORAGE COEFFICIENT = .10000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 10.00 | 12.50 | 830000.00 | WELL 18 |
| 12.50 | 12.50 | 830000.00 | WELL 19 |
| 14.45 | 12.50 | 830000.00 | WELL 20 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00499-W

PERMIT NAME: City of Boynton Beach

ALLOCATION: 3.89 Billion Gallons Per Year
(10.7 Million Gallons Per Day)

NUMBER OF WELLS: 16 (excluding emergency standby wells #1-#5)

MODELED DAILY PUMPAGE PER WELL:
Wellfield #5 (Well #15-Well #22): 937,500 Gallons Per Day Per Well
Wellfields #3 & #4 (Well #6-Well #14): 400,000 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Lake Worth

AQUIFER: Surficial
*T = 65,000 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Roger T. Gresh, *Supplemental Engineering Report, South Florida Water Management District, City of Boynton Beach, Florida, Permit Application No. 24859,* Consultant Report, Palm Beach Co., C#43, April, 1977, Russell & Axon, Daytona Beach, Florida, p.V-2.

COMMENTS:
In August, 1976, Russell & Axon, engineering consultants, performed two different eight hour, continuous-drawdown pump tests at locations corresponding to well #15 and well #19. They derived transmissivity values by analyzing log-log and semi-log time-drawdown plots using the modified Hantush and the modified Jacob methods. The resulting transmissivity values were "adjusted" (?) by the consultants to compensate for the effects of partial penetration, boundary influences, well inefficiencies and pumping durations. The transmissivity values for each site were averaged to get a final T value of 65,000 GPD/FT. Although the specific capacities of wells #6-#11 indicated slightly higher transmissivities in these wells, the conservative transmissivity value of 65,000 GPD/FT was used to model all the City of Boynton Beach wellfields.

The model was run with wellfield #5 pumping 7.5 million gallons per day (937,500 GPD/Well) as dictated by special condition #16 in Water Use Permit #50-00499-W. Wellfields #3 and #4 were modeled as pumping the balance of the average day allocation. This scenario probably best represents normal pumping conditions.

Wells #1-#5 are used only as emergency standby wells due to their close proximity to the encroaching 250 mg/l isochlor boundary. These wells were not included in this model.

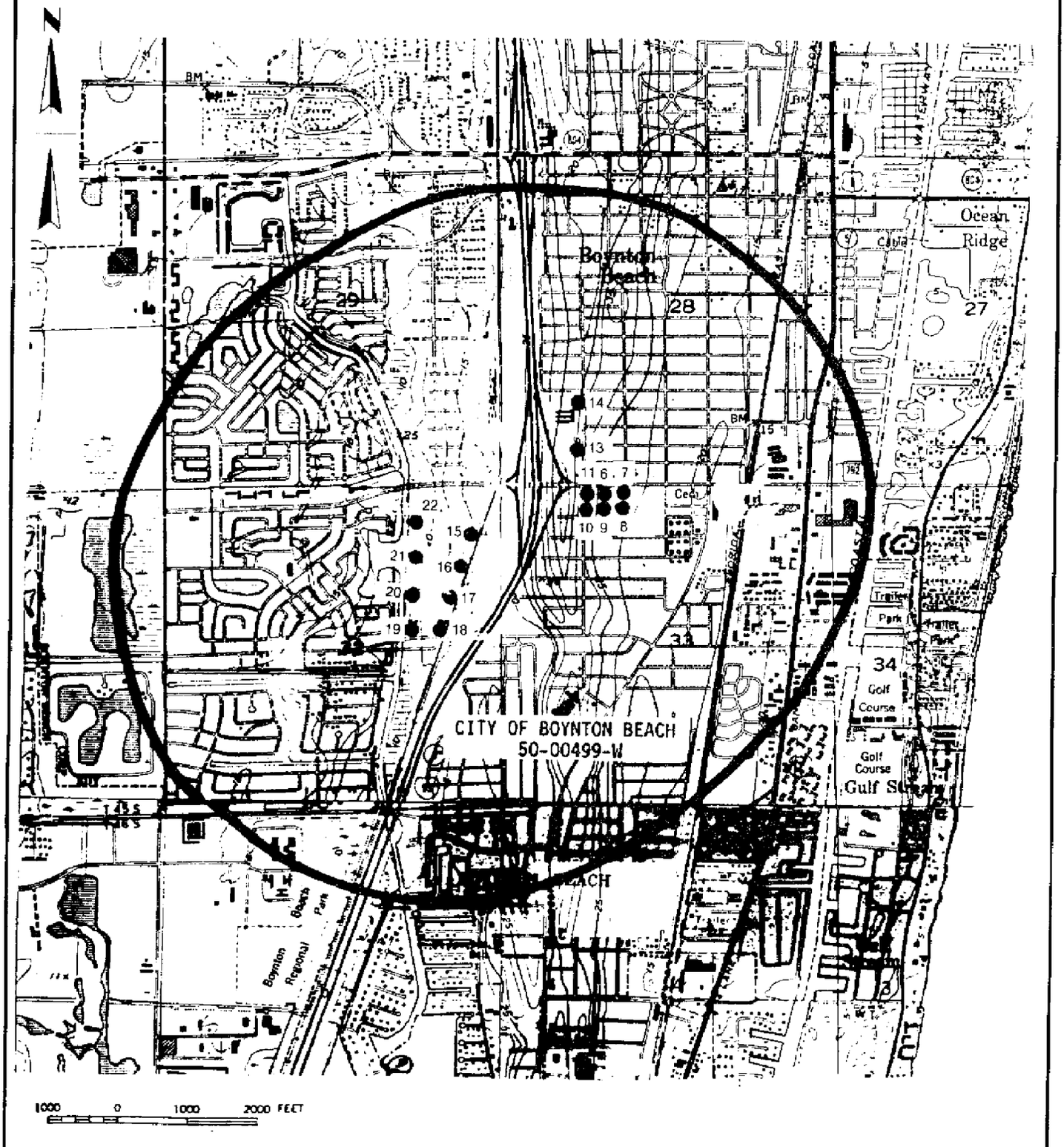


**Figure 17 ONE FOOT DRAWDOWN; CITY OF BOYNTON BEACH (Generated September, 1986)**

CITY OF BOYNTON BEACH
50-00499-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

| | |
|---|---|
| TRANSMISSIVITY = | 65000. |
| STORAGE COEFFICIENT = | .20000000 |
| TIME (DAYS) = | 100.0000 |
| NODE SPACING = | 1000.00 |

