Memorandum

(Second Reading 09-12-06)

Date: May 9, 2006

Agenda Item No. 7(D)

To: Honorable Chairman Joe A. Martinez
and Members, Board of County Commissioners

From: George M. Burgess
County Manager

Subject: Ordinance Creating Wellfield Protection Zones for the South Miami Heights Wellfield Complex; Amending Sections 24-5 of the Code of Miami-Dade County, Florida, Providing Definitions; Amending Section 24-18 Relating to Operating Permits; Amending Section 24-43 Relating to Protection of Public Potable Water Supply Wells; Amending Section 24-43.1 relating to Liquid Waste Disposal and Potable Water Supply Systems

RECOMMENDATION

It is recommended that the Board approve the attached ordinance amending Sections 24-5 of the Code of Miami-Dade County, Florida (Code), providing definitions; amending Section 24-18 relating to operating permits; amending Section 24-43 relating to protection of public potable water supply wells; and amending Section 24-43.1 relating to liquid waste disposal and potable water supply systems. The changes to these sections of the Code provide for inclusion of the new wellfield protection zones for the proposed South Miami Heights Wellfield Complex.

BACKGROUND

Miami-Dade County is proposing to establish wellfield protection zones for four (4) new drinking water wellfields to serve as raw water supplies for the future South Miami Heights water treatment facility by amending Chapter 24 of the Code. The proposed amendments will incorporate a map which establishes wellfield protection zones and respective land use restrictions in a manner which is consistent with other wellfield protection programs currently existing in the Code.

The Miami-Dade Water and Sewer Department (WASD) plans to start the construction of a new potable water treatment plant at SW 212th Street and SW 117th Avenue in Miami-Dade County. The untreated raw water which will be processed at this new water treatment facility will be supplied from groundwater production wells which will be drilled into the Biscayne Aquifer at four (4) locations in the South Miami Heights area. These new wellfields are to be located in three (3) existing Miami-Dade County parks: Roberta Hunter Park, Caribbean Park, and Rockpit 77 Park. The fourth wellfield will be located at the South Miami Heights water treatment plant property at 11495 SW 190th Terrace Road. This group of four (4) wellfields shall be known as the South Miami Heights Wellfield Complex and, by adoption of this ordinance, will be incorporated into the County's wellfield protection program. Initially these wells will replace supplies currently coming from other older wells in the region. It is likely that some of the planned capacity of this new treatment plant will be for treatment of water from the Floridan Aquifer, a brackish aquifer below the Biscayne Aquifer. It is also possible that some amount of Biscayne Aquifer water will be treated and stored in the Floridan Aquifer during the wet season for retrieval

and use in the dry season. The details of these options will be addressed in the consumptive use permit application over the next eighteen months. This wellfield protection program provides a level of protection to the raw water of this future drinking water treatment plant and it is important to provide this protection for future water use options.

The wellfield protection area boundary map which is incorporated by reference in this ordinance was developed utilizing the MODFLOW-96 computer model. Both the wellfield protection area boundary map and technical report entitled "Development of a Groundwater Model to Determine Wellfield Protection Zones for the Miami-Dade County's South Miami Heights Wellfield Complex (November 2005)", are attached hereto (Attachments A and B) and are incorporated in the ordinance by reference.

The MODFLOW-96 computer model as well as the raw input field data used to create the attached wellfield boundary map have been compiled on a compact disc (CD) and will be maintained on file in read-only format as a public record in the Office of the Clerk and in the Office of the Director of the Department of Environmental Resources Management.

FISCAL IMPACT

This ordinance will have no fiscal impact.

4/28/06
Assistant County Manager

MEMORANDUM

(Revised)

TO: Honorable Chairman Joe A. Martinez and Members, Board of County Commissioners

DATE: September 12, 2006

FROM: Murray A. Greenberg
County Attorney

SUBJECT: Agenda Item No. 7(D)

Please note any items checked.

_____ **"4-Day Rule" ("3-Day Rule" for committees) applicable if raised**

_____ **6 weeks required between first reading and public hearing**

_____ **4 weeks notification to municipal officials required prior to public hearing**

_____ **Decreases revenues or increases expenditures without balancing budget**

_____ **Budget required**

_____ **Statement of fiscal impact required**

_____ **Bid waiver requiring County Manager's written recommendation**

_____ **Ordinance creating a new board requires detailed County Manager's report for public hearing**

_____ **Housekeeping item (no policy decision required)**

_____ **No committee review**

Approved _____ Mayor

Veto _____

Override _____

Agenda Item No. 7(D)

09-12-06

ORDINANCE NO. _____

ORDINANCE CREATING WELLFIELD PROTECTION ZONES FOR THE SOUTH MIAMI HEIGHTS WELLFIELD COMPLEX; AMENDING SECTION 24-5 OF THE CODE OF MIAMI-DADE COUNTY, FLORIDA, PROVIDING DEFINITIONS; AMENDING SECTION 24-18, OF THE CODE OF MIAMI-DADE COUNTY, FLORIDA, RELATING TO OPERATING PERMITS; AMENDING SECTION 24-43 OF THE CODE OF MIAMI-DADE COUNTY, FLORIDA, RELATING TO PROTECTION OF PUBLIC POTABLE WATER SUPPLY WELLS; AMENDING SECTION 24-43.1 OF THE CODE OF MIAMI-DADE COUNTY, FLORIDA, RELATING TO LIQUID WASTE STORAGE AND DISPOSAL METHODS AND POTABLE WATER SUPPLY SYSTEMS; PROVIDING SEVERABILITY, INCLUSION IN AND EXCLUSION FROM THE CODE, AND AN EFFECTIVE DATE

BE IT ORDAINED BY THE BOARD OF COUNTY COMMISSIONERS OF MIAMI-DADE COUNTY, FLORIDA:

Section 1. Section 24-5 of the Code of Miami-Dade County, relating to definitions, is hereby amended as follows:[1]

Sec. 24-5. Definitions.

In construing the provisions of this chapter, where the context will permit and no definition is provided herein, the definitions provided in Chapter 403, Florida Statutes, as may be amended from time to time, and in rules and regulations promulgated thereunder, as may be amended from time to time, shall apply. The following words and phrases when used in this chapter shall have the meanings ascribed to them in this section:

1990 Urban Development Boundary shall mean the line established by the Miami-Dade County Board of County Commissioners on July 8, 1983 by Ordinance 83-

[1] Words stricken through and/or [[double bracketed]] shall be deleted. Underscored words and/or >>double arrowed<< constitute the amendment proposed. Remaining provisions are now in effect and shall remain unchanged.

58 delineating the approved urban development boundary for Miami-Dade County, as amended by ordinance from time to time.

* * *

>>*Outer wellfield protection zone* shall mean the maximum extent of area protected by the wellfield protection provisions set forth in Chapter 24 of the Code of Miami-Dade County, Florida, for one wellfield or if a wellfield complex exists, the maximum extent of area protected by the wellfield protection provisions set forth in Chapter 24 of the Code of Miami-Dade County, Florida, as set forth in the wellfield protection maps adopted by the Board of County Commissioners.<<

* * *

>> *South Miami Heights Wellfield Complex* shall mean the following wellfields: South Miami Heights, Roberta Hunter Park, Caribbean Park and Rockpit 77 Park wellfields. <<

* * *

>>*Wellfield complex* shall mean two or more wellfields which: a.) provide raw water to the same water treatment facility or provide raw water to interconnected water treatment facilities for treatment of raw water from the same wellfield and, b.) which wellfields are within the same outer wellfield protection zone.<<

* * *

Section 2. Section 24-18 of the Code of Miami-Dade County, relating to operating permits, is hereby amended as follows:

Sec. 24-18. Operating permits.

(A) *Permit Required* No person shall operate, maintain or permit, cause, allow, let or suffer the operation or maintenance of a public water system, public sewerage system, location at which a site rehabilitation action has been completed in accordance with the provisions set forth in Section 24-44(2)(k)(ii) or any of the following facilities, all of which will reasonably be expected to be a source of air pollution, ground pollution or water pollution, without a valid operating permit issued by the Director or the Director's designee or in violation of any condition, limitation or restriction which is part of an operating permit:

(1) Interim package sewage treatment plants;

(2) Interim package water treatment plants;

(3) Private sewage pumping station;

* * *

(6) Notwithstanding any provision of this Code, nonresidential land uses which are served or will be served by any liquid waste storage, disposal or treatment method (other than public sanitary sewers) or those

nonresidential land uses which use, generate, handle, dispose of, discharge or store hazardous materials, on any portion of the property within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield >>,<< [[~~or~~]] Hialeah Wellfield >>or within the outer protection zone of the South Miami Heights Wellfield Complex.<<;

* * *

Section 3. Section 24-43 of the Code of Miami-Dade County, relating to protection of public potable water supply wells, is hereby amended as follows:

Sec. 24-43. Protection of public potable water supply wells.

The provisions of this section which impose upon land uses within the West Wellfield Interim protection area regulations which are more restrictive than those regulations applicable to the other public utility potable water supply wellfields in Miami-Dade County shall be deemed interim in nature. Said more restrictive regulations shall be reviewed by such technical review task force(s) or committee(s) as provided by the Board of County Commissioners or its designee upon recommendation of the Director. The Director shall submit to the Board of County Commissioners progress reports, as necessary, pertaining to said review, and recommendations necessary to protect the public health, safety and welfare arising out of said review shall be presented to the Board of County Commissioners. The Miami-Dade County Conflict of Interest and Code of Ethics Ordinance (Section 2-11.1 of this Code) shall not be applicable to task forces or committees provided for in this section.

(1) *Legislative intent.* The intent and purpose of this section is to safeguard the public health, safety and welfare by providing scientifically established standards for land uses within the cones of influence thereby protecting public potable water supply wells from contamination.

(2) *Short title; applicability; construction.* This section shall be known as the "Potable Water Supply Well Protection Ordinance." The provisions of this section shall be effective in the incorporated and unincorporated areas of Miami-Dade County and shall be liberally construed to effect the purposes set forth herein.

(3) *Maps of cones of influence, the Northwest Wellfield protection area,* [[~~*and*~~]] *the West Wellfield Interim protection area>>,and the South Miami Heights Wellfield Complex protection area*<<. The Director of the Department of Environmental Resources Management or his designee, shall maintain maps of cones of influence of public utility potable water supply wells, map(s) of the Northwest Wellfield protection area, [[~~and~~]] map(s) of the West Wellfield Interim protection area >>,and the map(s) of

the South Miami Heights Wellfield Complex wellfield protection area dated November, 2005<<. The cone of influence maps dated December 30, 1980, as may be amended from time to time, prepared by the Department of Environmental Resources Management are incorporated herein by reference hereto. Any changes, additions or deletions to said maps shall be approved by the Board of County Commissioners by ordinance. The cone of influence maps of the Northwest Wellfield dated December 30, 1980, as amended effective May 31, 1985, shall hereinafter be referred to as the Northwest Wellfield protection area map(s). The Northwest Wellfield protection area map(s) dated May 31, 1985, [[~~and~~]] the West Wellfield Interim protection area map(s) dated February 28, 1989 >>and the map(s) of the South Miami Heights Wellfield Complex wellfield protection area dated November, 2005,<<, as all of same may be amended from time to time, prepared by the Department of Environmental Resources Management, are incorporated herein by reference hereto. Any changes, additions or deletions to said Northwest Wellfield protection area map(s) >> , << [[~~or~~]] West Wellfield Interim protection area map(s) >>or South Miami Heights Wellfield Complex wellfield protection area map(s)<< shall be approved by the Board of County Commissioners by ordinance. >> The Director, or the Director's designee, shall maintain the DERM Technical Report: "Development of a Groundwater Model to Determine Wellfield Protection Zones for the Miami-Dade County, Florida, South Miami Heights Wellfield Complex". The wellfield protection zones of the South Miami Heights Wellfield Complex have been established using the procedures and input parameters set forth in the aforesaid Technical Report dated, November, 2005. The aforesaid Technical Report dated, November, 2005, a copy of which is attached hereto, is hereby incorporated by reference, as same may be amended from time to time. Any changes, additions or deletions to the aforesaid Technical Report dated November, 2005 shall be approved by the Board of County Commissioners by ordinance. <<

(4) *Septic tanks, sanitary sewers, storm water disposal, liquid waste storage, disposal or treatment and violations of this chapter within wellfield protection area.* Notwithstanding any provisions of this Code, no County or municipal officer, agent, employee or Board shall approve, grant or issue any building permit, certificate of use and occupancy (except for changes in ownership), municipal occupational license (except for changes in ownership), platting action (final plat, waiver of plat or equivalent municipal platting action) or zoning action (district boundary change, unusual use, use variance or equivalent municipal zoning action) for any land use served or to be served by a septic tank, sanitary sewer, storm water disposal method, or liquid waste storage, disposal or treatment method, and which is within the Northwest Wellfield protection area or within the West Wellfield Interim protection area >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex<< or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest

Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield or within the basic wellfield protection area of any public utility potable water supply well, until the County or municipal officer, agent, employee or Board has obtained the prior written approval of the Director of the Department of Environmental Resources Management or his designee. Furthermore, not withstanding any provision of this Code, no person shall construct, utilize, operate, occupy or cause, allow, let, permit or suffer to be constructed, utilized, operated or occupied any land use served or to be served by septic tank, sanitary sewer, storm water disposal method, or liquid waste storage, disposal or treatment method, and which is within the Northwest Wellfield protection area or within the West Wellfield Interim protection area >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex<< or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield or within the basic wellfield protection area of any public utility potable water supply well, until the person has obtained the prior written approval of the Director of the Department of Environmental Resources Management or his designee. The Director or his designee shall issue his written approval only if he finds that all septic tanks, septic tank drain fields, storm water disposal methods and liquid waste storage, disposal or treatment methods will be installed upon the property as far away as is reasonably possible from all potable water supply wells, and:

(a) *Septic tanks.* That the septic tank sewage loadings will not exceed the number of gallons per day for each unsubmerged acre of land as set forth in Tables A-1, A-2, A-3 and A-4, except that neither the Director nor his designee shall issue his written approval for any land use served or to be served by a septic tank within the Northwest Wellfield protection area unless the septic tank was installed prior to September 30, 1983, or within the West Wellfield Interim protection area unless the septic tank was installed prior to the effective date of this ordinance [Ordinance No. 89-80] , or that the land use served or to be served by a septic tank within the Northwest Wellfield protection area or within that portion of the West Wellfield Interim protection area which is west of the Urban Development Boundary of the Comprehensive Development Master Plan as may be amended from time to time, is residential or is an ancillary rockmining use necessary for extracting and processing subsurface materials and which residential or ancillary rockmining use shall not exceed a maximum sewage loading of seventy (70) gallons per day per acre and which septic tanks shall be located within an area of twenty-one thousand seven hundred eighty (21,780) square feet of unsubmerged land, or that the property served or to be served by septic tanks is residential, uses a

public water supply, has not been the subject of any zoning action (district boundary change, unusual use, use variance, or equivalent municipal zoning action) or any platting action (final plat, waiver of plat, or equivalent municipal platting action) after March 13, 1981, and is in compliance with Section 24-43.1, or that the owner of the property served or to be served by septic tanks is applying for the original certificate of use and occupancy or original municipal occupational license pursuant to a valid building permit obtained prior to June 1, 1983, for property within the basic wellfield protection area of any public utility potable water supply well, or, in the case of property within the Northwest Wellfield protection area obtained prior to September 30, 1983, or, in the case of property within the West Wellfield Interim protection area obtained prior to the effective date of this ordinance [Ordinance No. 89-80] >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex obtained prior to the effective date of this ordinance<<, or, in the case of property not within the basic wellfield protection area but within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield and Southwest Wellfield, obtained prior to February 1, 1985, or, in the case of property not within the basic wellfield protection area but within the maximum day pumpage wellfield protection area of the Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield and Hialeah Wellfield, obtained prior to December 12, 1986, which permit has been valid and continuously in full force and effective since its issuance, or that the owner of the property is applying for a certificate of use and occupancy or municipal occupational license for a land use served or to be served by a septic tank installed prior to March 13, 1981 for property within the basic wellfield protection area of any public utility potable water supply well, or, in the case of property within the Northwest Wellfield protection area installed prior to September 30, 1983, or, in the case of property within the West Wellfield Interim protection area installed prior to the effective date of this ordinance [Ordinance No. 89-80] >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex obtained prior to the effective date of this ordinance<< or, in the case of property not within the basic wellfield protection area but within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, and Southwest Wellfield, installed prior to February 1, 1985, or, in the case of property not within the basic wellfield protection area but within the maximum day pumpage wellfield protection area of the Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield and Hialeah Wellfield, installed prior to December 12, 1986, which uses a public water supply and which is

in compliance with Section 24-43.1.

(i) Notwithstanding the provisions of Section 24-43(4)(a), there shall be required within the Northwest Wellfield protection area, within the West Wellfield Interim protection area, >>within the outer wellfield protection zone of the South Miami Heights Wellfield Complex,<< and within the maximum day wellfield protection area of all public utility potable water supply wells a minimum separation equivalent to ten (10) days travel time between any potable water supply well (other than a public utility potable water supply well) and any septic tank or septic tank drainfield.

(b) *Sanitary sewers.* That the sewage loading into sanitary sewers will not exceed the number of gallons per day for each unsubmerged acre of land as set forth in Table B-1, or that the property served or to be served by sanitary sewers is residential, uses a public water supply, has not been the subject of any zoning action (district boundary change, unusual use, use variance, or equivalent municipal zoning action) or any platting action (final plat, waiver of plat, or equivalent municipal platting action) after March 13, 1981, and is in compliance with Section 24-42.4, or that the owner of the property served or to be served by sanitary sewers is applying for the original certificate of use and occupancy or original municipal occupational license pursuant to a valid building permit obtained prior to June 1, 1983, for property within the basic wellfield protection area of any public utility protable water supply well, or, in the case of property within the Northwest Wellfield protection area, obtained prior to September 30, 1983, for property within the Northwest Wellfield protection area, or, in the case of property within the West Wellfield Interim protection area, obtained prior to the effective date of this ordinance, for property within the West Wellfield Interim protection area, >>or for property within the outer wellfield protection zone of the South Miami Heights Wellfield Complex obtained prior to the effective date of this ordinance,<< or, in the case of property not within the basic wellfield protection area, but within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield and Southwest Wellfield, obtained prior to February 1, 1985, or, in the case of property not within the basic wellfield protection area but within the maximum day pumpage wellfield protection area of the Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield and Hialeah Wellfield, installed prior to December 12, 1986, which permit has been valid and continuously in full force and effect since its issuance.