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 13.30 | 13.05 | 400000.00 | WELL 6 |
| 13.55 | 13.05 | 400000.00 | WELL 7 |
| 13.55 | 12.80 | 400000.00 | WELL 8 |
| 13.30 | 12.80 | 400000.00 | WELL 9 |
| 13.00 | 12.80 | 400000.00 | WELL 10 |
| 13.00 | 13.05 | 400000.00 | WELL 11 |
| 12.85 | 13.70 | 400000.00 | WELL 13 |
| 12.85 | 14.45 | 400000.00 | WELL 14 |
| 11.20 | 12.40 | 937500.00 | WELL 15 |
| 11.00 | 11.85 | 937500.00 | WELL 16 |
| 10.85 | 11.35 | 937500.00 | WELL 17 |
| 10.70 | 10.80 | 937500.00 | WELL 18 |
| 10.30 | 10.80 | 937500.00 | WELL 19 |
| 10.30 | 11.35 | 937500.00 | WELL 20 |

CITY OF BOYNTON BEACH
50-00499-W

WELL DESCRIPTIONS
(CONTINUED)

| | | | |
|---|---|---|---|
| 10.30 | 12.00 | 937500.00 | WELL 21 |
| 10.30 | 12.55 | 937500.00 | WELL 22 |

--DISPLAY DRAWDOWNS ARE ACTUAL VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00501-SW

PERMIT NAME: Pratt and Whitney Aircraft Division of United Technologies

ALLOCATION: 1.07 Billion Gallons Per Year (2.93 Million Gallons Per Day)

NUMBER OF WELLS: 8

MODELED DAILY PUMPAGE PER WELL: 366,250 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: West Palm Beach 2 N.E.

AQUIFER: Surficial
*T = 36,000 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Howard L. Searcy, *Palm Beach Park of Commerce Hydrogeologic Report, Palm Beach County, Florida,* as found in *Response to Determination of Informational Sufficiency for Palm Beach Park of Commerce, Development of Regional Impact, Application for Development Approval,* Consultant Report, Palm Beach Co., C#91, October, 1981, Howard L. Searcy, P.E., Consulting Engineer, Inc., West Palm Beach, FL, Question 23B, p. 3.

COMMENTS:
The transmissivity value used in this model is the mean of transmissivities determined analytically from semi-log plots of time-drawdown, distance-drawdown, recovery and residual-drawdown data. The data were taken from pump tests performed on a 124 foot deep test well in Palm Beach Park of Commerce. The test well is located approximately 7000' east of Pratt and Whitney production well #5 (see 1' drawdown quad map for location).