(i) Notwithstanding the provisions of Section 24-43(4)(b), all sanitary sewers installed within the Northwest Wellfield protection area, or within the West Wellfield Interim protection area, >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex,<< or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, or Hialeah Wellfield, or within the basic wellfield protection area of any public utility potable water supply well, after June 13, 1986, shall comply with the following standards:

Residential land use--No gravity sanitary sewer shall have an exfiltration rate greater than fifty (50) gallons per inch pipe diameter per mile per day. Sewer lateral lines located in the public right-of-way shall be a minimum of six (6) inches in diameter.

Nonresidential land use--No gravity sanitary sewer shall have an exfiltration rate greater than twenty (20) gallons per inch pipe diameter per mile per day. Sewer lateral lines located in the public right-of-way shall be a minimum of six (6) inches in diameter.

Sanitary sewer force mains--All sanitary sewer force mains installed within the Northwest Wellfield protection area, or within the West Wellfield Interim protection area, >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex,<< or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, or Hialeah Wellfield, or within the basic wellfield protection area of any public utility potable water supply well, shall be constructed of either ductile iron or reinforced concrete pressure sewer pipe. No such ductile iron sanitary sewer force main shall, exfiltrate at a rate greater than the allowable leakage rate specified in American Water Works Association Standard C600-82 at a test pressure of one hundred (100) pounds per square inch. No such reinforced

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concrete pressure sanitary sewer force main shall exfiltrate at a rate greater than one-half (1/2) the allowable leakage rate specified for ductile iron pipe in American Water Works Association Standard C600-82 at a test pressure of one hundred (100) pounds per square inch.

* * *

(c) *Storm water disposal methods.* That the storm water disposal methods utilized or to be utilized will be limited as set forth in Table C-1.

Furthermore, land uses adjacent to the Snapper Creek extension canal and secondary canals directly connected to the Snapper Creek extension canal shall provide an earth berm, or alternative structure as approved by the Director of the Department of Environmental Resources Management or his designee, which shall be constructed upon the perimeter of all canals to prevent overland storm water runoff from entering the canal. The berm shall be constructed adjacent to the canal top of slope on the landward side. Said berm shall extend one (1) foot above the canal bank elevation. The landward slope of the berm shall have a gradient not steeper than one (1) foot vertical to four (4) feet horizontal. The canalward slope shall not be steeper than the canal slope. The construction of berming and backsloping shall be subject to the approval of the Director of the Department of Environmental Resources Management or his designee.

(d) *Liquid waste storage, disposal or treatment methods other than septic tanks utilized for the disposal, discharge, storage or treatment of domestic sewage; sanitary sewer lift stations; and public sanitary sewers.* That liquid waste storage, disposal or treatment methods (other than septic tanks utilized for the disposal, discharge, storage or treatment of domestic sewage; sanitary sewer lift stations; and public sanitary sewers); shall be prohibited within the Northwest Wellfield protection area, the West Wellfield Interim protection area, >>the outer wellfield protection zone of the South Miami Heights Wellfield Complex<< the average day pumpage wellfield protection areas of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, and Hialeah Wellfield, and the basic wellfield protection area of any public utility potable water supply well unless, in the case of property within the Northwest Wellfield protection area, said liquid waste storage, disposal or treatment method was

installed prior to September 30, 1983, or, unless, in the case of property within the West Wellfield Interim protection area, said liquid waste storage, disposal or treatment method was installed prior to the effective date of this ordinance [Ordinance No. 89-80] >>or within the outer wellfield protection zone of the South Miami Heights wellfield complex installed prior to the effective date of this ordinance<<, or, unless, in the case of property within the average day pumpage wellfield protection area but not within the basic wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield and Southwest Wellfield, said liquid waste storage, disposal or treatment method was installed prior to February 1, 1985, or, [[~~or,~~]] in the case of property not within the basic wellfield protection area but within the average day pumpage wellfield protection area of the Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, and Hialeah Wellfield, said liquid waste, storage, disposal or treatment method was installed prior to December 12, 1986, unless in the case of property within the basic wellfield protection area of any public utility potable water supply well, said liquid waste storage, disposal or treatment method was installed prior to June 13, 1986.

(e) *Violations of this chapter.* That the septic tank, sanitary sewer, storm water disposal method or liquid waste storage, disposal or treatment method utilized or to be utilized will serve an existing land use within the Northwest Wellfield protection area or within the West Wellfield Interim protection area >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex,<< or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, and Hialeah Wellfield, or within the basic wellfield protection area of any public utility potable water supply well and which is required by the Director or his designee to correct violation(s) of this chapter. Notwithstanding the foregoing, the Director or his designee shall not issue his written approval unless the Director or his designee determines that the land use will comply with all the provisions of this chapter and that the following water pollution prevention and abatement measures and practices shall be provided:

(i) Monitoring and detection of water pollution caused by hazardous materials, and

(ii) Secondary containment of water pollution caused by hazardous materials, and

(iii) Inventory control and record keeping of hazardous materials, and

(iv) Storm water management of water pollution caused by

hazardous materials, and

(v) Protection and security of facilities utilized for the generation, storage, usage, handling, disposal or discharge of hazardous materials.

(5) *Protection of hazardous materials within wellfield protection area.* Notwithstanding any provisions of this Code, no County or municipal officer, agent, employee or Board shall approve, grant or issue any building permit, certificate of use and occupancy (except for changes in ownership), municipal occupational license (except for changes in ownership), platting action (final plat, waiver of plat or equivalent municipal platting action) or zoning action (district boundary change, unusual use, use variance or equivalent municipal zoning action) for any nonresidential land use, other than a bona fide agricultural land use, a bona fide rockmining use (like excavation), a public sewer facilities use, or a public water supply facilities use, within the Northwest Wellfield protection area or within the West Wellfield Interim protection area >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex,<< or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, John E. Preston Wellfield, or Hialeah Wellfield or within the basic wellfield protection area of any public utility potable water supply well, without obtaining the prior written approval of the Director of the Department of Environmental Resources Management or his designee. The director or his designee shall issue his written approval only if the Director or his designee determines that the nonresidential land use is in compliance with Sections 24-43(5)(a), 24-43(5)(b) or 24-43(5)(c).

Furthermore, notwithstanding any provision of this Code, no person shall construct, utilize, operate, occupy or cause, allow, let, permit or suffer to be constructed, utilized, operated or occupied any nonresidential land use, other than a bona fide agricultural land use, a public sewer facilities use, or a public water supply facilities use, within the Northwest Wellfield protection area or within the West Wellfield Interim protection area >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex,<< or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, or Hialeah Wellfield, or within the basic wellfield protection area of any public utility potable water supply well, and which uses, generates, handles, disposes of, discharges or stores hazardous materials, until the person has obtained the prior written approval of the Director of the Department of Environmental Resources Management or his designee.

Pursuant to the foregoing, the Director or his designee shall issue his written approval only if the Director or his designee determines that all

potential sources of pollution will be installed upon the property as far away as is reasonably possible from all potable water supply wells; hazardous materials will not be used, generated, handled, disposed of, discharged or stored on that portion of the property within the Northwest Wellfield protection area or within the West Wellfield Interim protection area or within the basic wellfield protection area of any public utility potable water supply well; and hazardous wastes will not be used, generated, handled, disposed of, discharged or stored on that portion of the property >>within the outer wellfield protection zone of the South Miami Heights Wellfield Complex, or<< within the average day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, or Hialeah Wellfield.

Notwithstanding the foregoing, fuels and lubricants required for rockmining operations (lake excavations, concrete batch plants, rock crushing and aggregate plants) within the Northwest Wellfield protection area or within the West Wellfield Interim protection area; electrical transformers serving nonresidential land uses; small quantity generators of hazardous wastes as defined in this chapter, >>within the outer wellfield protection zone of the South Miami Heights Wellfield Complex or<< within the average day pumpage wellfield protection area but not within the basic wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, [[~~and~~]] Hialeah Wellfield >>, and the South Miami Heights Wellfield Complex<< and existing land uses required by the Director or his designee to correct violations of this chapter; shall not be prohibited when the water pollution prevention and abatement measures and practices set forth in Sections 24-43(5)(a)(i), (ii), (iii), (iv) and (v) will be provided and the Director or his designee has approved same.

Notwithstanding the foregoing, the use, handling or storage of factory prepackaged products intended primarily for domestic use or consumption determined by the Director or his designee to be hazardous materials shall not be prohibited; provided, however, that the requirements of Sections 24-43(5)(a)(vi), (vii), (viii) and (ix) are fulfilled.

(a) The owner of the property has submitted to the Director or his designee a covenant running with the land executed by the owner of the property in favor of Miami-Dade County which provides that hazardous materials shall not be used, generated, handled, disposed of, discharged or stored on that portion of the property located within the Northwest Wellfield protection area or within the West Wellfield Interim protection area or within the basic wellfield protection area of any public utility potable water supply well; and that hazardous wastes shall not be used, generated, handled, disposed of, discharged or stored on that portion of the

property within the average day pumpage wellfield protection area but not within the basic wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, or Hialeah Wellfield >>,or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex<<.

Furthermore, the aforesaid covenant shall provide that fuels and lubricants required for rockmining operations (lake excavations, concrete batch plants, rock crushing and aggregate plants) within the Northwest Wellfield protection area or within the West Wellfield Interim protection area; electrical transformers serving nonresidential land uses; small quantity generators of hazardous wastes as defined in this chapter, >>within the outer wellfield protection zone of the South Miami Heights Wellfield Complex or<< within the average day pumpage wellfield protection area but not within the basic wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs ~~Lower Wellfield, Miami Springs Upper Wellfield, John E.~~ Preston Wellfield, and Hialeah Wellfield and existing land uses required by the Director or his designee to correct violations of this chapter; shall not be prohibited when the following water pollution prevention and abatement measures and practices will be provided:

(i) Monitoring and detection of water pollution caused by hazardous materials, and

(ii) Secondary containment of water pollution caused by hazardous materials, and

(iii) Inventory control and record keeping of hazardous materials, and

* * *

(viii) The nonresidential land use is served or is to be served by public water and public sanitary sewers, and

(ix) Said building is located more than thirty (30) days' travel time from any public utility potable water supply well.

Said covenants shall be in a form(s) prescribed by the Director and approved by the Board of County Commissioners. The covenants shall be recorded in the public records of Miami-Dade County, Florida, by the Department of Environmental Resources Management at the expense of the owner of the property, or

(b) If the Director or his designee determines that the owner of the property is applying for the original certificate of use and occupancy or original municipal occupational license pursuant to a

valid building permit obtained prior to June 1, 1983, for property within the basic wellfield protection area of any public utility potable water supply well, or, in the case of property within the Northwest Wellfield protection area, obtained prior to September 30, 1983, or, in the case of the West Wellfield Interim protection boundary, obtained prior to effective date of this ordinance [Ordinance No. 89-80] >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex obtained prior to the effective date of this ordinance<<, or, in the case of property within the average day pumpage wellfield protection area, but not within the basic wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield or Southwest Wellfield, obtained prior to February 1, 1985 or, in the case of property not within the basic wellfield protection area but within the maximum day pumpage wellfield protection area of the Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield, obtained prior to December 12, 1986 and which permit has been valid and continuously in full force and effect since its issuance, or

(c) If the Director or his designee determines:

(i) That the application for a building permit, certificate of use and occupancy (except for changes in ownership), municipal occupational license (except for changes in ownership), platting action (final plat, waiver of plat or equivalent municipal platting action) or zoning action (district boundary change, unusual use, use variance or equivalent municipal zoning action) is for the replacement, modification or limited expansion of an existing facility, provided in no case shall such replacement, modification or limited expansion cause, permit, let, suffer or allow the use, generation, handling, disposal, discharge or storage of hazardous materials on the property to be increased by more than fifty (50) percent over the use, generation, handling, disposal, discharge or storage of hazardous materials which existed on the property on September 30, 1983, for properties within the Northwest Wellfield protection area, or which existed on the property on the effective date of this ordinance [Ord. No. 89-80] for properties within the West Wellfield Interim protection area, or which existed on March 13, 1981 for properties within the basic wellfield protection area of any public utility potable water supply well, and

* * *

(7) *Pipelines for hazardous materials.* Notwithstanding any provision of this Code, no County or municipal officer, agent, employee or Board, after July 13, 1984 shall approve, grant or issue any permit of any kind whatsoever for the installation, modification, or expansion of that portion of any pipeline used or to be used for the transmission or storage of any hazardous materials and which portion is within the Northwest Wellfield protection area or the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield or Southwest Wellfield or within the basic wellfield protection area of any public utility potable water supply well or, in the case of that portion of any pipeline not within the basic wellfield protection area but within the maximum day pumpage wellfield protection area of the Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield, after December 12, 1986, or, in the case of that portion of any pipeline within the West Wellfield Interim protection area, after the ~~effective date of this~~ ordinance [~~Ordinance No.~~ 89-80] >>~~or within the~~ outer wellfield protection zone of the South Miami Heights Wellfield Complex after the effective date of this ordinance<< .

Furthermore, notwithstanding any provision of this Code, no person shall install, construct, utilize, operate, occupy or cause, allow, let, permit or suffer to be installed, constructed, utilized, operated or occupied any pipeline or portion of any pipeline used or to be used for the transmission or storage of any hazardous materials within the Northwest Wellfield Protection Area or the maximum day pumpage wellfield protection area of the Northwest Wellfield, Alexander Orr Wellfield, Snapper Creek Wellfield or Southwest Wellfield or within the basic wellfield protection area of any public utility potable water supply well, after July 13, 1984, unless said person installed, constructed, utilized, operated or occupied said pipeline used or to be used for the transmission or storage of hazardous materials before July 13, 1984, or, in the case of the West Wellfield Interim protection area, no person shall install, construct, utilize, operate, occupy or cause, allow, let, permit or suffer to be installed, constructed, utilized, operated or occupied any pipeline or portion of any pipeline used or to be used for the transmission or storage of any hazardous materials within the West Wellfield Interim protection area after the effective date of this ordinance [Ordinance No. 89-80] >>or, in the case of that portion of any pipeline within the outer wellfield protection zone of the South Miami Heights Wellfield Complex after the effective date of this ordinance unless said person installed, constructed, utilized, operated or occupied said pipeline used or to be used for the transmission or storage of hazardous materials prior to the effective date of this ordinance<<, unless said person installed, constructed, utilized, operated or occupied said pipeline used or to be used for the transmission or storage of hazardous materials prior to the effective date of this

ordinance [Ordinance No. 89-80].

Furthermore, notwithstanding any provision of this Code, no person shall install, construct, utilize, operate, occupy or cause, allow, let, permit or suffer to be constructed, utilized, operated or occupied any pipeline or portion of any pipeline used or to be used for the transmission or storage of any hazardous materials within the maximum day pumpage wellfield protection area but not within the basic wellfield protection area of the Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield after the effective date of this subsection [December 12, 1986] , unless said person installed, constructed, utilized, operated or occupied said pipeline used or to be used for the transmission or storage of hazardous materials before the effective date of this subsection [December 12, 1986].

* * *

(11) *Prohibition of resources recovery and management facility within wellfield protection areas.* Notwithstanding any provision of this Code, no County or municipal officer, agent, employee or Board shall approve, grant, modify or issue any permit (except for renewal of valid operating permits, issued pursuant to this chapter, no later than March 12, 1987), certificate of use and occupancy (except for changes in ownership), certificate of use and occupancy (except for changes in ownership), platting action (final plan, waiver of plat or equivalent municipal platting action) or zoning action (district boundary change, unusual use, use variance or equivalent municipal zoning action) for any resource recovery and management facility within the Northwest Wellfield protection area or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, or Hialeah Wellfield, or within the basic wellfield protection area of any public utility potable water supply well after December 12, 1986, unless said resource recovery and management facility was in operation and had obtained all other applicable permits prior to June 25, 1986 and obtained a valid operating permit issued pursuant to this chapter no later than March 12, 1987 >>or, in the case of a resource recovery and management facility within the outer wellfield protection zone of the South Miami Heights Wellfield Complex, was in operation and had obtained all other applicable permits prior to the effective date of this ordinance <<.

Notwithstanding any provision of this Code, no County or municipal officer, agent, employee or Board shall approve, grant, modify or issue any permit (except for renewal of valid operating permits issued pursuant to this chapter, renewed no later than ninety (90) days after the effective date of this ordinance [Ordinance No. 89-80]), certificate of use and

occupancy (except for changes in ownership), platting action (final plat, waiver of plat or equivalent municipal platting action) or zoning action (district boundary change, unusual use, use variance or equivalent municipal zoning action) for any resource recovery and management facility (unless the facility's primary purpose is to collect paper, glass, plastics or aluminium for transport out of the West Wellfield Interim protection area or the facility provides composting for on-site organic plant materials at plant nurseries) within the West Wellfield Interim protection area after the effective date of this ordinance [Ordinance No. 89-80], unless said resource recovery and management facility was in operation and had obtained all other applicable permits prior to the effective date of this ordinance [Ordinance No. 89-80] and obtained a valid operating permit issued pursuant to this chapter no later than ninety (90) days after the effective date of this ordinance [Ordinance No. 89-80].

Furthermore, notwithstanding any provision of this Code, no person shall construct, utilize, operate, occupy or cause, allow, let, permit or suffer to be constructed, utilized, operated or occupied any resource recovery and management facility within the Northwest Wellfield protection area or within the maximum day pumpage wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield, or Hialeah Wellfield, or within the basic wellfield protection area of any public utility potable water supply well after December 12, 1986, unless said resource recovery and management facility was in operation and had obtained all other applicable permits prior to June 25, 1986 and obtained a valid operating permit pursuant to this chapter, no later than March 12, 1987 >>or, in the case of a resource recovery and management facility within the outer wellfield protection zone of the South Miami Heights Wellfield Complex, was in operation and had obtained all other applicable permits prior to the effective date of this ordinance<<.

Notwithstanding any provision of this Code, no person shall construct, utilize, operate, occupy or cause, allow, let, permit or suffer to be constructed, utilized, operated or occupied any resources recovery and management facility within the West Wellfield Interim protection area after the effective date of this ordinance [Ordinance No. 89-80], unless said resource recovery and management facility was in operation and had obtained all other applicable permits prior to the effective date of this ordinance [Ordinance No. 89-80] and obtained a valid operating permit pursuant to this chapter, no later than ninety (90) days after the effective date of this ordinance [Ordinance No. 89-80].

* * *

Section 4. Section 24-43.1 of the Code of Miami-Dade County, relating to liquid waste disposal and potable water supply systems, is hereby amended as follows:

Sec. 24-43.1. Liquid waste disposal and potable water supply systems.

(1) The intent and purpose of this section is to safeguard the public health, safety, and welfare by regulating liquid waste storage, disposal and treatment methods other than sanitary sewers and any source of potable water supply.