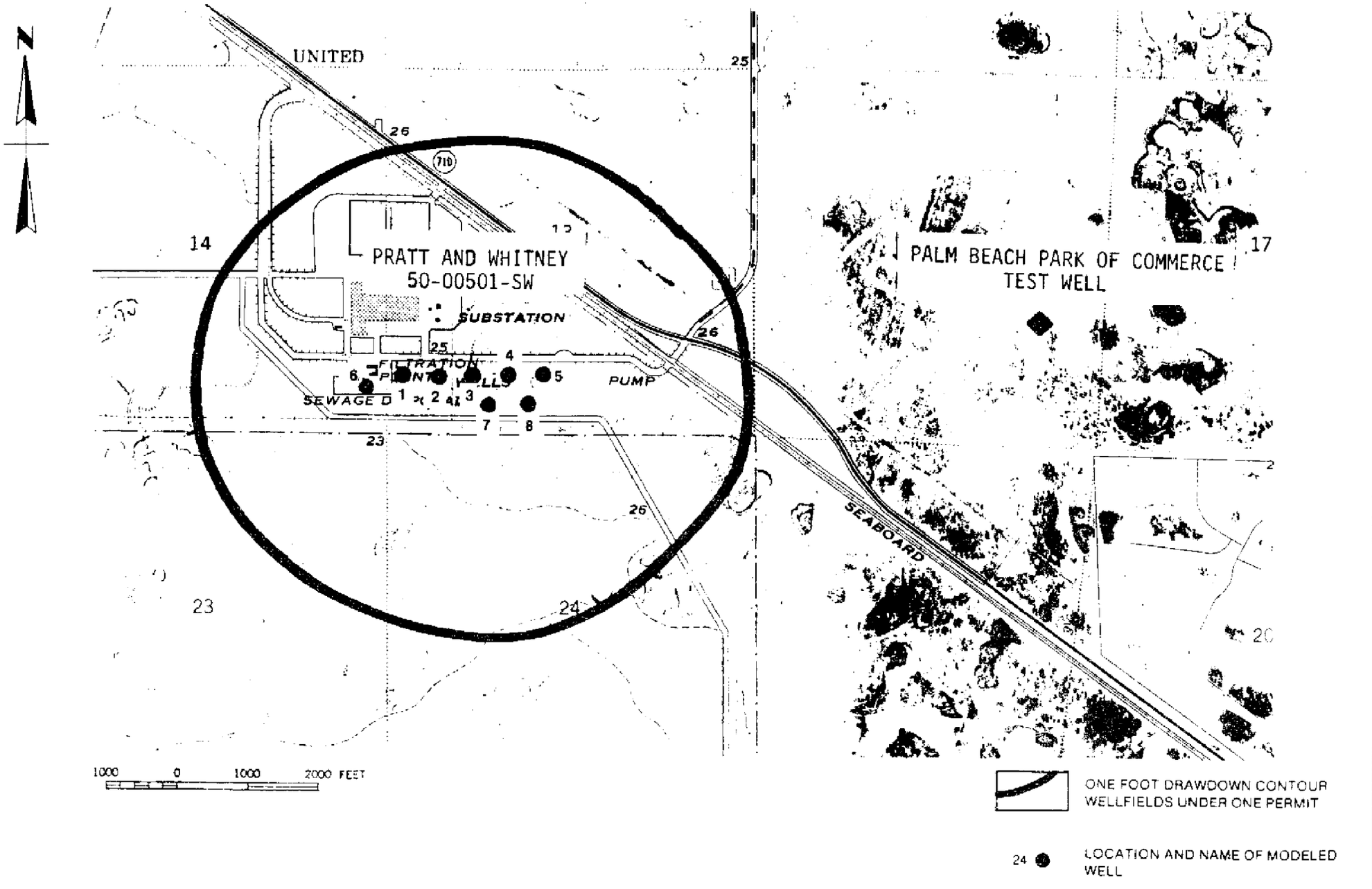


**Figure 18 ONE FOOT DRAWDOWN; PRATT AND WHITNEY AIRCRAFT DIVISION OF UNITED TECHNOLOGIES (Generated September, 1986)**

PRATT AND WHITNEY
50-00501-SW

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 36000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.00 | 13.00 | 366250.00 | WELL 1 |
| 13.00 | 13.00 | 366250.00 | WELL 2 |
| 11.50 | 13.00 | 366250.00 | WELL 3 |
| 12.00 | 13.00 | 366250.00 | WELL 4 |
| 12.50 | 13.00 | 366250.00 | WELL 5 |
| 10.50 | 12.80 | 366250.00 | WELL 6 |
| 12.25 | 12.60 | 366250.00 | WELL 7 |
| 12.80 | 12.60 | 366250.00 | WELL 8 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00506-W

PERMIT NAME: Town of Manalapan

ALLOCATION: 437 Million Gallons Per Year
(1.20 Million Gallons Per Day)

NUMBER OF WELLS: 10

MODELED DAILY PUMPAGE PER WELL: 120,000 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Lake Worth

AQUIFER: Surficial
*T = 373,772 GPD/FT
Sy = 0.2 (assumed for shallow, unconfined aquifer)

REFERENCES:
*Don Padgett, Neuman analysis of drawdown data recorded October 1982 at Town of Manalapan Well #12 pump test, as found in Water Use Permit File #50-00506-W, South Florida Water Management District, West Palm Beach, Florida.

COMMENTS:
The transmissivity value of 373,772 GPD/FT was derived from data acquired October, 1982 during a 7 hour, continuous drawdown pump test performed on Town of Manalapan Well #12 by Barker, Osha & Anderson, Inc. Don Padgett, SFWMD, analyzed early time drawdown data from Test Well #1 using log-log plots and Neuman type curves for an unconfined aquifer system. The resulting transmissivity value was far lower than that derived by Barker, Osha & Anderson, Inc., but was very reasonable when compared to specific capacities of wells in both the Town of Lantana and Town of Manalapan wellfields. The large discrepancy in transmissivity values may be due to the curve matching techniques used by Barker, Osha & Anderson, Inc.

A drawdown model incorporating both the Town of Lantana and the Town of Manalapan wellfields was run in an attempt to simulate the combined effects of drawdown from these wellfields.

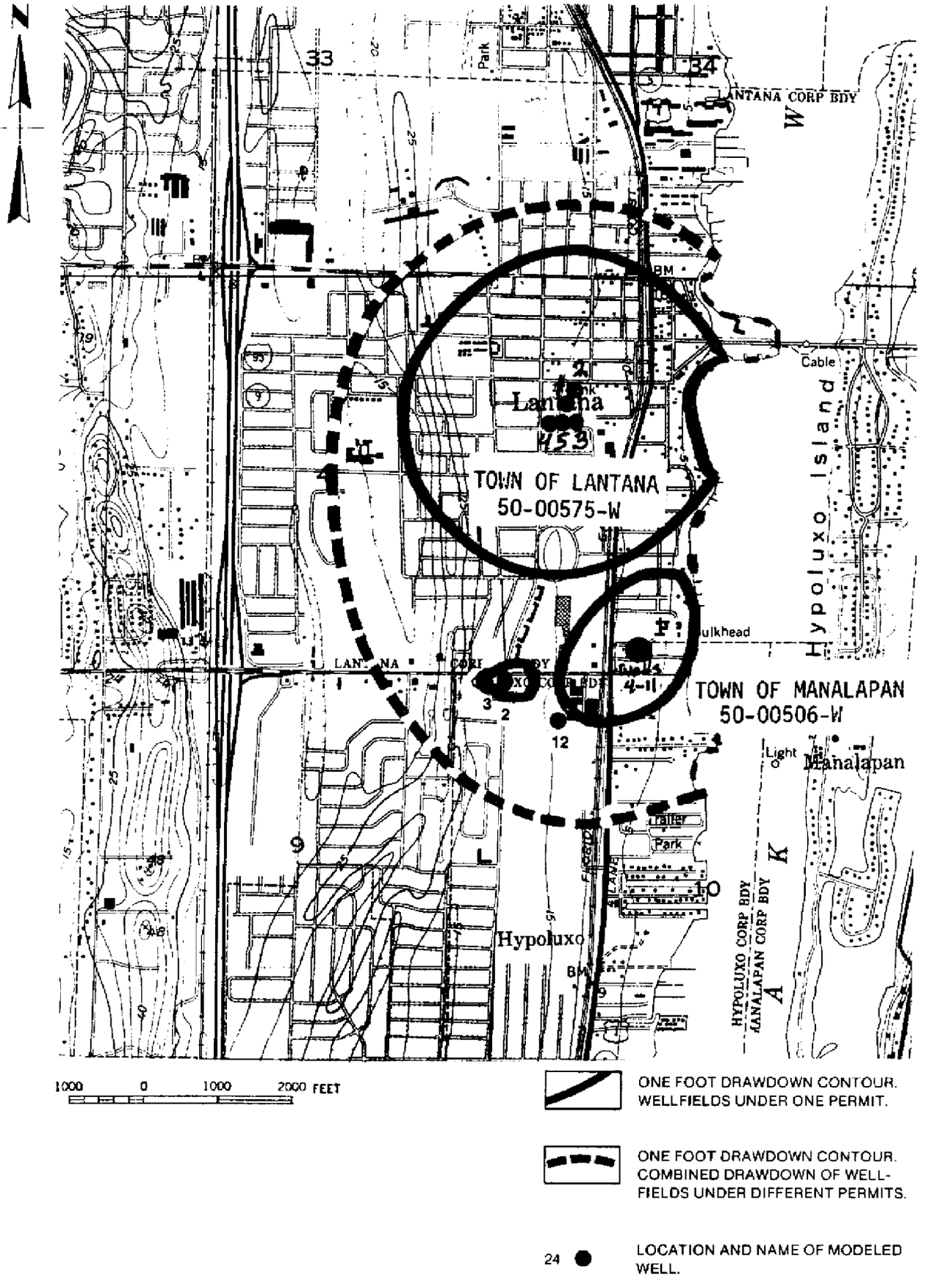


**Figure 19 ONE FOOT DRAWDOWN; TOWN OF MANALAPAN (Generated September, 1986)**

TOWN OF MANALAPAN
50-00506-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 373772.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.20 | 11.00 | 120000.00 | WELL MA2 |
| 10.95 | 11.00 | 120000.00 | WELL MA3 |
| 13.00 | 11.50 | 840000.00 | WELLS MA4-MA11 |
| 11.95 | 10.50 | 120000.00 | WELL MA12 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00511-W

PERMIT NAME: Palm Beach County Water Utilities, (System #3)

ALLOCATION: 1.559 Billion Gallons Per Year
(4.271 Million Gallons Per Day)

NUMBER OF WELLS: 7

MODELED DAILY PUMPAGE PER WELL: 610,143 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: University Park

AQUIFER: Surficial (Biscayne)
*T = 500,000 GPD/FT
Sy = 0.2 (assumed for a shallow, unconfined aquifer)

REFERENCES:
*Unknown author, *Hydrologic Report, Palm Beach County Utilities, System 3,* Consultant Report, Palm Beach Co., C#130, November, 1982, Environmental Sciences and Engineering, Inc., Gainesville, Florida, p. 9-18.

COMMENTS:
Transmissivities were derived from a 72 hour continuous-rate pump test performed on production well #6. Production well #6 is located less than 200' from Canal L-30. The transmissivity value of 500,000 GPD/FT was derived analytically using the Theis method to analyze drawdown data gathered from the piezometer closest to well #6.