(2) No person shall discharge or cause, allow, permit, let or suffer to be discharged any liquid waste or other substance of any kind whatsoever into a septic tank other than domestic sewage.

* * *

(6) Notwithstanding any provision of this Code, no County or municipal officer, agent, employee, or Board shall approve, grant or issue any building permit, certificate of use and occupancy (except for changes in ownership), platting action (final plat, waiver of plat or equivalent municipal platting action) or zoning action (district boundary change, unusual use, use variance or equivalent municipal zoning action) for any nonresidential land use served or to be served by any liquid waste storage, disposal or treatment method other than public sanitary sewers or any source of potable water supply other than a public water main without obtaining the prior written approval of the Director of the Department of Environmental Resources Management or his designee.

Furthermore, notwithstanding any provision of this Code, no person shall construct, utilize, operate, occupy or cause, allow, let, permit or suffer to be constructed, utilized, operated or occupied any nonresidential land use served by any liquid waste storage, disposal or treatment method other than public sanitary sewers or any source of potable water supply other than a public water main without obtaining the prior written approval of the Director of the Department of Environmental Resources Management or his designee.

The Director or his designee shall issue his written approval only if:

(a) The Director or his designee determines that the existing nonresidential land use for the property or the nonresidential land use for the property is a nonresidential land use served or to be served by a public water main and is not one (1) or more of the nonresidential land uses permitted under the following Miami-Dade County zoning classifications:

* * *

(b) The Director or his designee determines that the existing nonresidential

land use for the property or the nonresidential land use requested for the property is a nonresidential land use served or to be served by an on site domestic well system and is not an establishment primarily engaged in the handling of food and drink (except factory prepackaged products), educational institutions, intermediate care facilities and health care facilities and is not one (1) or more of the nonresidential land uses permitted under the following Miami-Dade County zoning classifications:

(i) BU-1A (excluding those land uses permitted by BU-1 except an establishment primarily engaged in the handling of food and drink (except factory prepackaged products), educational institutions, intermediate care facilities and health care facilities),

* * *

(g) The Director or his designee determines that no portion of the property is located within the Northwest Wellfield protection area or within the West Wellfield Interim protection area or within the maximum day wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex<< or within the basic wellfield protection area of any public utility potable water supply well, that the owner of the property is applying for a land use prohibited by Section 24-43.1(6)(a) above, and:

* * *

(h) The Director or his designee determines that no portion of the property is located within the Northwest Wellfield protection area or within the West Wellfield Interim protection area or within the maximum day wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex<< or within the basic wellfield protection area of any public utility potable water supply well, that the owner of the property is applying for a land use prohibited by Section 24-43.1(6)(b)(i), (ii), and (iii) above, and:

* * *

(i) The Director or his designee determines that no portion of the property is located within the Northwest Wellfield protection area or within the West Wellfield Interim protection area or within the maximum day wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex<< or within the basic wellfield protection area or any public utility potable water supply well, that property is located within the boundaries of a sanitary sewer improvement district approved by the Board of County Commissioners or a municipal governing body, that the owner of the property is applying for a land use prohibited by subsection Section 24-43.1(6)(a) above, and

* * *

(j) The Director or his designee determines that the property is located within the maximum day wellfield protection area of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield >>or within the outer wellfield protection zone of the South Miami Heights Wellfield Complex<< or within the basic wellfield protection area of any public utility potable water supply well, that the property is located within the boundaries of a sanitary sewer improvement district approved by the Board of County Commissioners or a municipal governing body, that the owner of the property is applying for a land use prohibited by Section 24-43.1(6)(a) above, and

* * *

(8) Notwithstanding any provision of this Code, the use of any liquid waste storage, disposal or treatment methods (excluding public sanitary sewers and stormwater disposal methods) for any nonresidential land use within the Northwest Wellfield protection area, within the West Wellfield Interim protection area, the maximum day pumpage wellfield protection areas of the Alexander Orr Wellfield, Snapper Creek Wellfield, Southwest Wellfield, Miami Springs Lower Wellfield, Miami Springs Upper Wellfield, John E. Preston Wellfield or Hialeah Wellfield >>or within the outer wellfield protection zone of the South Miami Heights wellfield complex<< or within the basic wellfield protection area of any public utility

potable water supply well shall cease within six (6) months from the date that the Director or his designee determines that an approved public gravity sanitary sewer has been made available and operative in any portion of the public right-of-way or easement abutting the property, or the use of any liquid waste storage, disposal or treatment methods (excluding public sanitary sewers and stormwater disposal methods) for any nonresidential land use which exceeds the maximum allowable sewage loading permitted by Section 24-43.1(4)(b) of this Code, shall cease within six (6) months from the date that the Director or his designee determines that an approved public gravity sanitary sewer has been made available and operative in any portion of the public right-of-way or easement abutting the property. Thereafter, all liquid wastes that are generated, handled, disposed of, discharged or stored on the property shall be discharged to an approved and operative gravity sanitary sewer except those liquid wastes, other than domestic sewage, that are permitted by this chapter to be generated, handled, treated or stored on the property.

* * *

Section 5. If any section, subsection, sentence, clause or provision of this ordinance is held invalid, the remainder of this ordinance shall not be affected by such invalidity.

Section 6. It is the intention of the Board of County Commissioners, and it is hereby ordained that the provisions of this ordinance, including any Sunset provision, shall become and be made a part of the Code of Miami-Dade County, Florida; except that, the South Miami Heights Wellfield Complex Boundary map referenced in Section 3 of this ordinance, and the technical report entitled "Development of a Groundwater Model to Determine Wellfield Protection Zones for the Miami-Dade County, Florida, South Miami Heights Wellfield Complex", dated November 2005, set forth in Section 3 of this ordinance shall not be codified. The sections of this ordinance may be renumbered or relettered to accomplish such intention, and the word ordinance may be changed to section, article, or other appropriate word.

Section 7. This ordinance shall become effective ten (10) days after the date of enactment unless vetoed by the Mayor, and if vetoed, shall become effective only upon an override by this Board.

PASSED AND ADOPTED:

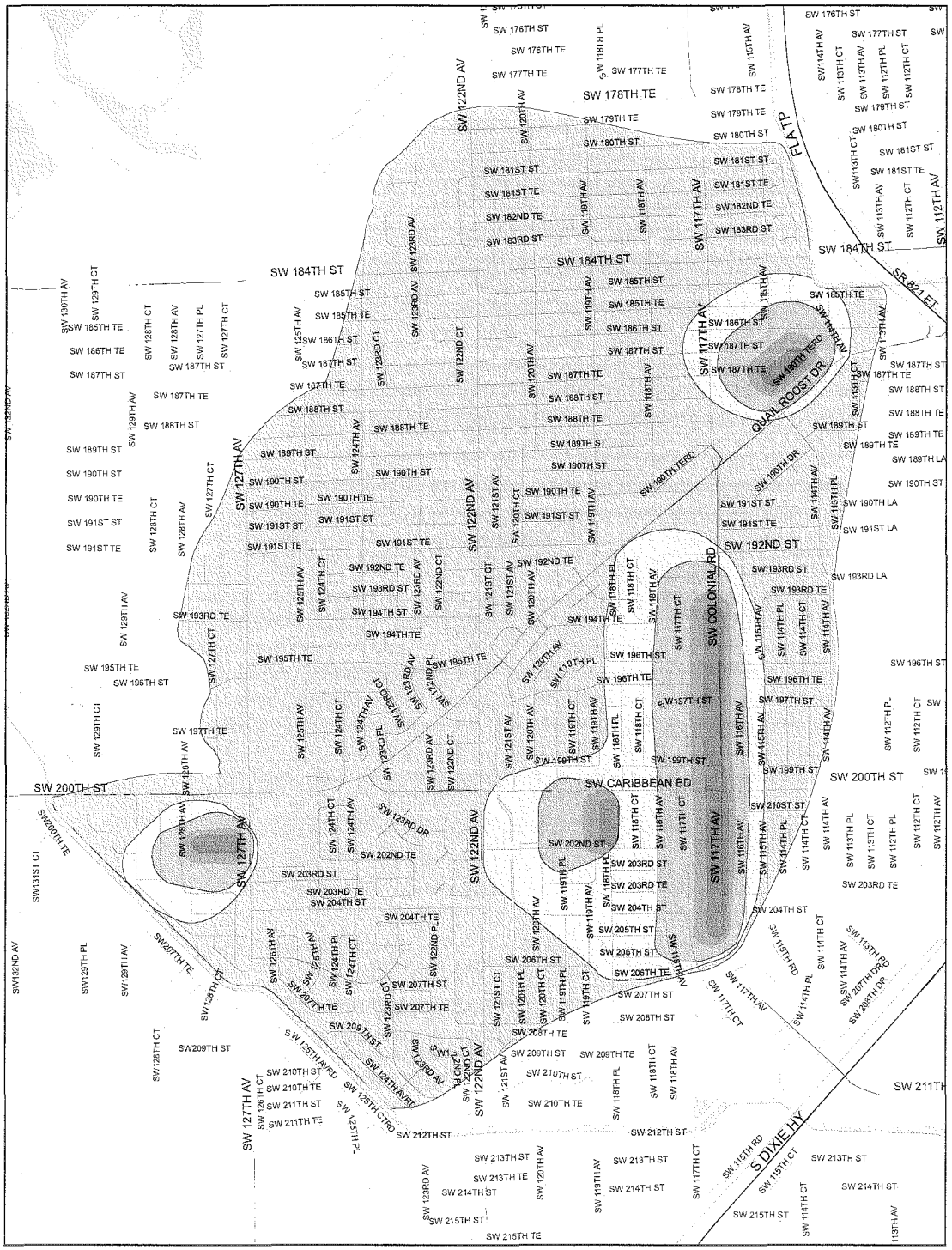
Approved by County Attorney as to form and legal sufficiency:

Prepared by:

Peter S. Tell

ATTACHMENT A

Wellfield Protection Zones for the South Miami Heights Wellfield Complex



Wellfield Protection Zones
- 10 Day
- 30 Day
- 100 Day
- 210 Day
- Outer

Water

Major Roads

Map created November, 2005.

ATTACHMENT B

Development of a Groundwater Model to Determine Wellfield Protection Zones for the Miami-Dade County, Florida, South Miami Heights Wellfield Complex

Hillol Guha, Ph.D., P.G., P.HGW

Miami-Dade County
Department of Environmental Resources Management
Miami, Florida
November, 2005

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[1] DRAFT REPORT by Hillol Guha, Miami-Dade County, Department of Environmental Resources Management

Development of a Groundwater Model to Determine Wellfield Protection Zones for the Miami-Dade County, Florida, South Miami Heights Wellfield Complex

1.0 Introduction

Miami-Dade Water and Sewer Department (WASD) has designed and is currently constructing a new water treatment plant that will be supplied by four new wellfields in the South Miami Heights area. The new wellfields are sited at three county parks, Roberta Hunter Park, Caribbean Park and Rockpit 77 Park and the discontinued South Miami Heights water treatment plant as shown in Figure 1. As a group, the four wellfields are referred to as the South Miami Heights Wellfield Complex and have a projected design capacity of 26 million gallons per day (MGD). In advance of the new system becoming operational, staff at the Department of Environmental Resources Management Department (DERM) was tasked with incorporating the future wellfields into the county's existing wellfield protection program. The two integral components of that program are mapped wellfield protection zones for each wellfield and wellfield complex and accompanying land use restrictions, both of which are to be considered for adoption by the Board of County Commissioners as an ordinance and placed within Chapter 24 of the Code of Miami-Dade County, Florida. This report describes the groundwater modeling process used to develop the wellfield protection zones and the resulting wellfield maps for the South Miami Heights wellfield complex.

2.0 Background

All utility raw water supplies in Miami-Dade County are protected by land use restrictions within regulatory zones based on modeled outputs generally approximating 10-, 30-, 100- and 210-day theoretical groundwater time of travel distances (travel time contours). The basis for applying modeled travel time contour lines as wellfield protection zones is presented within the technical document "Protection of Potable Water Supply Wells Program" dated December 1980. At that time, Ordinance 81-23 (dated 3/3/81) established "Section 24-12.1. Protection of potable water supply wells." of the Code of Metropolitan Dade County, Florida that has since been reorganized as "Section 24-43. Protection of potable water supply wells." of the Code of Miami-Dade County, Florida. Ordinance 81-23 also incorporated a reference to a map (dated 12/30/80) delineating 10-, 30-, 100- and 210-day based wellfield protection zones for all utility wellfields existing at that time. Since 1981, the official map has been amended to remove wellfield protection zones for wellfields permanently taken out of service, to expand existing wellfield protection for wellfields retrofitted with additional withdrawal capacity or to add wellfield protection zones for new wellfields.

Recognizing that the larger wellfields and wellfield complexes needed more protection than provided by the 210-day wellfield protection zone, one or more outer zones were adopted for certain wellfields encompassing more of their respective watershed area. The

resulting set of wellfield protection zones were depicted on a separate map for each of these wellfields and wellfield complexes. The basis for selecting an outer zone for a particular wellfield varies on a case-by-case basis. Some of the factors considered include proportion of developed vs. undeveloped land, zoning and land use patterns and trends, and economic impact among others. For the South Miami Heights Wellfield Complex, the proposed outer wellfield protection zone approximates the 1,500 -day travel time contour simulating all four wellfields pumping at their total projected design capacity of 26 MGD. Wellfield protection zones based on 210-, 100-, 30- and 10-day travel times were modeled for each of the four wellfields within the Miami Heights Wellfield Complex (Roberta Hunter Park, Caribbean Park, Rockpit 77 Park and South Miami Heights) at their respective projected design capacity. The following sections describe the groundwater modeling process used to generate the wellfield protection zones for the proposed official map for the South Miami Heights Wellfield Complex.

3.0 Groundwater Modeling

3.1 Steady-State Regional Model

The South Dade wellfield systems were modeled using a USGS Finite Difference three-dimensional MODFLOW-96 code (McDonald and Harbaugh, 1996). The wellfield modeled area is a subset of a larger South Dade steady-state regional model. The original regional model was a transient model developed by South Florida Water Management District (SFWMD, 2002). The steady-state model comprises of all the hydrogeologic properties that was used in the SFWMD model. Detailed description of the calibrated South Dade model is described later in this report. To be brief, the steady-state South Dade model comprises an average dry period of record (01/01/1988 to 04/30/1988 and 12/01/1988 to 04/30/1989). Daily hydrologic values are averaged for the two dry period of record. It has total of five layers, with the top layer depicted as an unconfined layer, LAYCON 1 and the other four layers as an unconfined LAYCON 3 of the Block Centered Flow (BCF) package of MODFLOW-96. Each layer was discretized into 430 rows (running east-west) and 367 columns (running north-south). Nodal spacing was 500 feet east-west and 500 feet north-south. The solver used in the model simulation was preconditioned conjugate gradient (PCG2) solver. The canals were simulated using the river (RIV) and drain (DRN) packages of MODFLOW-96. The river package was used on those canals when there is canal and aquifer interactions while drain package was generally used on the canals that only served as one way flow of groundwater into the canal but not vice versa. Evapotranspiration and recharge rates were simulated using the EVT and RCH packages of MODFLOW-96 respectively. General head boundary (GHB) was used in the northern and the western boundary, while equivalent fresh-water head was determined in the coastal boundary in the east. The specific yield used in the transient South Dade model by SFWMD was 0.25 and this value is also used for the porosity. Porosity is a function of heterogeneity of the subsurface and can vary widely in the Biscayne Aquifer. The municipal and agricultural wells in the South Dade model were simulated using the well (WEL) package of MODFLOW-96. The top layer is modeled as an overland flow with different landuse characteristics. The landuse was

simulated by giving different hydraulic conductivity, the detailed values of the hydraulic conductivity is obtained from Evans (2003) report. Autosensitivity analysis was done on five different zones of recharge and evapotranspiration rates. The model was calibrated to average groundwater heads from 29 different locations. The calibrated parameters were the five zones of recharge. Calibration was done using PEST under both predictive and regularization mode. The simulated and observed head was very close, except near the wellheads, where the model derived heads overpredicted the observed heads. This is expected because of the non-laminar and non-darcian flow characteristics pattern at or very near to the wellfield.

3.2 Calibration of Steady-State Regional South Dade Model

The transient model developed by SFWMD was converted into a steady-state model using an average dry period of record (01/01/1988 to 04/30/1988 and 12/01/1988 to 04/30/1989). This period represents 1:10-year drought period (as communicated by SFWMD). For wellfield protection modeling purposes a most conservative hydrologic period needs to be used to model the wellfield protection areas. The location of the South Dade regional model is shown in figure 2. Figure 3 shows the elevations of the layers in NGVD 29 feet, used in the model. Hydraulic conductivity of the overland layer and the other four layers are shown in figure 4. Recharge and evapo-transpiration rates are shown in figure 5.

3.3 Sensitivity Analysis of Steady-State Regional South Dade Model

An automatic sensitivity analysis on recharge and evapotranspiration rates was conducted on five different zones (Figure 5). Eleven simulations were conducted on each zone with multiplying factors of 0.1, 0.3, 0.5, 0.7, 0.9, 1, 1.2, 1.4, 1.6, 1.8, and 2. The initial recharge and evapotranspirations values for each of the five zones that were multiplied by the above multiplying factors were 0.00685 ft/day and 0.0171 ft/day respectively. The plot of the sensitivity analysis shows that zones 2 and 5 of recharge rates were sensitive, whereas evapotranspirations rates were not very sensitive across all zones, no change of sum of squared residuals values with change in the evapotranspiration rates (Figure 6).

3.4 Parameter Estimation Using PEST

Calibration of the steady-state regional model was performed using the PEST calibration tool, developed by John Doherty of Watermark Computing. PEST is a model independent parameter optimization tool and uses a nonlinear estimation technique known as the Gauss-Marquadt-Levenberg algorithm. In a traditional model calibration, minimization of objective function is undertaken which comprises the sum of the squared deviations between model and measured ("field") values. However, in a traditional model

calibration there are often many different sets of parameter values for which the objective function is at its minimum or near minimum (Doherty, 1994). The PEST calibration conducted for the steady-state South Dade regional model was performed under both predictive and regularization mode. PEST does predictive analysis, to be brief, it estimates a unique parameter set which results in the maximum or minimum model prediction while still calibrating the model. To run PEST in predictive analysis mode the user informs PEST of the objective function value below which the model can be considered to be calibrated, this value is normally slightly less than the calibration run conducted under the parameter estimation mode (Doherty, 1994). In the regularization mode, a large number of parameter sets can be simultaneously estimated without incurring the numerical instability that normally accompanies parameter nonuniqueness. When the parameter estimation value is spatially distributed in two –or three-dimensional model domain, running PEST under the regularization mode can be advantageous.