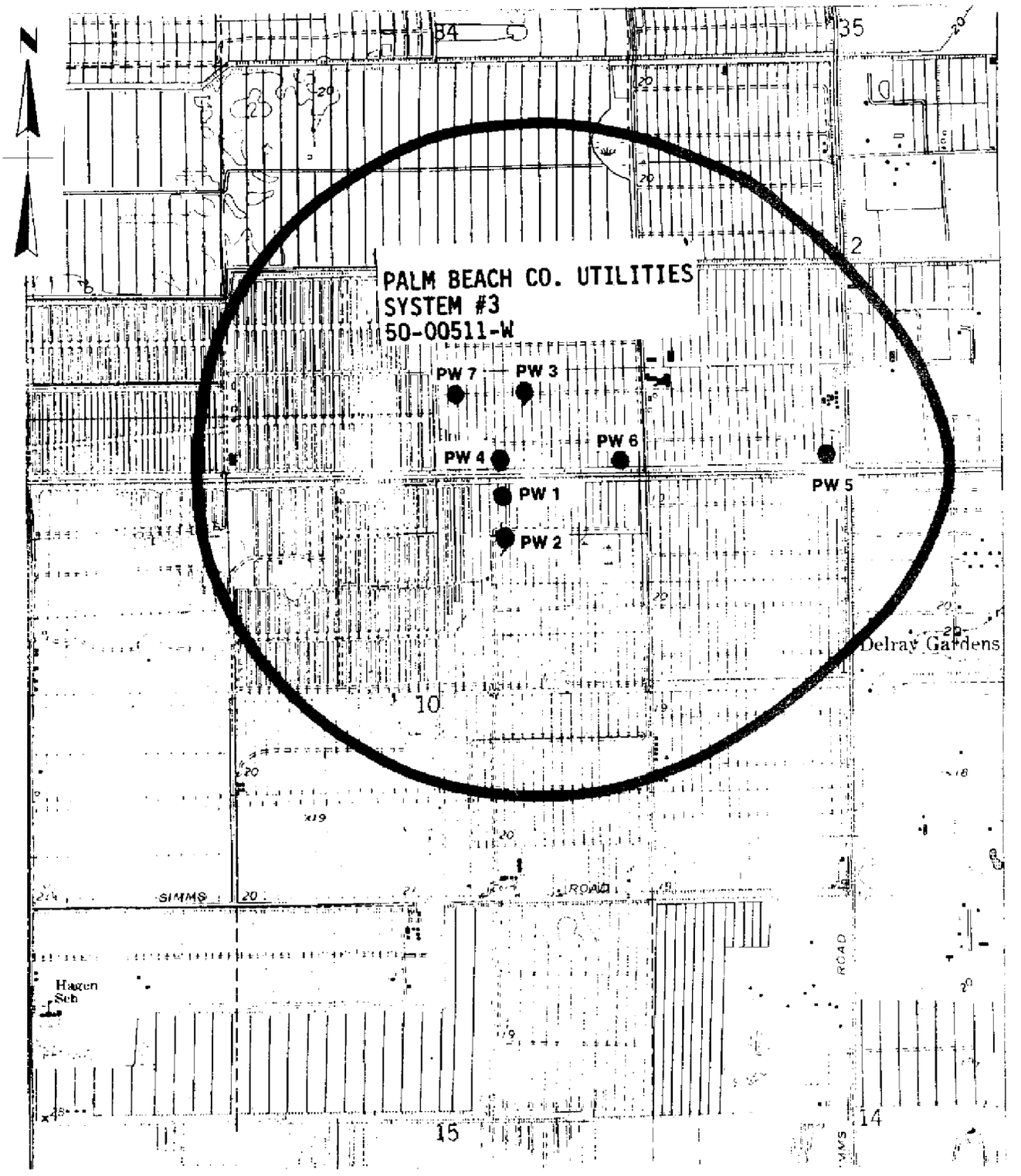


**Figure 20 ONE FOOT DRAWDOWN; PALM BEACH COUNTY WATER UTILITIES (SYSTEM #3) (Generated September, 1986)**

PALM BEACH CO. UTILITIES
SYSTEM #3
50-00511-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 500000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 12.00 | 12.50 | 610143.00 | PW 1 |
| 12.00 | 12.00 | 610143.00 | PW 2 |
| 12.30 | 13.85 | 610143.00 | PW 3 |
| 12.00 | 13.00 | 610143.00 | PW 4 |
| 16.15 | 13.00 | 610143.00 | PW 5 |
| 13.50 | 13.00 | 610143.00 | PW 6 |
| 11.40 | 13.80 | 610143.00 | PW 7 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00562-W

PERMIT NAME: Meadowbrook Utility System

ALLOCATION: 624 Million Gallons Per Year
(1.71 Million Gallons Per Day)

NUMBER OF WELLS: 2

MODELED DAILY PUMPAGE PER WELL: 855,000 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Palm Beach Farms

AQUIFER: Surficial (Turnpike)
T = 800,000 GPD/FT.
Sy = 0.2

COMMENTS:
Transmissivity and storativity values were assumed for a surficial, unconfined aquifer with a high percentage of secondary, effective porosity development.

The closest APT was performed on well #10 of Palm Beach County Utilities Water Treatment Plant #8. This well is located 1,600 feet to the northwest of Meadowbrook Utilities Production Well #1. The APT performed on well #10 yielded transmissivity values ranging from 1.4 MGPD/ FT to 3.8 MGPD/FT (see Wellfield Summary Sheet for Permit #50-00135-W). As these transmissivity values were the highest determined for the Surficial Aquifer System in Palm Beach County, a more conservative transmissivity value of 800,000 GPD/FT was used to model the drawdown of Meadowbrook Utilities Wellfield.