The groundwater head distribution in the Biscayne Aquifer depends on the precipitation rates, a high precipitation results in more recharge of the groundwater table resulting in higher hydraulic heads. The original transient model developed by SFWMD was calibrated by trial and error process, the model parameters used for calibration were: river and drain conductances, horizontal hydraulic conductivity, boundary conductance of the layers, vertical conductance of the layers, and storage coefficient (SFWMD, 2002). Based on the sensitivity analysis conducted, only recharge was sensitive in the steady-state model across two different zones. However, five recharge zones were calibrated using PEST under predictive and regularization mode. The calibration of river and drain conductances, horizontal hydraulic conductivity, boundary conductance of the layers, and vertical conductance of the layers were not conducted because optimized parameter values were used from the transient model into the steady-state model. A total of 29 average groundwater observation values were used to fit the model derived values against the measured values. The estimated parameter values for the five zones of recharge are:

Zones	Recharge Rates (ft/day)
1	9.920902E-03
2	5.496658E-05
3	1.664453E-02
4	3.300688E-0
5	2.168074E-05

Output of the PEST optimization results is detailed in APPENDIX A. The optimized measurement objective function was 74.09 and the optimized regularization objective function was 27.36.

Table below shows the covariance matrix of the adjustable recharge parameters of the five zones.

	r1	r2	r3	r4	r5
r1	0.6403	-0.1127	-4.69E-02	1.352	-2.14E-02
r2	-0.1127	38.05	10.36	-46.93	-50.50
r3	-4.69E-02	10.36	3.342	-14.93	-14.59

r4	1.352	-46.93	-14.93	69.63	64.49
r5	-2.1E-02	-50.50	-14.59	64.49	78.68

The elements of the covariance matrix pertain to the parameters that PEST actually adjusts; this means that where a parameter is log-transformed, in this case the recharge rates in the South Dade steady-state model, the elements of the covariance matrix pertaining to that parameter actually pertain to the logarithm (to the base 10) of that parameter. The variances and covariances occupying the elements of the covariance matrix are valid only in so far as the linearity assumption is valid (Doherty, 2002). The diagonal elements of the above covariance matrix represent the variances of the adjustable recharge parameters. The standard deviation of the five-recharge zones, which is the square root of the variances are: 0.8; 6.17; 1.83; 8.34; and 8.87. This indicates that the 95% confidence interval cited for the parameters r2, r3, r4, and r5 are very wide (APPENDIX A). However, when PEST is run in predictive analysis or regularization modes, parameter confidence limits are not really applicable. They are provided here as an indicator of relative uncertainty only. The off-diagonal elements of the covariance matrix represent the covariances between parameter pairs.

Table below shows the correlation coefficient matrix of the adjustable recharge parameters of the five zones.

	r1	r2	r3	r4	r5
r1	1.000	-2.28E-02	-3.21E-02	0.2025	-3.02E-03
r2	-2.28E-02	1.000	0.9184	-0.9117	-0.9230
r3	-3.21E-02	0.918	1.000	-0.9787	-0.9001
r4	0.2025	-0.911	-0.9787	1.000	0.8712
r5	-3.02E-03	-0.923	-0.9001	0.8712	1.000

Based on the above table, recharge zone 1 shows medium correlation with zone 4; recharge zone 2 is very highly correlated with zones 3, 4, and 5; recharge zone 3 is very highly correlated with zones 2, 4, and 5; recharge zone 4 is highly correlated with zones 2, 3, and 5, while medium correlated with zone 1; and finally recharge zone 5 is highly correlated with zones 2, 3, and 4, but no correlation with zone 1. Thus, it can be inferred with certainty that zone 1 is not correlated with other 3 zones except medium correlation with zone 2. This explains why, individually, these parameters are determined with a high degree of uncertainty in the parameter estimation process, as evidenced by their wide confidence intervals.

Another important observation to be made in the parameter estimation process is the eigenvalues. The square root of each eigenvalue is the length of the corresponding semiaxis of the probability ellipsoid in the *n*-dimensional adjustable parameter space. The higher the eigenvalues, it defines the direction of maximum insensitivity of the adjustable parameters and the greatest elongation of the probability ellipsoid. The eigenvalue of recharge zone 5 is 177, which is about 18 times insensitive to the nearest adjustable parameter zone 4. The ratio of the highest to the lowest eigenvalue constitutes another significant information. The square root of this ratio is related to the "condition number" of the matrix that PEST must invert when solving for the parameter upgrade vector. If the

condition number of the matrix is too high, then inversion of this matrix becomes numerically difficult or impossible. In general, if the ratio of the highest to the lowest eigenvalue is greater than 10^8, there is a strong possibility that PEST is having difficulty in calculating the parameter upgrade vector because of parameter insensitivity and/or correlation (Doherty, 2002). In this problem the ratio of the highest to the lowest eigenvalue is about 6000, it indicates that PEST did not have problem in calculating the parameter upgrade vector.

Figure 7 shows relation between observed and calculated heads. Figure 8 shows the relation between measured heads and residuals. Figure 9 shows residual distribution. The residuals were high near the wellfields and in the wetlands. It is expected that computed heads and observed heads will not match near the wellfields because of non-darcian flows, the wetlands were simulated as very high hydraulic conductivity which in reality is much complex physical processes than it is attributed. Again, steady-state calibration is much difficult as average measured heads is considered, which do not assume the range of values that a transient model considers.

The calibrated model was run for 10,000 days under steady-state conditions to determine the hydraulic heads (Figure 10). The mass balance of the model simulation was 0.03%, details of the output is provided in APPENDIX B.

3.5 Telescopic Mesh Refinement: Subregional Wellfield Model

A telescopic mesh refinement (TMR) was done on the calibrated regional steady-state South Dade model in the area covering the four South Dade wellfield system (Figure 1). The approach consists of designing a nested set of grids so that the site grid, which has the finest nodal spacing, is embedded in a regional grid with coarser nodal spacing. The solution of the regional model is then used to define the boundary conditions for the site model (Anderson and Woessner, 1992). The horizontal grid descritization was 44 feet by 53 feet in east-west and north-south direction respectively (i.e., each cell covering an area of 2340 square feet). Total of five layers represented the TMR model and each layer was discretized into 350 rows (running east-west) and 350 columns (running north-south). The boundary conditions were depicted as general head boundary (GHB) in the model. The GHB boundary was determined for the nested-model from the hydraulic heads of the calibrated steady-state South Dade model. All other hydrologic and hydrogeologic information remained the same as in the calibrated South Dade steady-state regional model, except for the canal conductance of reach C1-W and C1-N. In the calibrated regional transient model of South Dade developed by SFWMD, conductance of the canal was calculated based on the MODFLOW-96 river package conductance method, where the conductance of the C1-W and C1-N reaches in the model domain were about 7.9×10^4 ft^2/day and 4×10^4 ft^2/day per 1000 feet of canal reach length respectively. Based on reach transmissivity method to determine canal leakage, canal conductance values for the two canal reaches are three-orders of magnitude higher than was in the regional model. There are no measured canal conductance values for the two reaches, however, canal conductance values based on reach transmissivity for L-31N and Snapper Creek extension canal was determined by Chin (1990). The values were 1×10^7 ft^2/ day and 6.2×10^6 ft^2/ day per 1000 ft of canal reach for the L31-N and Snapper

Creek extension canal respectively. The two canals surrounding the four wellfields are significantly shallower and has less canal width than the two regional canals stated earlier. It is anticipated that canal conductance would be lower than the two regional canals, thus an 80% approximation of Snapper creek extension canal conductance was made, which translated to 5 x 10^6 ft^2/day per 1000 ft canal length. However, these values are approximate and a "best-guess" estimate was made based on two regional canals. Actual field estimation of canal-bed conductance is needed to determine the values for the C1-W and C1-N canals. Sensitivity analysis on canal conductance resulted in larger area drawdown for lower canal conductance than that for much higher conductance. Lower canal conductance resulted in 1/10th feet drawdown across the C1-W canal. However, higher canal conductance limited the drawdown within the two canal boundaries and acted as a hydrologic divide (Figure 11). The production wells of the four wellfields were concentrated in layer 4 of the model and at open bore interval from -38 to –73 feet NGVD 29. Figure 12 shows the distribution of elevations of each layer used in the model. Figure 13 show the distribution of hydraulic conductivity, while figure 14 shows the distribution of recharge and evapotranspiration rates used in the nested-model. A base case simulation without any of the proposed four wellfields were conducted under steady-state conditions for 10,000 days, the hydraulic heads of the simulation is provided in figure 15. The mass balance of the output was 0.0%, detail of the output result is provided in APPENDIX C. Similarly, a 10,000 days steady-state simulation was conducted with the four proposed wellfields and the hydraulic head distribution is provided in figure 16, the mass balance of the simulation was 0.0%. Detail of the output is provided in APPENDIX D.

3.6 Sub-regional Model Sensitivity Analysis

Sensitivity analysis was conducted to determine the response of model calculated drawdown and particle traces to changes in canal conductance of C1-W and C1-N reaches, recharge and evapotranspiration rates. Table below shows a matrix of the sensitivity analysis.

Sensitivity Run #	Canal Conductance, ft^2/day per 1000 ft of canal length		Recharge, inches/year	Evapotranspiration, inches/year
	C1-W	C1-N		
1	7.9 x 10^5	4 x 10^5	40.3 (from calibrated model)	18.5 (mean value from the calibrated model)
2	7.9 x 10^6	4 x 10^6	40.3 (from calibrated model)	18.5 (mean value from the calibrated model)
3	7.9 x 10^3	4 x 10^3	40.3 (from calibrated model)	18.5 (mean value from the calibrated model)
4	7.9 x 10^2	4 x 10^2	40.3 (from	18.5 (mean value

			calibrated model)	from the calibrated model)
5	5×10^6	5×10^6	87.6	18.5 (mean value from the calibrated model)
6	5×10^6	5×10^6	43.8	18.5 (mean value from the calibrated model)
7	5×10^6	5×10^6	4.38	18.5 (mean value from the calibrated model)
8	5×10^6	5×10^6	0.438	18.5 (mean value from the calibrated model)
9	5×10^6	5×10^6	40.3 (from calibrated model)	87.6
10	5×10^6	5×10^6	40.3 (from calibrated model)	43.8
11	5×10^6	5×10^6	40.3 (from calibrated model)	4.38
12	5×10^6	5×10^6	40.3 (from calibrated model)	0.438

In the first set of model simulations, canal conductance for the two reaches of C1-W and C1-N canal was varied by two orders of magnitude while keeping recharge and evapotranspiration rates value same as that in the regional calibrated model. Increase of canal conductance resulted in decrease of drawdown and capture zone area (Figure 17). Variation of recharge rates had minimal sensitivity on drawdown and capture zones (Figure 18). However, there was no sensitivity to drawdown and capture zone areas with two orders variation of evapotranspiration rates. As the variation was same for the evapotranspiration rates, only one figure (19) is shown.

The reason for no sensitivity of drawdown and capture zone areas with variation of recharge and evapotranspiration rates is due to dominance of canal leakage in the volumetric budget of the model.

3.7 Particle Tracking and Wellfield Protection Areas

An USGS MODPATH 3.0 code was used to conduct particle tracking (Pollock, 1994). Once the flow simulation was conducted and cell-by-cell flow data imported into the model, particles were released from the well-heads and back-tracked by running the

MODPATH 3.0 semi-analytical program. Five different intermediate time particle tracing was conducted, they are: 10, 30, 100, 210, and 1500 days. The reasoning of 10 to 210 days particle tracing with respect to wellfield protection areas are detailed in DERM report (1980). However, the reasoning of the 1500 day particle tracing and outer wellfield protection boundary is reported in the section "background and rationale for the new protection zones". Contour lines of equal times of 10, 30, 100, 210, and 1500 days were drawn by connecting points of equal time. Use of AUTOCAD™ computer program and experience of a drafter and a groundwater modeler was used to draw the contours and some level of smoothing was conducted. Figure 20 shows the particle traces in layers 2 to 5 of the model. The contrast of hydraulic conductivity and darcian velocity between layers 4 and 5 is two orders to three orders of magnitude difference respectively, and as a result the distance traveled by a particle in layer 4 is significantly less than in layer 5. Figures 21 shows polygons of the contoured 10, 30, 100, 210, and 1500 days wellfield protection areas for the four wellfields.

4.0 Assumption

Groundwater flow was assumed to flow through porous media and no preferential or non-darcian flow was considered. It was assumed that particles traveled at the same speed as groundwater and as a result no retardation and biogeochemical kinetics were assumed. To depict most conservative scenario for wellfield protection modeling, it is advisable to treat the particles as a conservative solute. No unsaturated flow modeling was considered as the study area has low relief and the unsaturated zone is relatively thin, so it was assumed that both surface runoff and any temporal delay between precipitation and recharge is negligible. One of the inherent assumption used in the local model was use of high conductance values in the C1-W and C1-N canals, whether these values represent actual field situation is beyond the scope of this modeling study.

5.0 References

Anderson, M.P. and Woessner, W.W. 1992. Applied Groundwater Modeling. Simulation of Flow and Advective Transport. Academic Press, Inc. 1-381 pp.

Chin, D. 1990. A Method to Estimate Canal Leakage to the Biscayne Aquifer, Dade County, Florida. U.S. Geological Survey, Water Resources Investigations Report 90-4135.

Department of Environmental Resources Management, 1980. Protection of Potable Water Supply Wells Program. DERM Technical Report 80-4. Miami, Florida: Metropolitan Dade County.

Doherty, J. 1994. PEST, Model Independent Parameter Estimation. Watermark

Computing.

Evans, A., 2003. Calibration and Verification of the MODBRANCH Numerical Model of the Pennsuco-Dade-Monroe (P-D-M) Area of South Florida. U.S. Army Corps of Engineers, Jacksonville District.

McDonald, M.G. and Harbaugh, A.W. 1996. A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model. Techniques of Water-Resources Investigations of the United States Geological Survey.

Pollock, D.W. 1994. Documentation of Computer Programs to Compute and Display Pathlines Using Results From the U.S. Geological Survey Modular Three-Dimensional Finite-Difference Ground-Water Flow Model. USGS Open File Report 94-464.

South Florida Water Management District, 2002 (DRAFT REPORT). A Three-Dimensional Finite Difference Groundwater Flow Model of the Surficial Aquifer-System, Dade County, Florida.

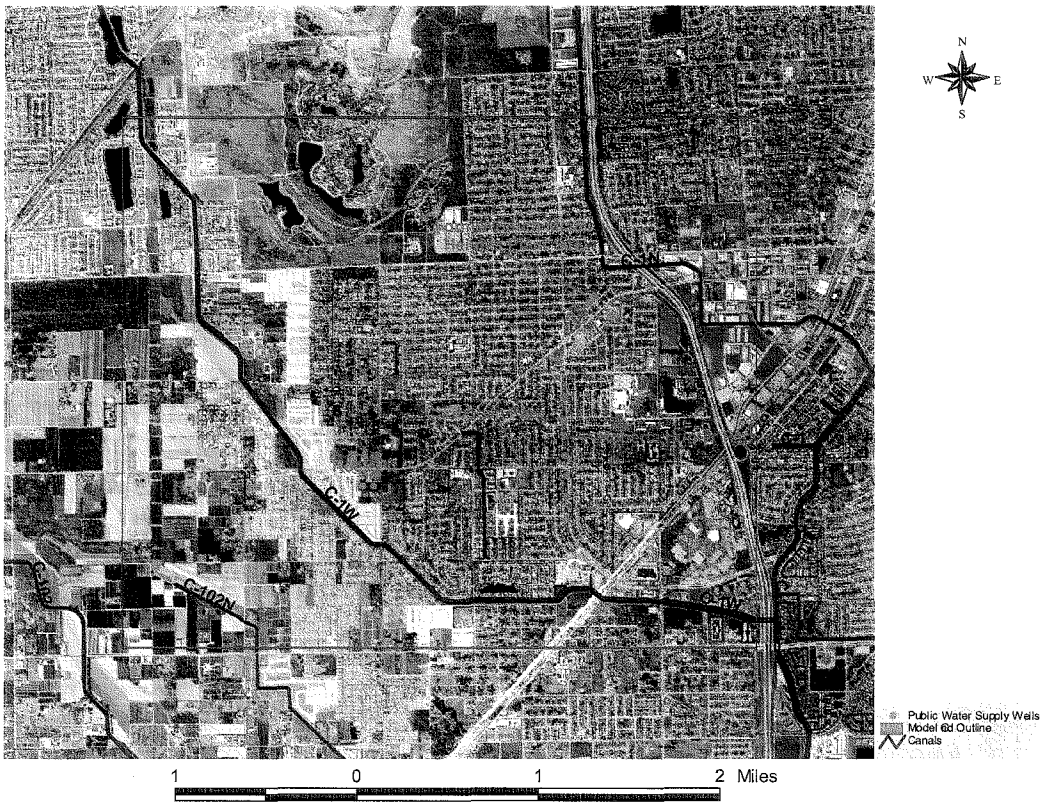


Figure 1: Location of the four proposed wellfields.

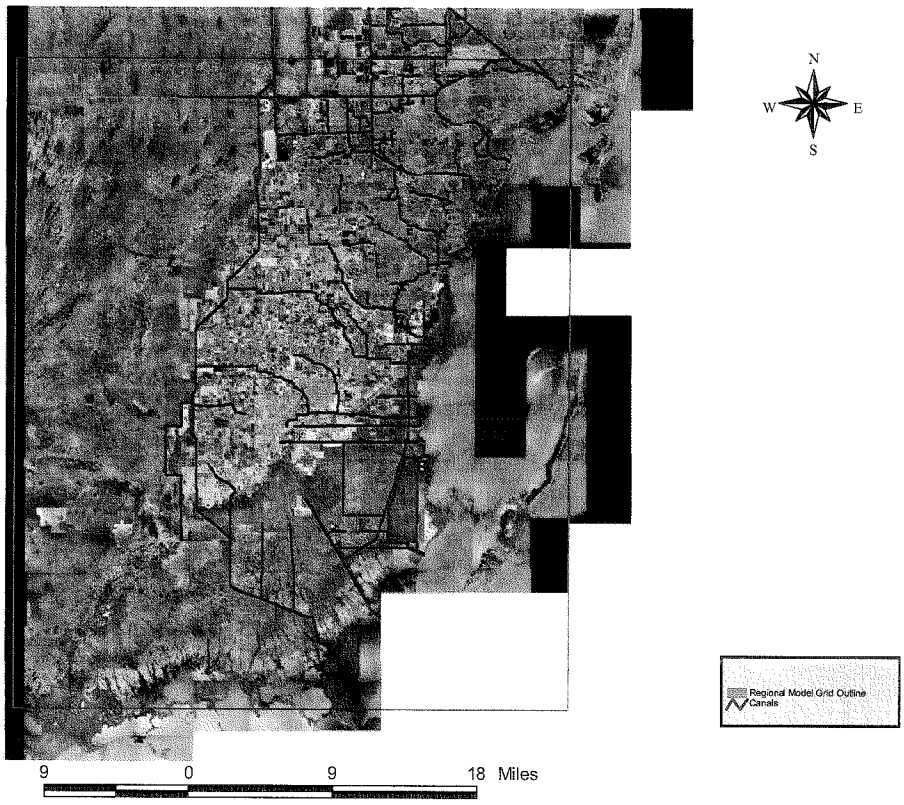


Figure 2: Modeled domain of the South Dade regional model.