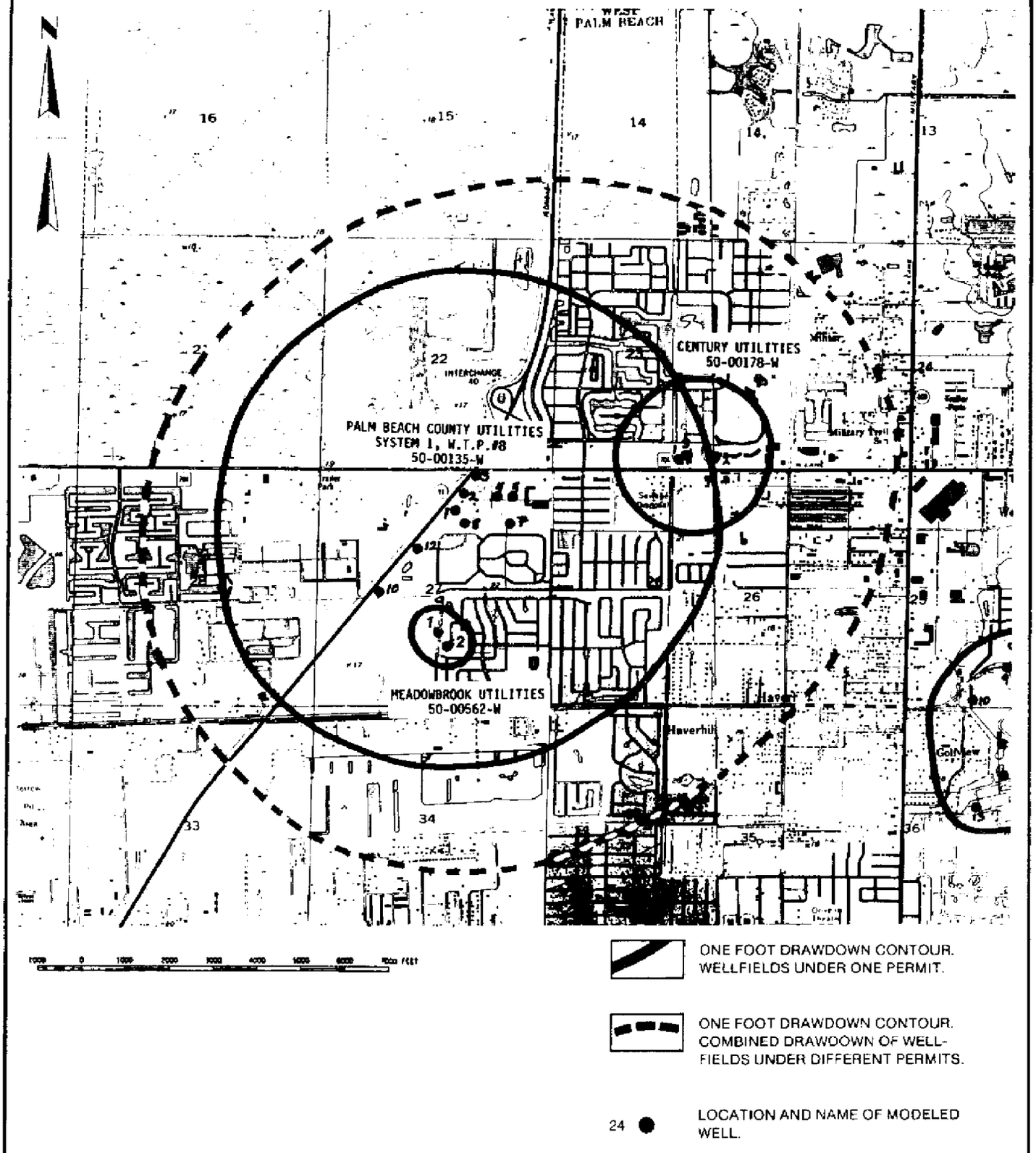


**Figure 21 ONE FOOT DRAWDOWN; MEADOWBROOK UTILITIES**
**(Generated September, 1986)**

MEADOWBROOK UTILITIES
50-00562-W

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 800000.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 100.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.35 | 9.05 | 855000.00 | WELL 1 |
| 11.60 | 8.85 | 855000.00 | WELL 2 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

## PALM BEACH COUNTY

PERMIT #: 50-00575-W

PERMIT NAME: Town of Lantana

ALLOCATION: 695.19 Million Gallons Per Year
(1.90 Million Gallons Per Day)

NUMBER OF WELLS: 5

MODELED DAILY PUMPAGE PER WELL: 381,000 Gallons Per Day Per Well

U.S.G.S. QUADRANGLE: Lake Worth

AQUIFER: Surficial
*T = 373,772 GPD/FT
Sy = 0.2 (assumed for a shallow, unconfined aquifer)

REFERENCES:
*Don Padgett, Neuman analysis of drawdown data recorded October 1982 at Town of Manalapan Well #12 pump test, as found in Water Use Permit File #50-00506-W, South Florida Water Management District, West Palm Beach, Florida.

COMMENTS:
The transmissivity value of 373,772 GPD/FT was derived from data acquired October, 1982 during a 7 hour, continuous drawdown pump test performed on Town of Manalapan Well #12 by Barker, Osha & Anderson, Inc. Don Padgett, SFWMD, analyzed early time drawdown data from Test well #1 using log-log plots and Neuman type curves for an unconfined aquifer system. The resulting transmissivity value was far lower than that derived by Barker, Osha & Anderson, Inc., but was very reasonable when compared to specific capacities of wells in both the Town of Lantana and Town of Manalapan wellfields. The large discrepancy in transmissivity values may be due to the curve matching techniques used by Barker, Osha & Anderson, Inc.

A drawdown model incorporating both the Town of Lantana and the Town of Manalapan wellfields was run in an attempt to simulate the combined effects of drawdown from these wellfields.