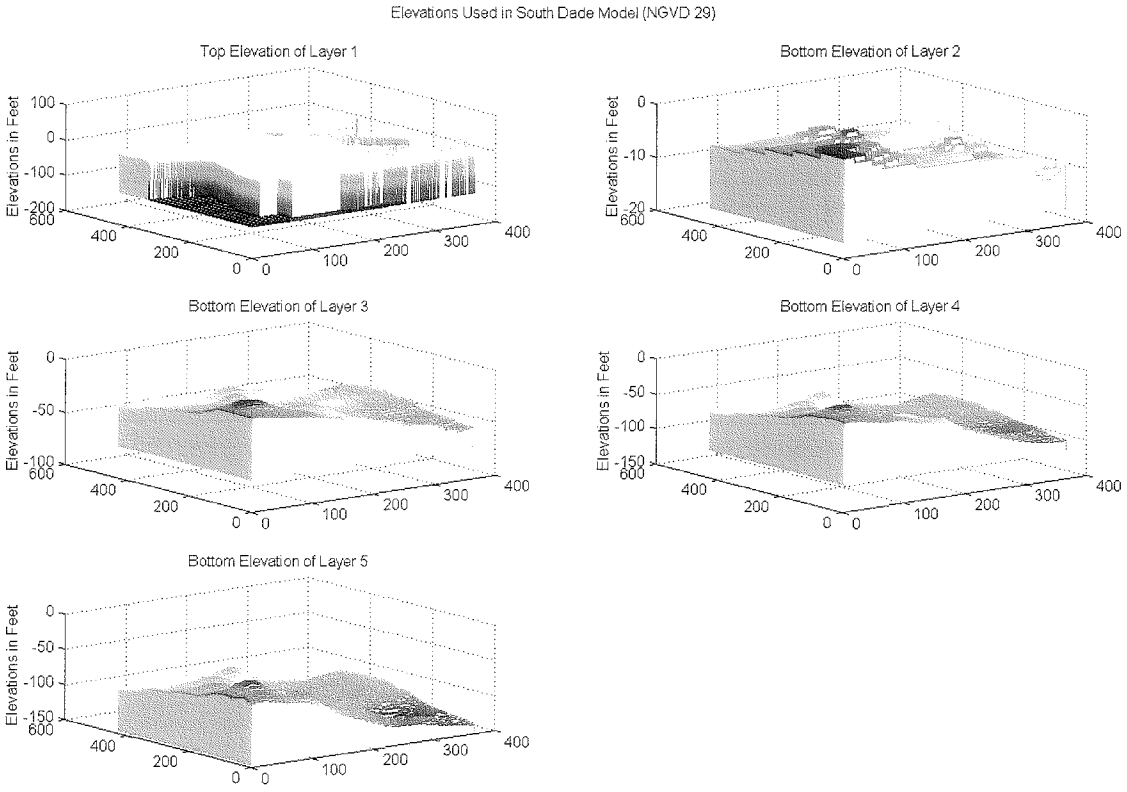


Figure 3: Elevations (in feet) of layers in the South Dade calibrated regional model.

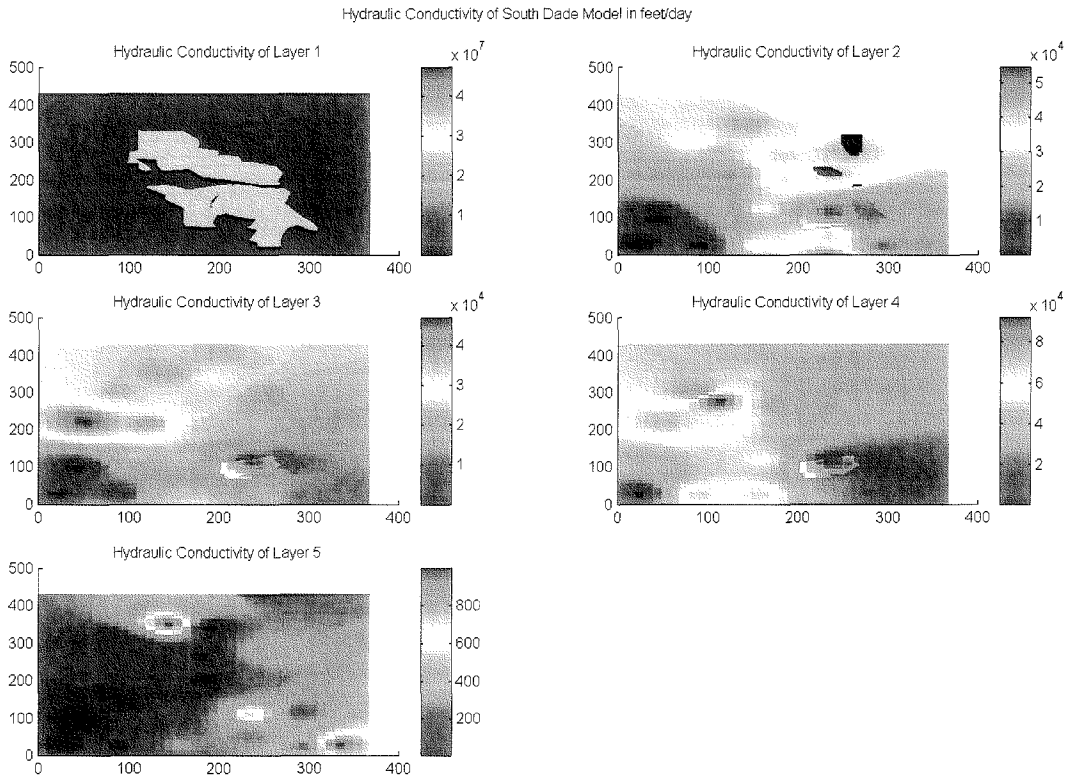


Figure 4: Hydraulic conductivity (feet/day) distribution in the calibrated regional South Dade model layers.

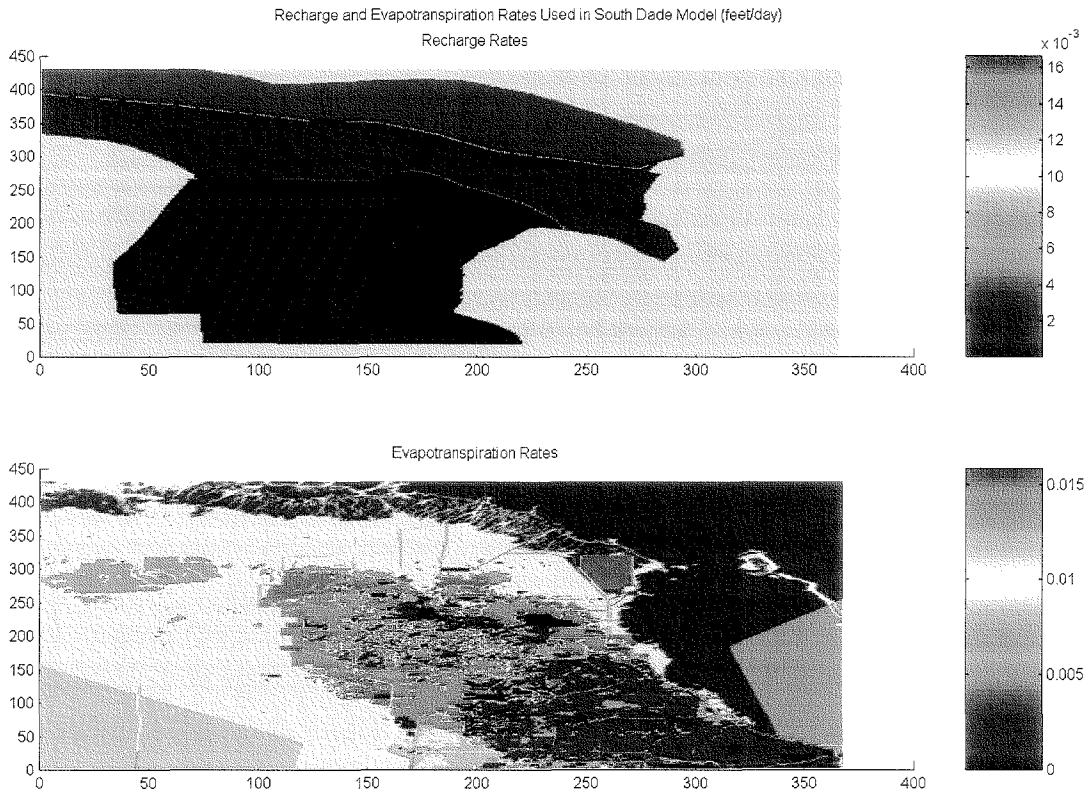
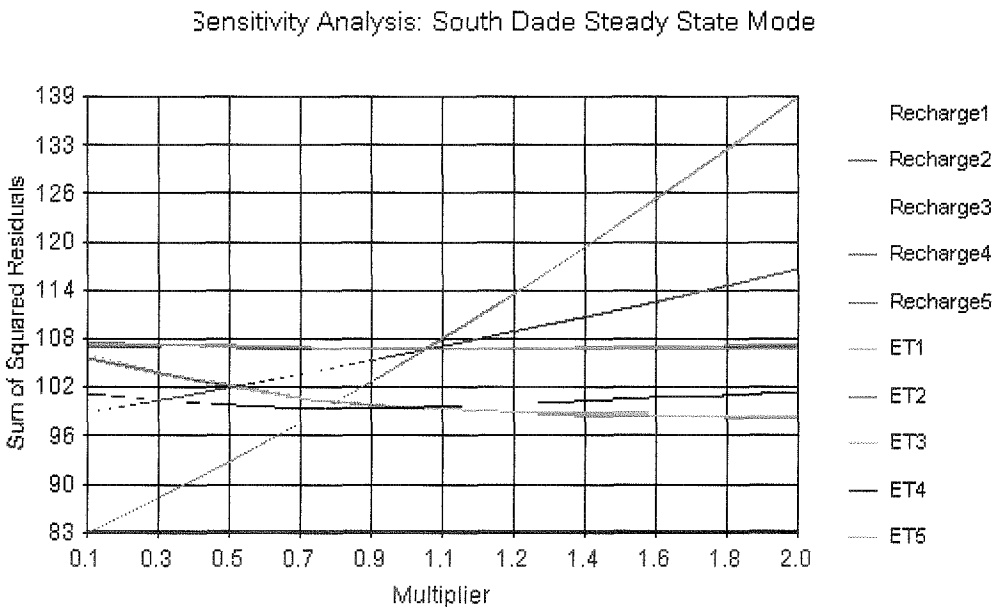


Figure 5: Recharge and Evapotranspiration rates (feet/day) used in the calibrated regional South Dade model.



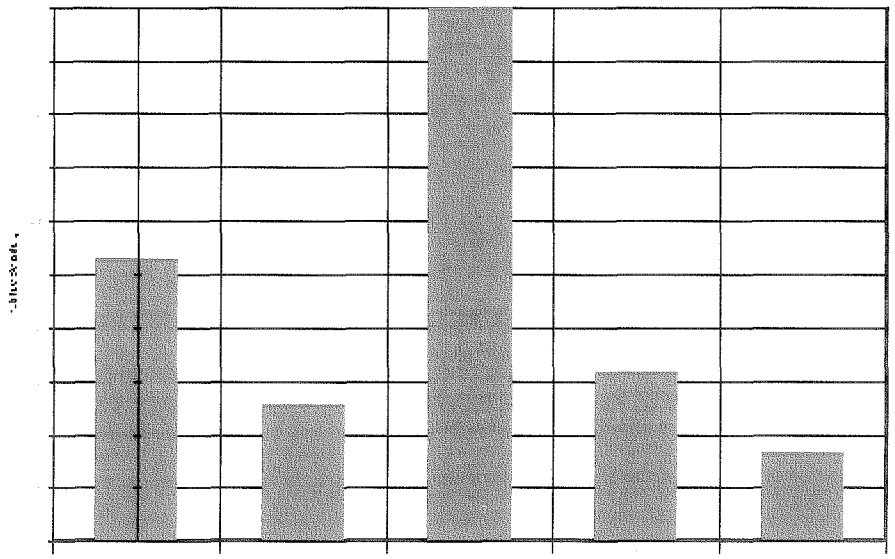


Figure 6: Plots of a) relation of sum of squared residuals with recharge and evapotranspiration rates under different multiplying factors; and b) relation of relative sensitivity of the five zones of recharge.

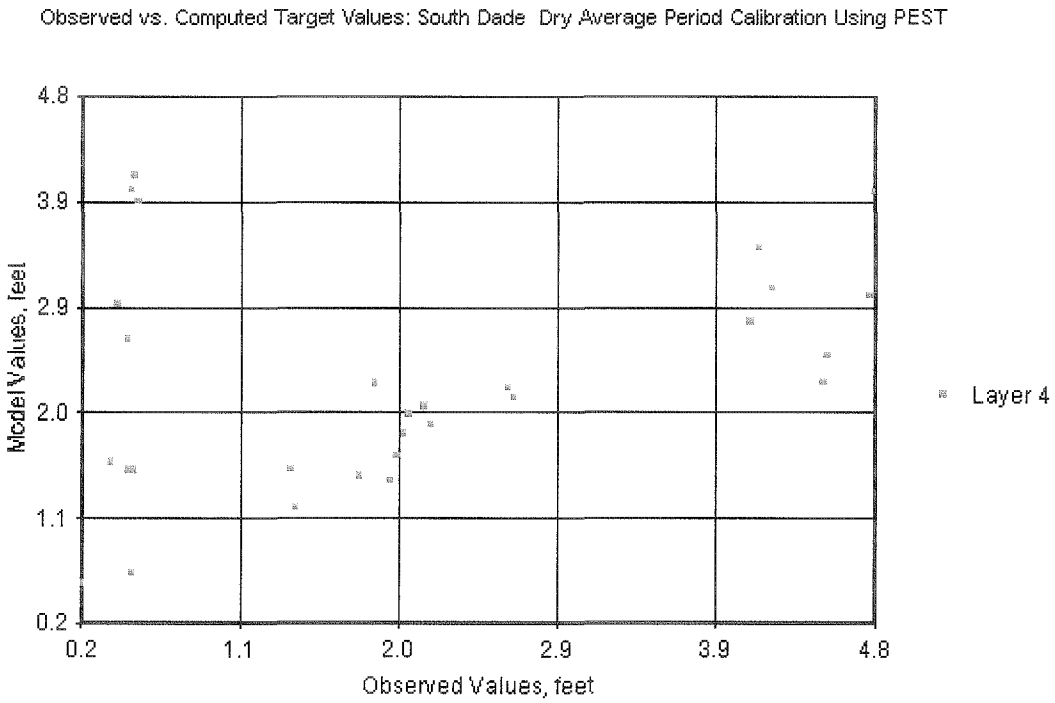


Figure 7: Shows relation between observed and calculated heads for the South Dade steady-state calibration model.

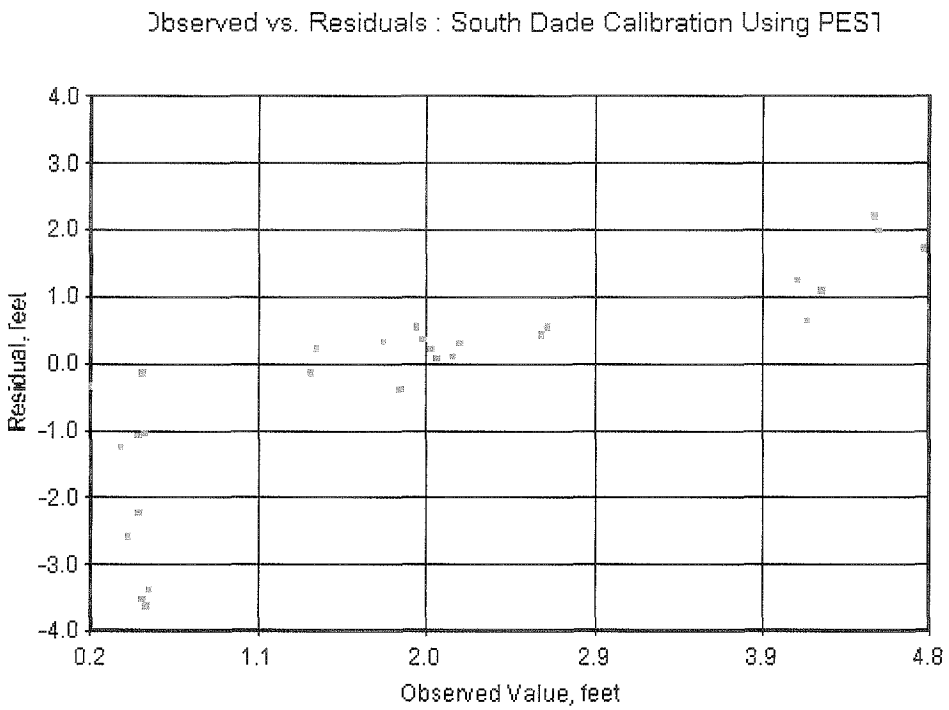


Figure 8: Shows relation between observed and residual heads for the South Dade steady-state calibration model.

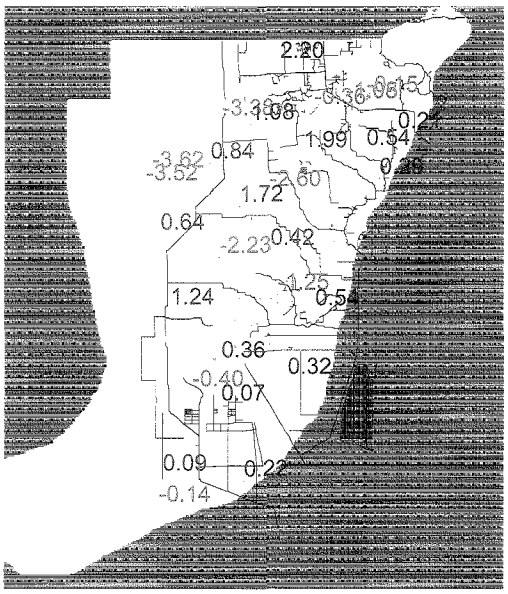


Figure 9: Shows hydraulic heads residual distribution. The blue color indicates calculated heads were greater than the measured heads, where as red color indicates vice versa.