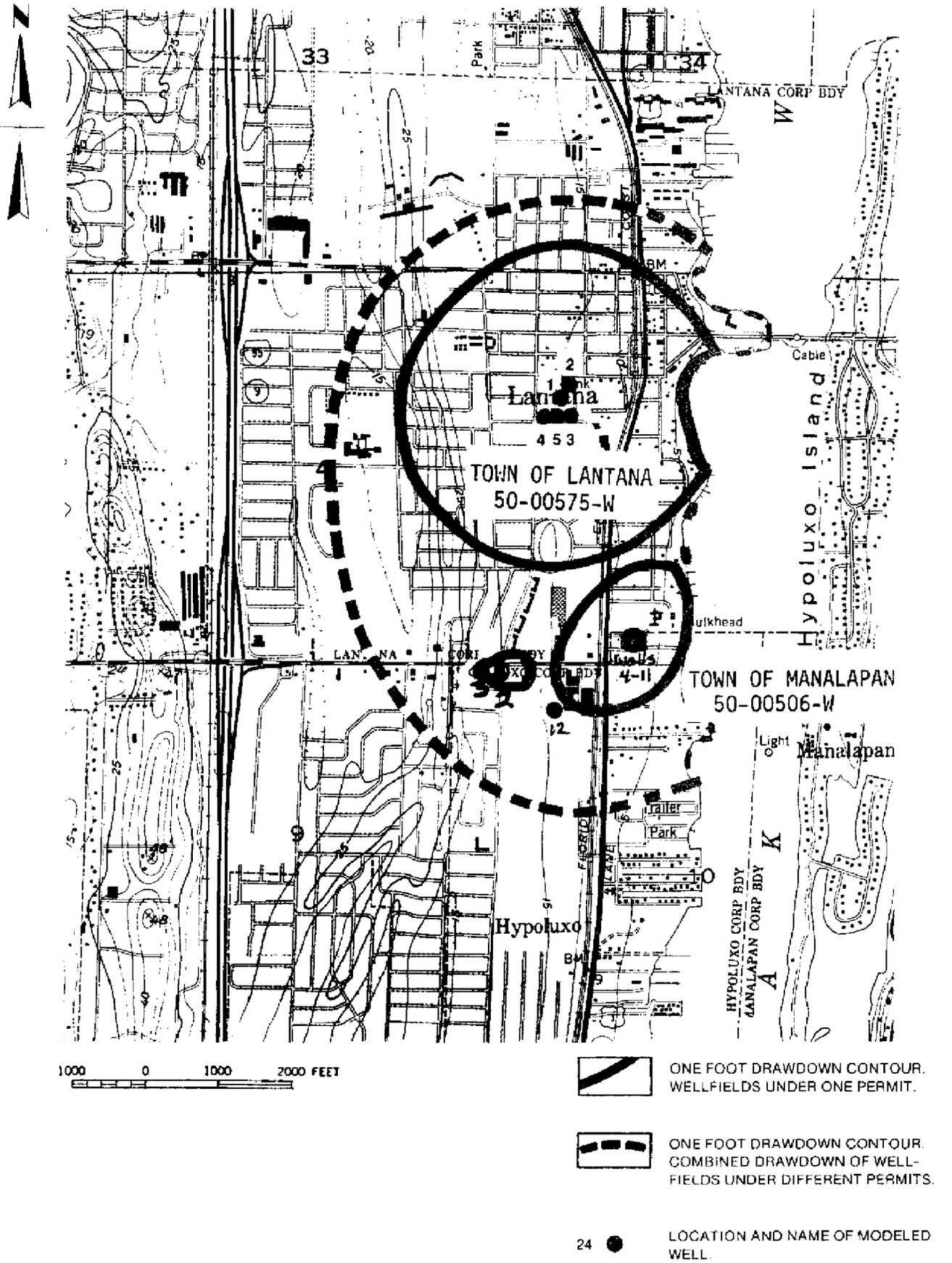


**Figure 22 ONE FOOT DRAWDOWN; TOWN OF LANTANA (Generated September, 1986)**

TOWN OF LANTANA
50-00575

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 373772.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.90 | 14.80 | 380000.00 | WELL LA1 |
| 12.00 | 15.00 | 380000.00 | WELL LA2 |
| 12.05 | 14.55 | 380000.00 | WELL LA3 |
| 11.65 | 14.55 | 380000.00 | WELL LA4 |
| 11.85 | 14.55 | 380000.00 | WELL LA5 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

COMBINED DRAWDOWN

TOWN OF LANTANA
50-00575

TOWN OF MANALAPAN
50-00506

SUMMARY OF INPUT DATA
NON-EQUILIBRIUM (THEIS) MODEL

TRANSMISSIVITY = 373772.

STORAGE COEFFICIENT = .20000000

TIME (DAYS) = 100.0000

NODE SPACING = 1000.00

WELL DESCRIPTIONS

| X-LOCATION | Y-LOCATION | Q(GPD) | WELL NAME |
|---|---|---|---|
| 11.90 | 14.80 | 380000.00 | WELL LA1 |
| 12.00 | 15.00 | 380000.00 | WELL LA2 |
| 12.05 | 14.55 | 380000.00 | WELL LA3 |
| 11.65 | 14.55 | 380000.00 | WELL LA4 |
| 11.85 | 14.55 | 380000.00 | WELL LA5 |
| 11.20 | 11.00 | 120000.00 | WELL MA2 |
| 10.95 | 11.00 | 120000.00 | WELL MA3 |
| 13.00 | 11.50 | 840000.00 | MA4-MA11 |
| 11.95 | 10.50 | 120000.00 | WELL MA12 |

--DISPLAY DRAWDOWNS ARE ACTUAL DRAWDOWN VALUES--

--ROUNDED UP ON 5 AND DOWN ON 4--

# APPENDIX II

# THEIS PROGRAM DOCUMENTATION

WATER USE DIVISION
USER DOCUMENTATION

PROGRAM: THEIS ACCOUNT: WULIB
DATE: March 21, 1986

## DESCRIPTION OF MODEL

The THEIS uniform properties analytical drawdown model calculates drawdown as a result of discharge from an aquifer. More than one discharge can be included, in which case the cumulative drawdown is determined by the superposition of individual drawdowns. The drawdown values calculated represent distance, in feet, of the final potentiometric surface below or above an initial surface with a uniform value of zero, and each value represents the drawdown at the specified nodal location.

Input to the model comprises appropriate aquifer properties, grid description, output display options, and location and volume of discharges or recharges. The model output is a printout of drawdown values for the specified grid, with the drawdown values printed in a display format of 1/2 inch internodal spacing. Also included in the output is a summary of input parameters, listed as a separate page or pages, in a format which facilitates inclusion in staff reports.

The working equation for the model is the Theis non-equilibrium flow equation (contemporary reference: Walton, W.C., 'Groundwater Resource Evaluation', 1970, page 147, equations 3.47 and 3.48). It is assumed that all discharged water is derived from storage with no recharge, and that all discharging wells are fully penetrating with no casing storage. The radial distance between a discharge point and each of the nodal points is calculated and the working equation is solved.

## INPUT DESCRIPTION

The following are input requirements for the THEIS model:

GRID SIZE: The length of the grid in the x-direction is fixed at 25 nodes, this size being a constraint of the width of printout paper. the number of nodes in the y-direction is variable between 1 and 75 and is selected by the user.

DISPLAY OPTION 1: Drawdown values can be displayed on output with either 1 (enter '1') or 2 (enter '2') digits to the right of the decimal point.