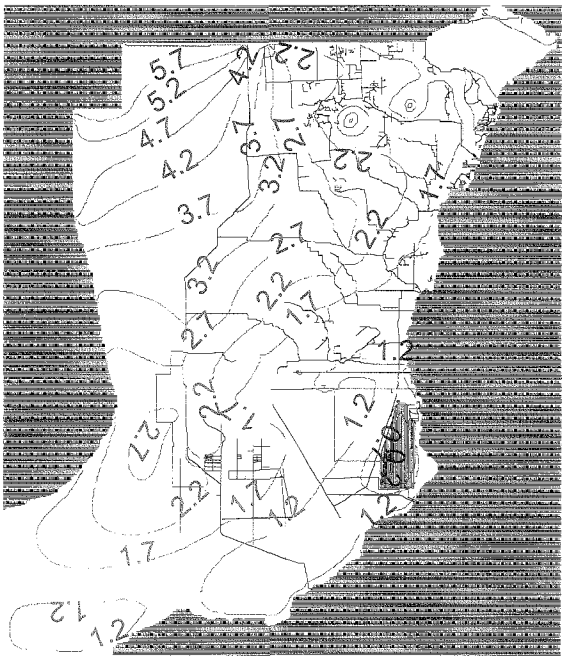


Figure 10: Shows contours of hydraulic head distribution in feet.

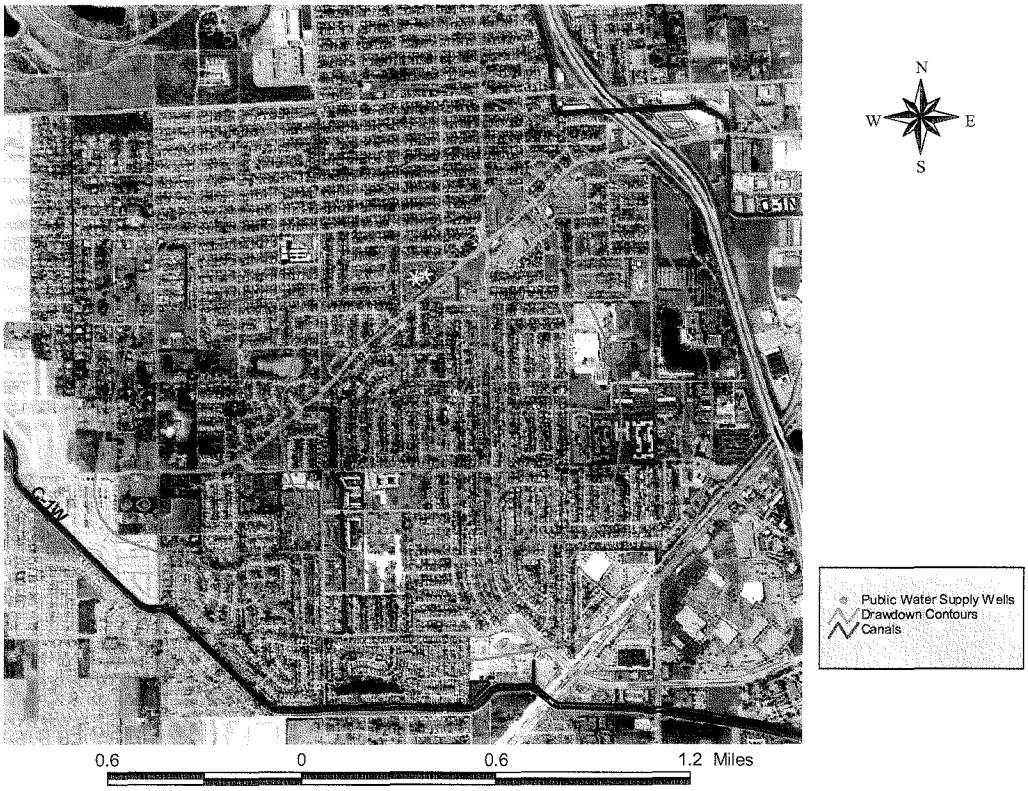


Figure 11: Shows drawdown contours in feet.

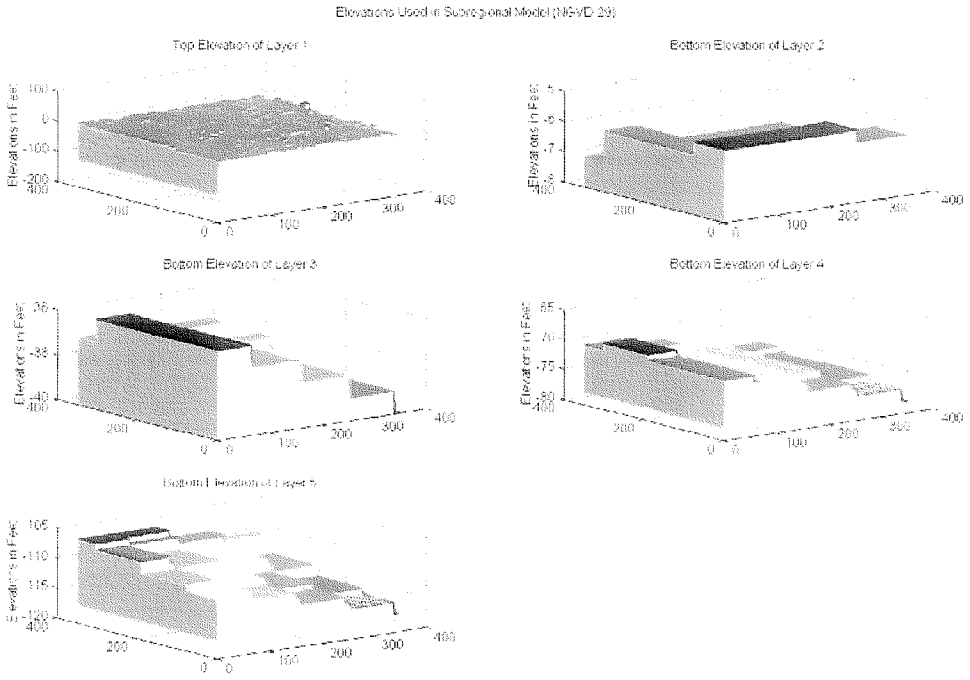


Figure 12: Shows elevations (ft) of layers in the subregional model.

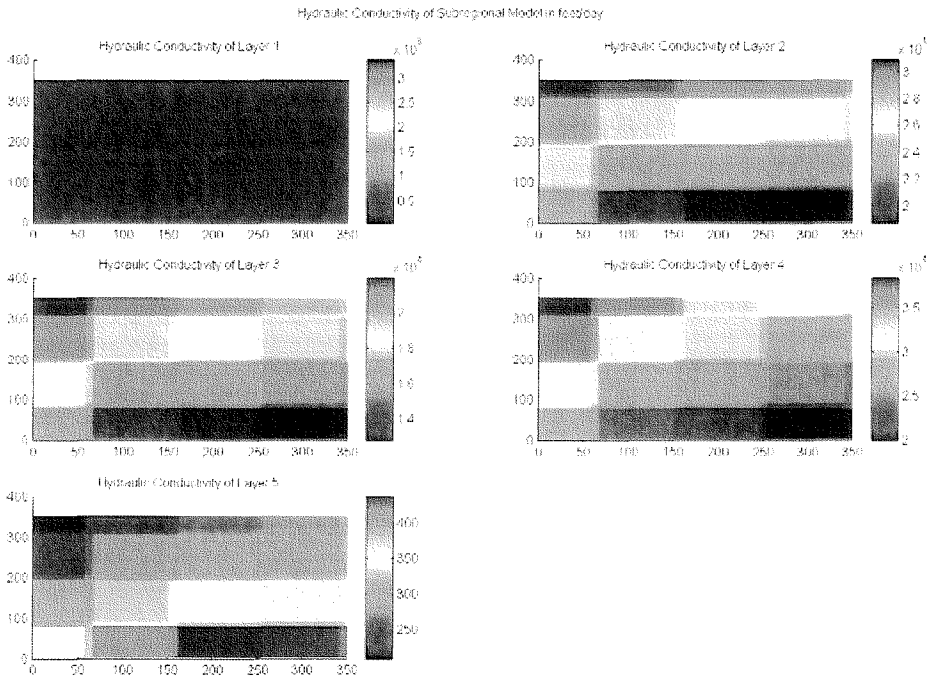


Figure 13Shows the distributi on of hydrauliconductivity (ft) within the layers of the subregional model.

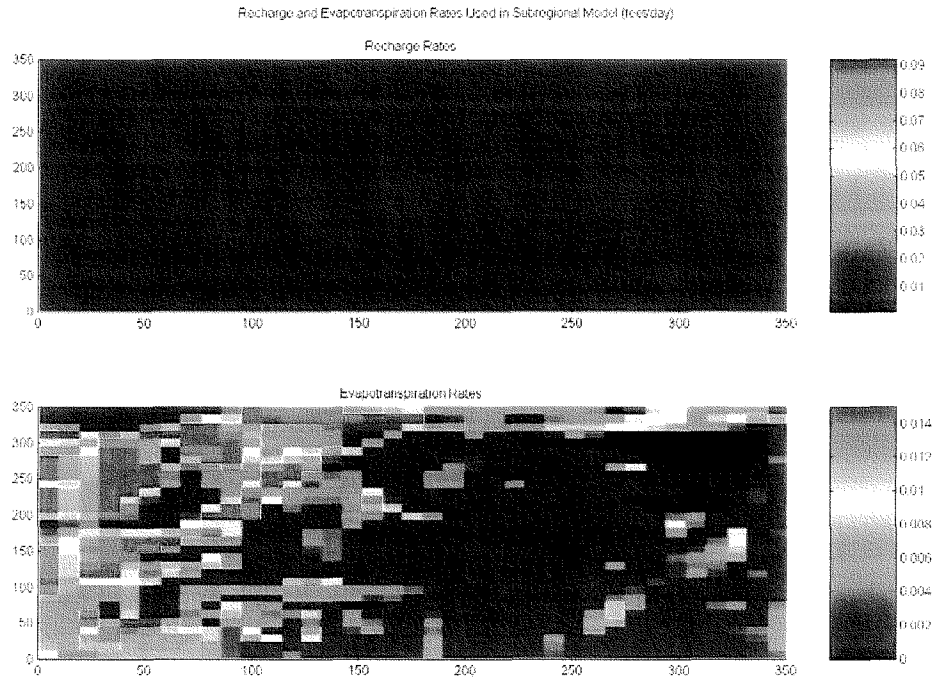


Figure 14Shows the distri bution of reharge and evaptransjration rates (ftday) in the subregional model.

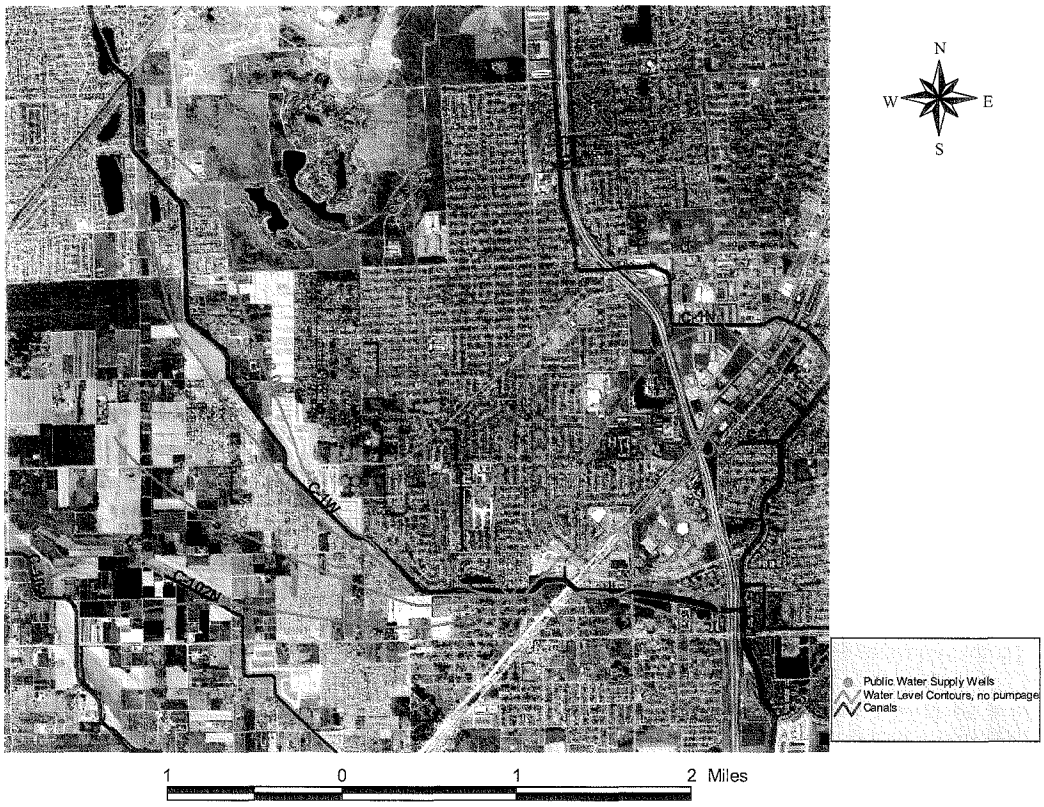


Figure 15: Distribution of hydraulic heads contour (ft) in layer 4 of the subregional model under no pumpage condition.

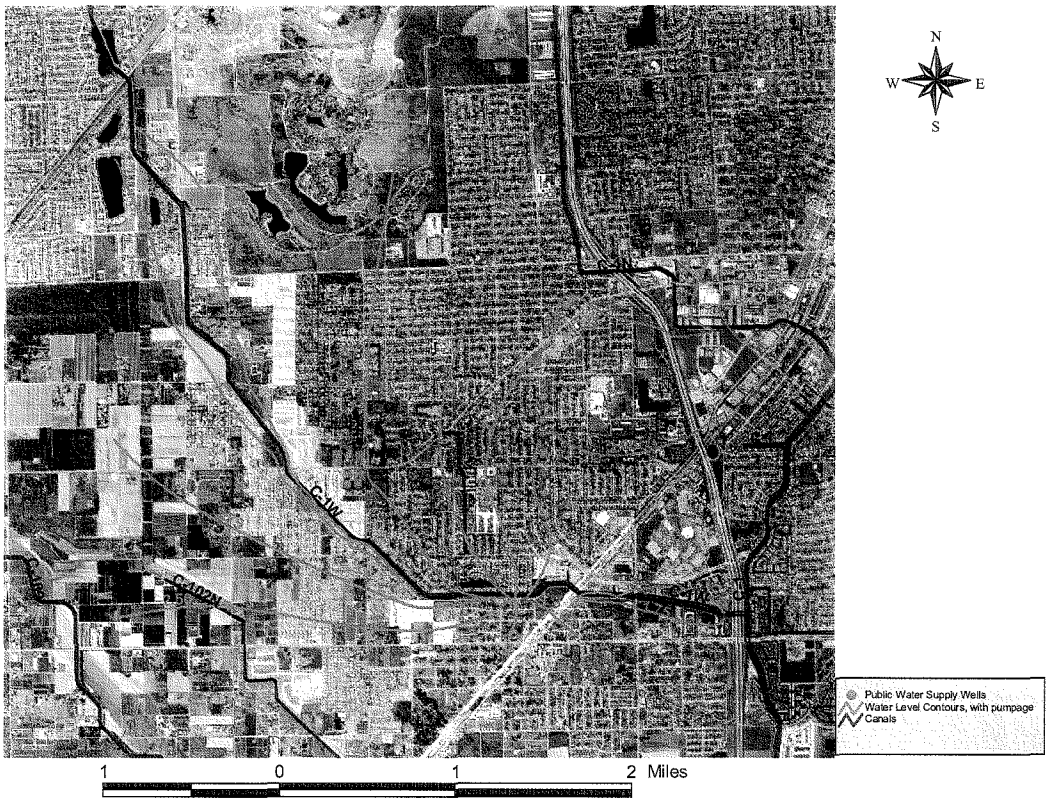


Figure 16: Distribution of hydraulic heads contour (ft) in layer 4 of the subregional model under pumpage condition.

Sensitivity Analysis on Canal Conductance

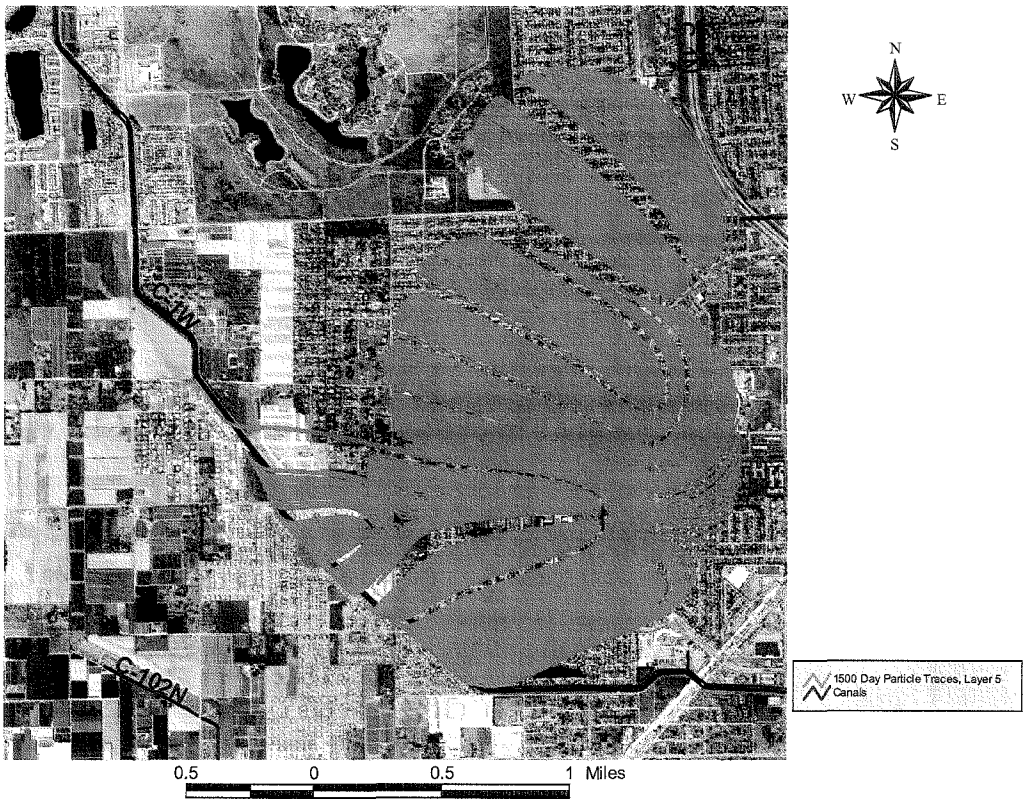


Figure 17-a. Sensitivity of 1500 day capture zone particle traces when canal conductance in C1-W and C1-N canals were set at 7.9 x 10^5 ft^2/ day and 4 x 10^5 ft^2/ day per 1000 ft of canal length respectively.

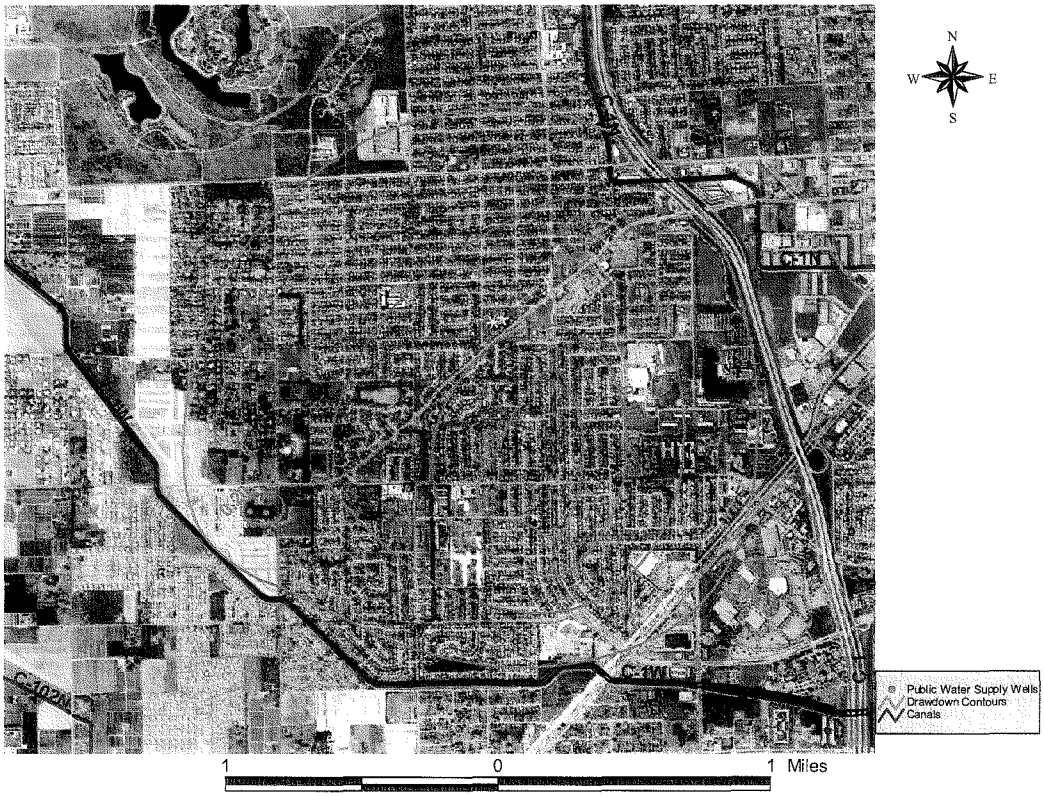


Figure 17-b. Sensitivity of groundwater drawdown when canal conductance in C1-W and C1-N canals were set at 7.9 x 10^5 ft^2/ day and 4 x 10^5 ft^2/ day per 1000 ft of canal length respectively.

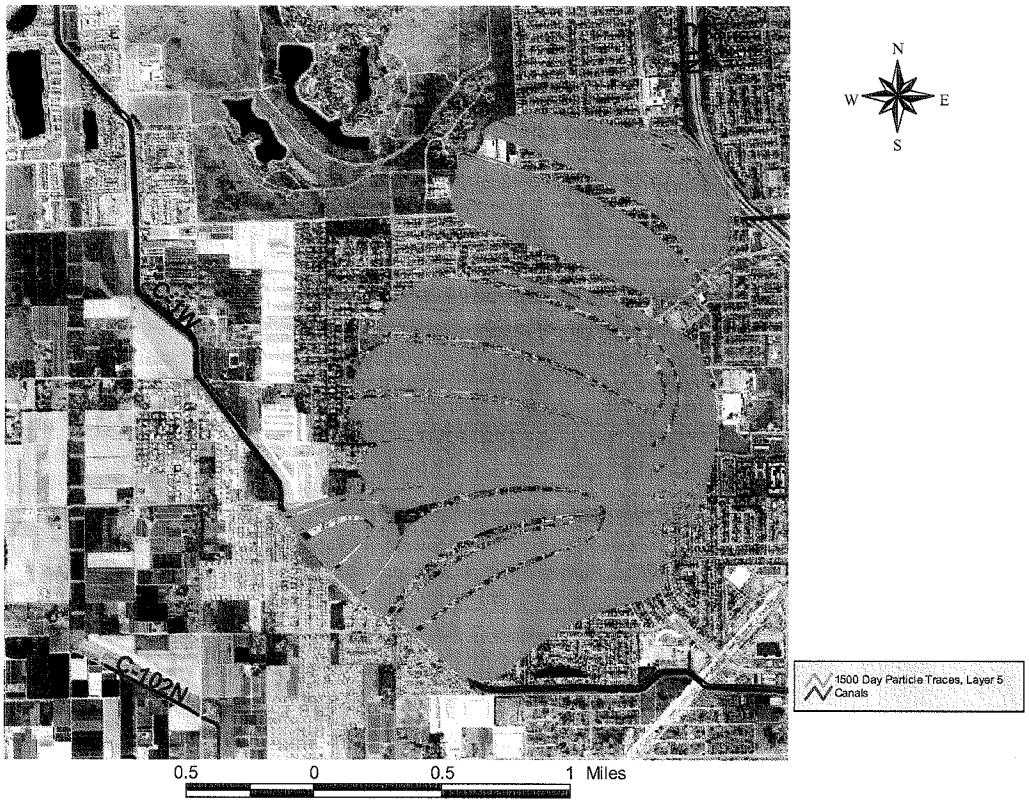


Figure 17-c. Sensitivity of 1500 day capture zone particle traces when canal conductance in C1-W and C1-N canals were set at 7.9 x 10^6 ft^2/ day and 4 x 10^6 ft^2/ day per 1000 ft of canal length respectively.

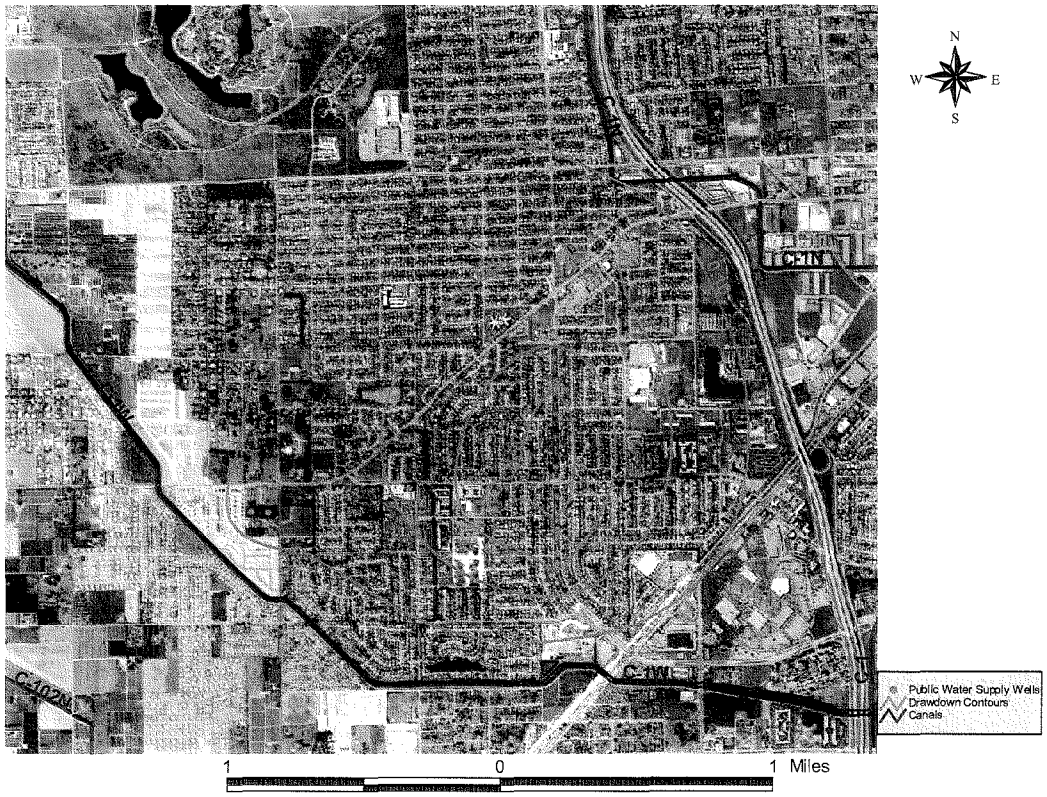


Figure 17-d. Sensitivity of groundwater drawdown when canal conductance in C1-W and C1-N canals were set at 7.9 x 10^6 ft^2/ day and 4 x 10^6 ft^2/ day per 1000 ft of canal length respectively.

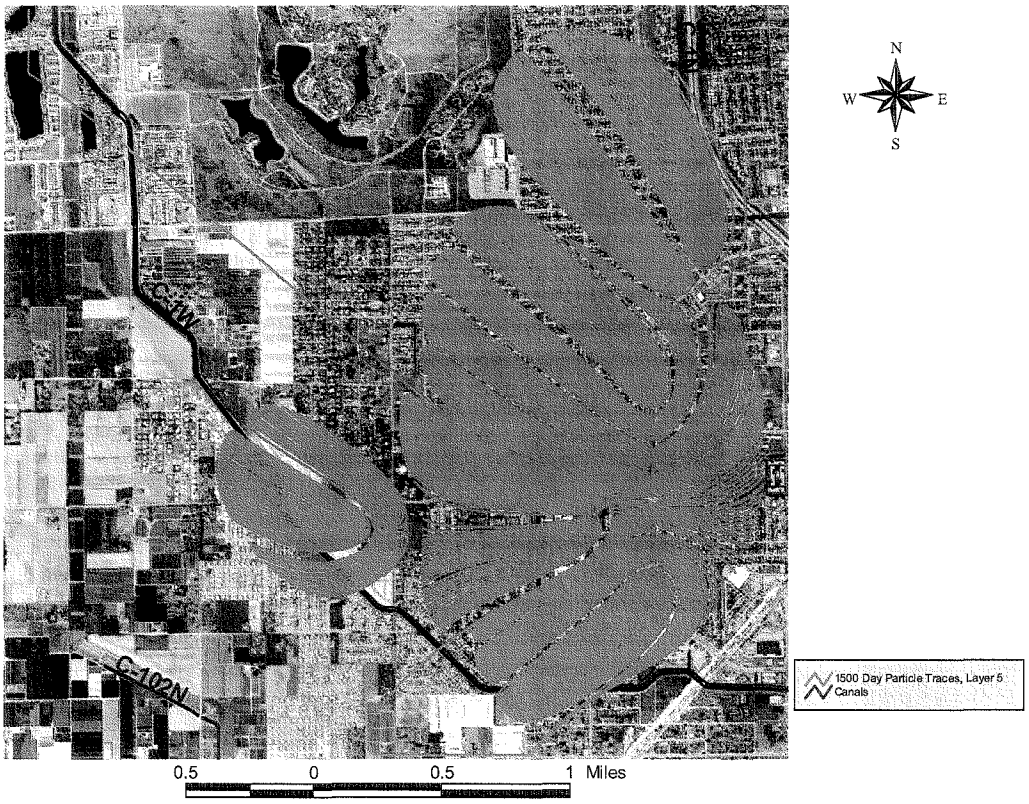


Figure 17-e. Sensitivity of 1500 day capture zone particle traces when canal conductance in C1-W and C1-N canals were set at 7.9 x 10^3 ft^2/ day and 4 x 10^3 ft^2/ day per 1000 ft of canal length respectively.

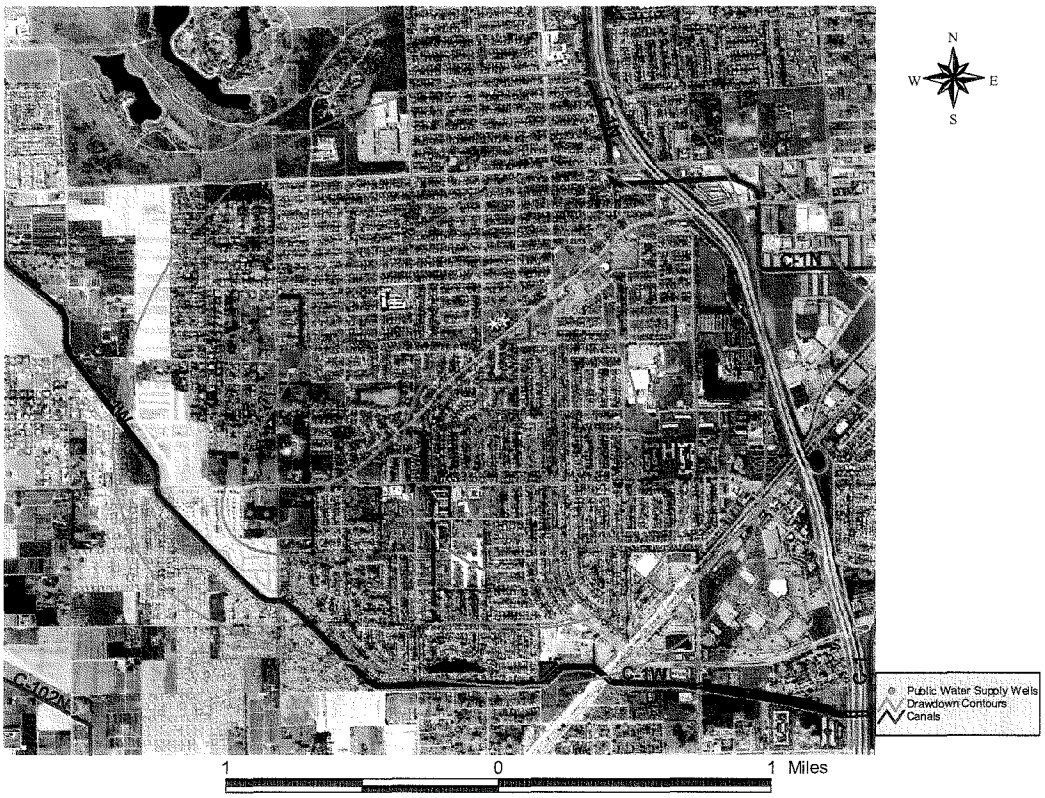


Figure 17-f. Sensitivity of groundwater drawdown when canal conductance in C1-W and C1-N canals were set at 7.9 x 10^3 ft^2/ day and 4 x 10^3 ft^2/ day per 1000 ft of canal length respectively.

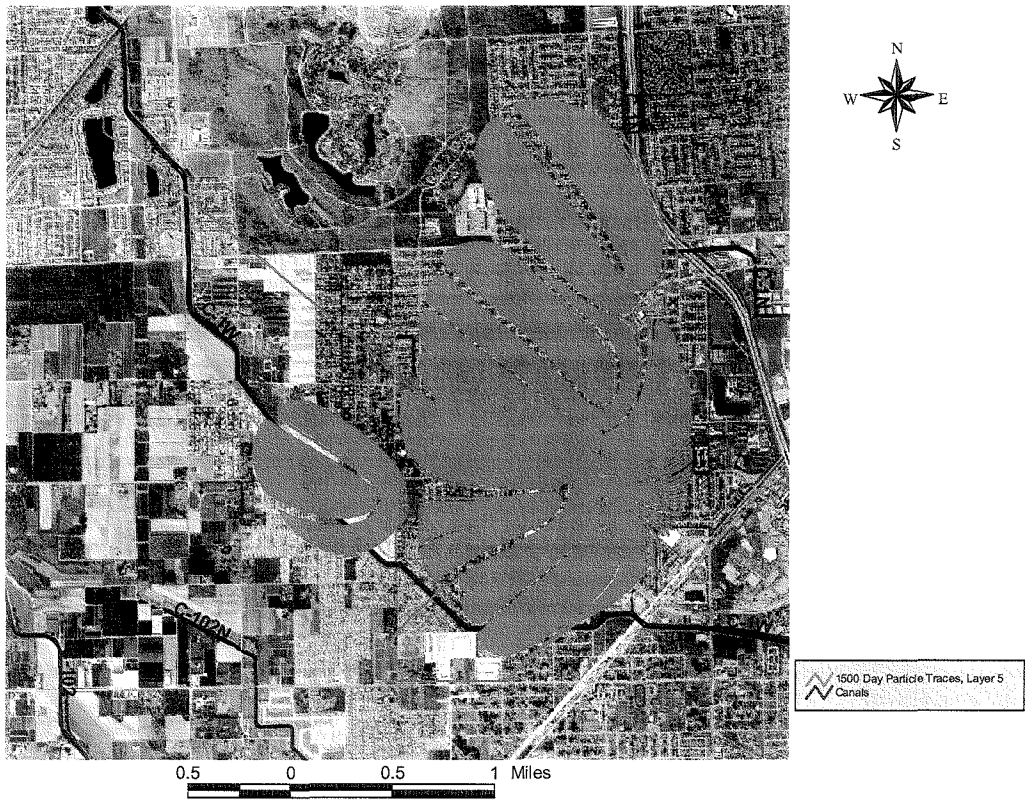


Figure 17-g. Sensitivity of 1500 day capture zone particle traces when canal conductance in C1-W and C1-N canals were set at 7.9 x 10^2 ft^2/ day and 4 x 10^2 ft^2/ day per 1000 ft of canal length respectively.