DISPLAY OPTION 2: Drawdown values can be displayed as actual values (enter '1') or as one-tenth of actual values (enter '2').

TRANSMISSIVITY, in gallons per day per foot.

STORAGE COEFFICIENT.

TIME, as number of days since discharge began.

NODAL SPACING, as feet between nodal points along axis lines.

DISCHARGE LOCATION AND RATE: the x and y coordinate location and the discharge (or recharge) rate in gallons per day are entered. The location can be directly on a nodal point or in any internodal area. When an on-node location is specified for the purpose of calculating drawdown in a well, a well diameter of one foot is assumed. To finish program execution, the values '0,0,0' are entered.

## PROGRAM EXECUTION OPTIONS

Three options for program execution are available:

1. INTERACTIVE MODE WITH USER INPUT: When executing under this option, the program prompts the user for required input items on the terminal screen, which the user enters on the terminal keyboard.

2. INTERACTIVE MODE WITH USER-SUPPLIED DATA FILE: With this option, the user combines the program with a perviously created data file, containing the required data items. The program then executes interactively, displaying the input item prompts and obtaining the corresponding input items from the data file.

3. BATCH MODE WITH USER-SUPPLIED DATA FILE: Under this option, the program and data file are routed for execution in batch mode. This option is recommended for simulations containing more than five wells, in order to minimize terminal use time.

## RUNNING THE PROGRAM

To utilize the THEIS model, sign on in your account, and type the entry:

```
get,procfil/un=wulib
```

To run the model in direct interactive mode, type the entry

```
-theis
```

To run the model interactively with a data file, type the entry

```
-theis,,dfn
```

where dfn represents the actual name of the data file

To route the model and a data file for execution in batch mode, type the entry

```
-remotel
```

This executes an interactive program which queries the user for the type of uniform properties model to execute, and the input data file to be used, then routes the model and data file for batch-mode execution.

When the model is run in either of the interactive modes, program output may be routed to the terminal screen, to the local line printer if the terminal is so equipped, or to the central line printer in data processing. To route the output to the terminal or local line printer, type the entry

```
-screen
```

To route the output to the central line printer, type the entry

```
-printer
```

If you want both local output and a printout from the central line printer, do the local routing first; once the output is routed to the central printer, it is no longer available locally.

## SAVING OUTPUT FROM THE MODEL

There may be occasions where the user wishes to retain a permanent file containg the model output. To save the output in your account, type the entries

```
rewind,*
replace,gg=pfn
```

where pfn represents the actual file name in which the output is to be saved. The output file will still be available locally for routing.

## Example of Using the THEIS Drawdown Model

```
get,procfil/un=wulib


-theis

 NUMBER OF NODES IN  X  DIRECTION
 IS FIXED AT  25 . NUMBER OF NODES
 IN  Y  DIRECTION IS VARIABLE
 FROM  1  TO  75 .


 ORIGIN OF GRID SYSTEM IS LOCATED
 AT THE LOWER LEFT HAND CORNER.


 HOW MANY NODES ARE REQUIRED IN THE  Y  DIRECTION
  (ENTER VALUE FROM 1 TO 75).
? 25
```

(The user selects 25 nodes in the y-direction)

```
 HOW MANY DIGITS ARE REQUIRED TO THE
 RIGHT OF DECIMAL (ENTER 1 OR 2).
? 1
```

(The user selects a '99.9' print format)

```
 DISPLAY ACTUAL DRAWDOWNS (ENTER 1) OR
 ONE TENTH ACTUAL DRAWDOWNS (ENTER 2)
? 1

 ENTER TRANSMISSIVITY (GPD/FT) :
? 100000

 ENTER STORAGE COEFFICIENT :
? .2

 ENTER TIME OF PUMPING (DAYS) :
? 120

 ENTER NODE SPACING (FEET) :
? 1000

 ENTER XY COORD AND POSITIVE OR NEGATIVE
 PUMPING RATE (X,Y,GPD).
? 12.5,12.5,150000
```

(The user locates a well 12500 feet in the x-direction and 12500 feet in the y-direction from the origin, withdrawing at 150000 gallons per day)

```
 IF THERE ARE NO MORE PUMPING NODES ENTER 0,0,0
 ENTER XY COORD AND POSITIVE OR NEGATIVE
 PUMPING RATE (X,Y,GPD).
? 12.5,13.5,100000
```

(The user locates a second well 12500 feet in the x-direction and 13500 feet in the y-direction from the origin, withdrawing at 100000 gallons per day)

```
 IF THERE ARE NO MORE PUMPING NODES ENTER 0,0,0
 ENTER XY COORD AND POSITIVE OR NEGATIVE
 PUMPING RATE (X,Y,GPD).
? 0,0,0
```

(The user stops program execution by entering three seroes)

```
TO SEND OUTPUT TO SCREEN AND LOCAL LINE PRINTER,
TURN ON LINE PRINTER AND ENTER --- BEGIN,SCREEN---


TO SEND OUTPUT TO CENTRAL LINE PRINTER ENTER ---BEGIN,PRINTER---


REVERT.
```

# APPENDIX III

# FORMATTED INPUT DATA FILE

```
25                          # of grid nodes in the "Y" direction
2                           # of digits to the right of the decimal
1                           display one tenth (2) or actual (1) drawdowns
500000                      transmisstvity (gpd/ft)
.2                          storativity
100                         # of days pumping
1000                        node spacing (feet)
12,12.5,610143              (X,Y) coordinates and pumping rate (gpd)
12,12,610143                          .
12.3,13.85,610143                     .
12,13,610143                          .
16.15,13,610143                       .
13.5,13,610143                        .
11.4,13.8,610143                      .
0,0,0                       signals end of data
```