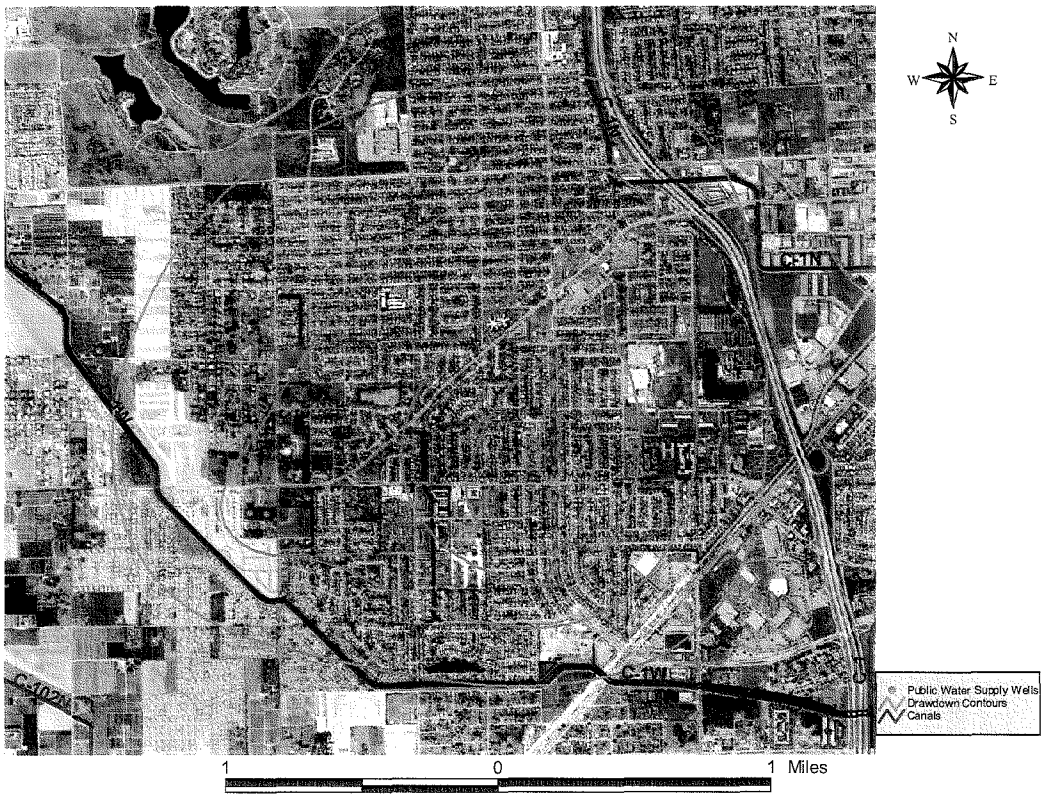


Figure 17-h. Sensitivity of groundwater drawdown when canal conductance in C1-W and C1-N canals were set at 7.9 x 10^2 ft^2/ day and 4 x 10^2 ft^2/ day per 1000 ft of canal length respectively.

Sensitivity Analysis on Recharge Rates

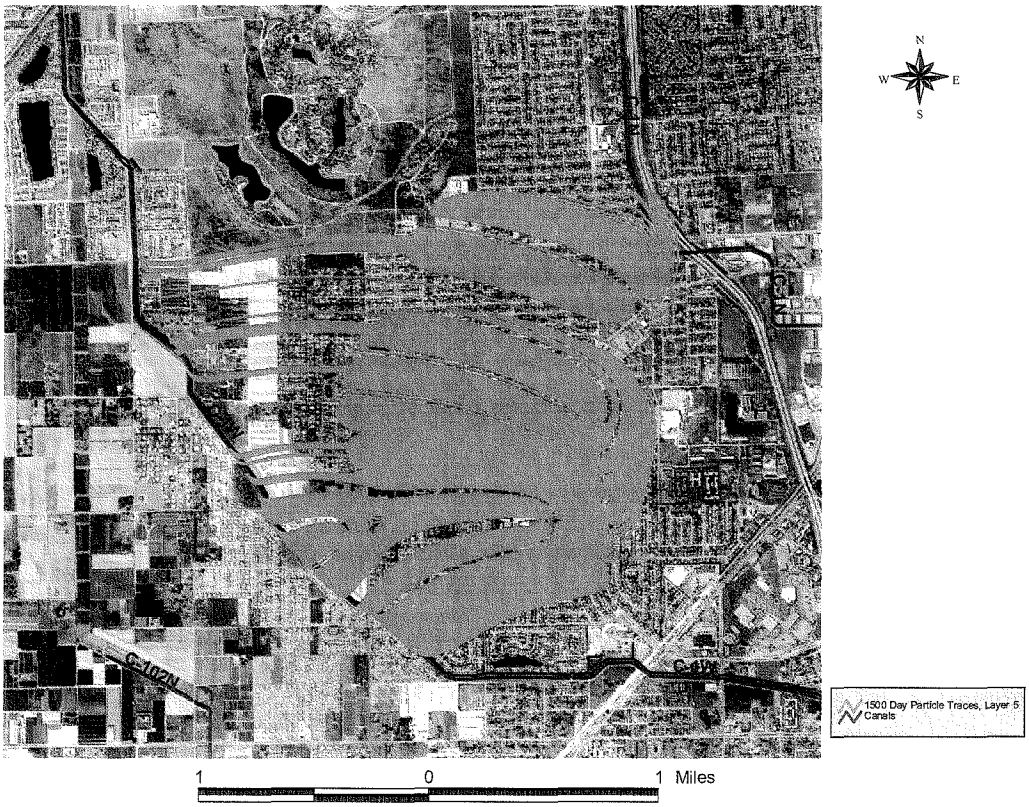


Figure 18-a. Sensitivity of 1500 day capture zone particle traces when recharge rate was 87.6 inches/year.

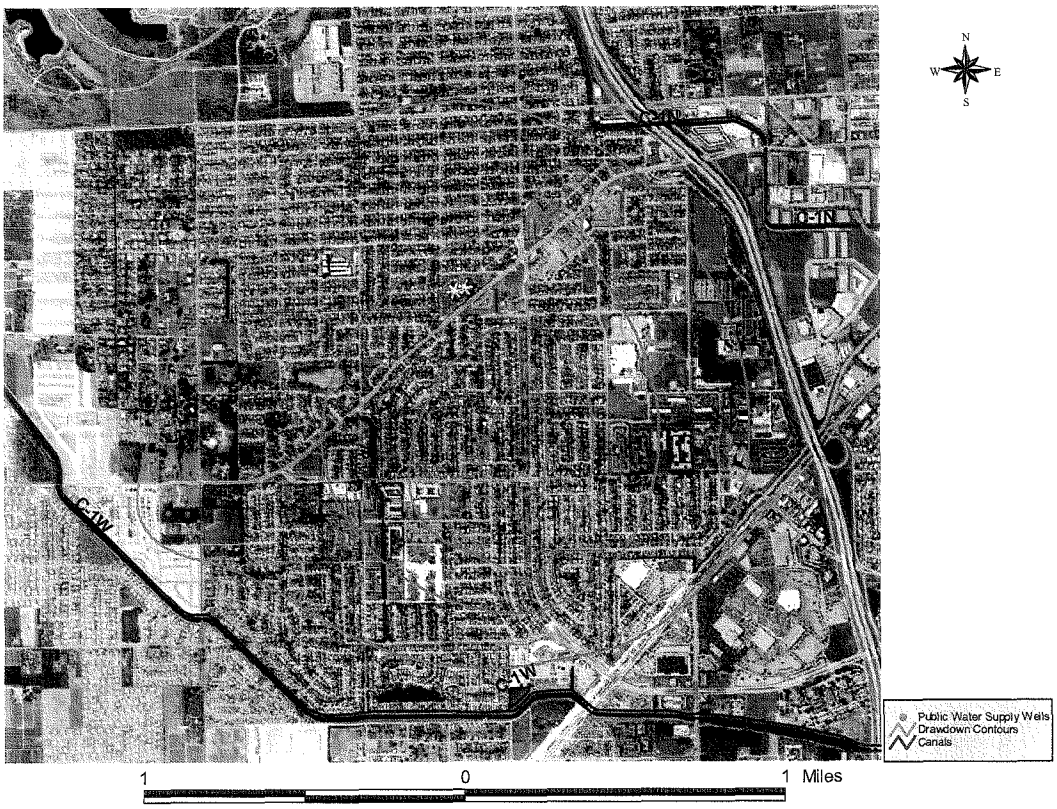


Figure 18-b. Sensitivity to drawdown when recharge rate was 87.6 inches/year.

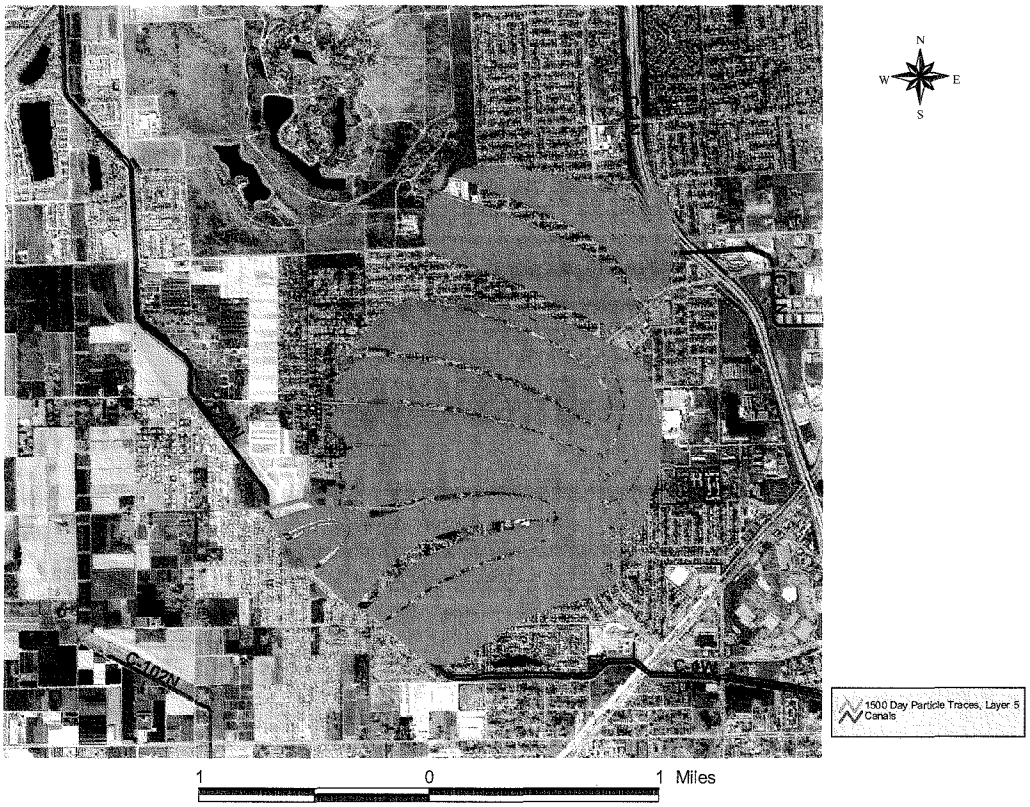


Figure 18-c. Sensitivity of 1500 day capture zone particle traces when recharge rate was 43.8 inches/year.

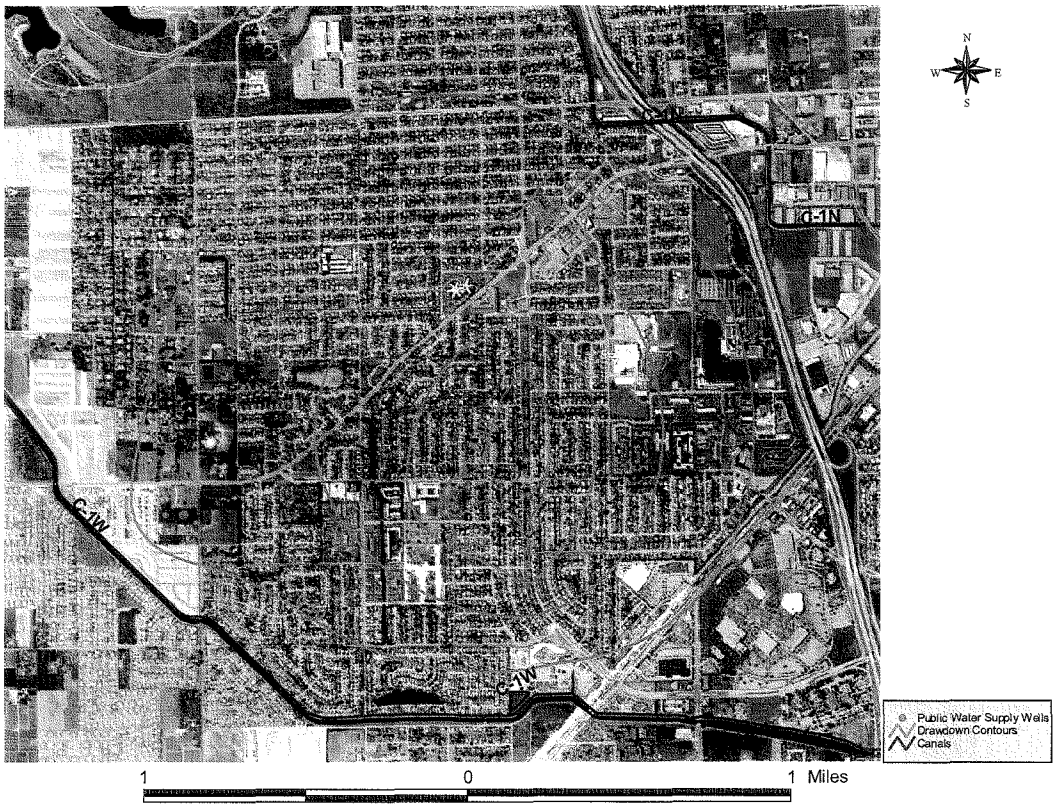


Figure 18-d. Sensitivity to drawdown when recharge rate was 43.8 inches/year.

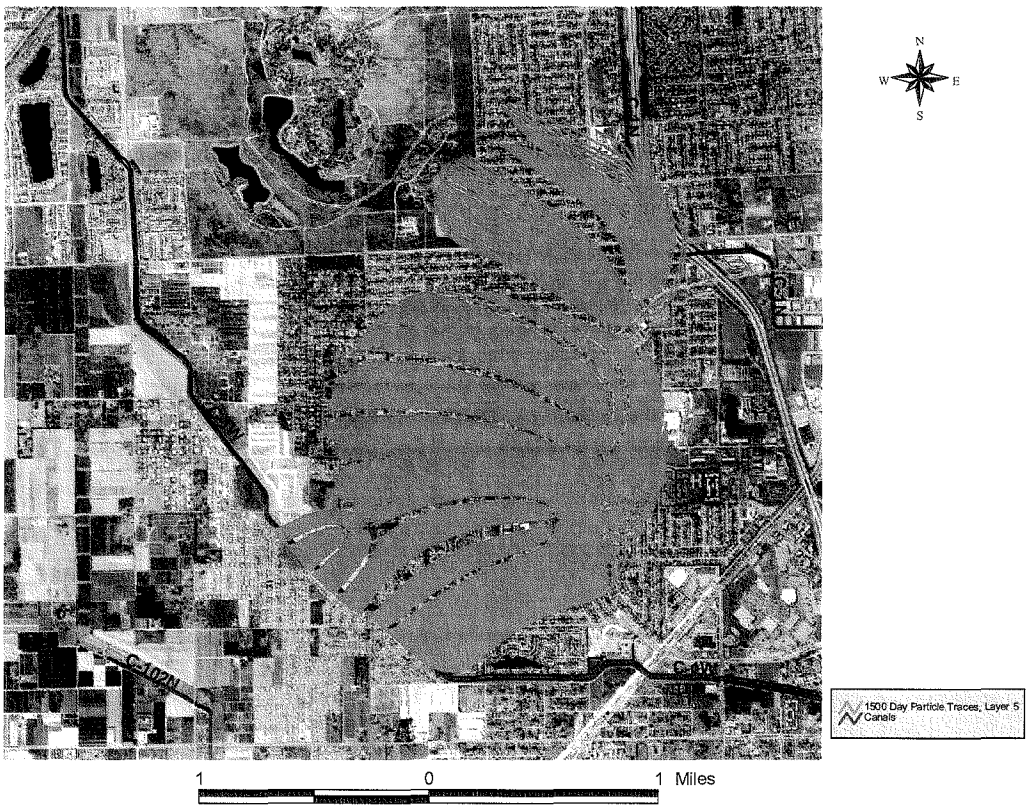


Figure 18-e. Sensitivity of 1500 day capture zone particle traces when recharge rate was 4.38 inches/year.

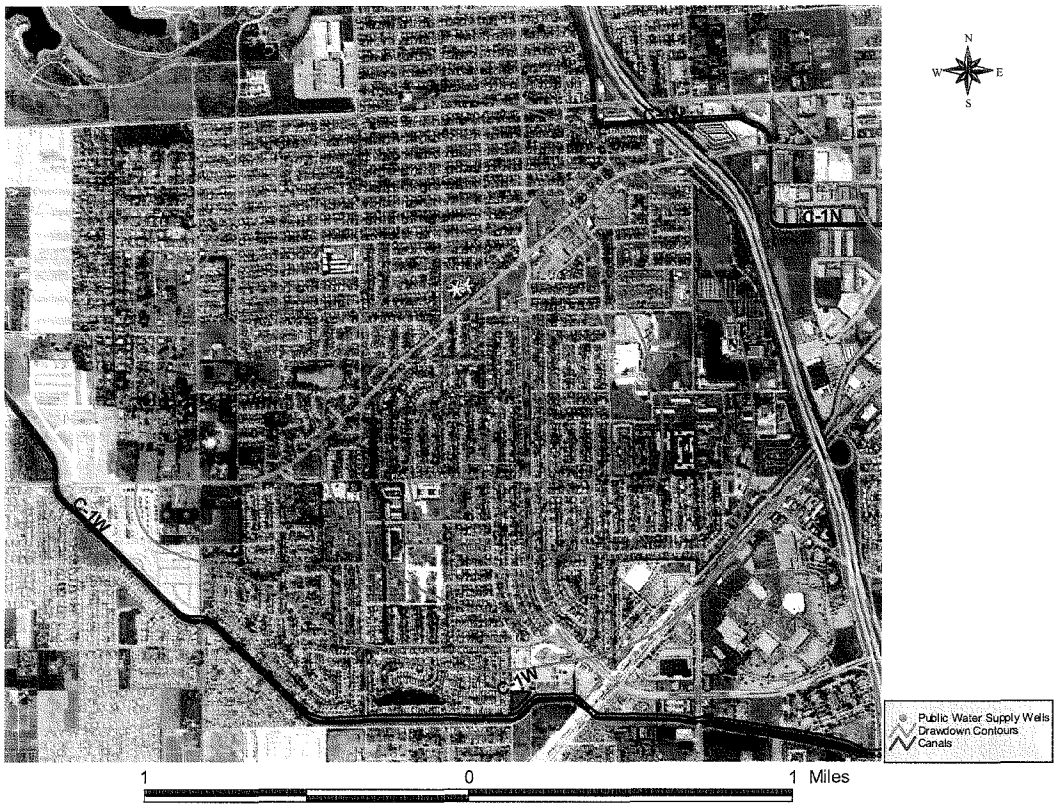


Figure 18-f. Sensitivity to drawdown when recharge rate was 4.38 inches/year.

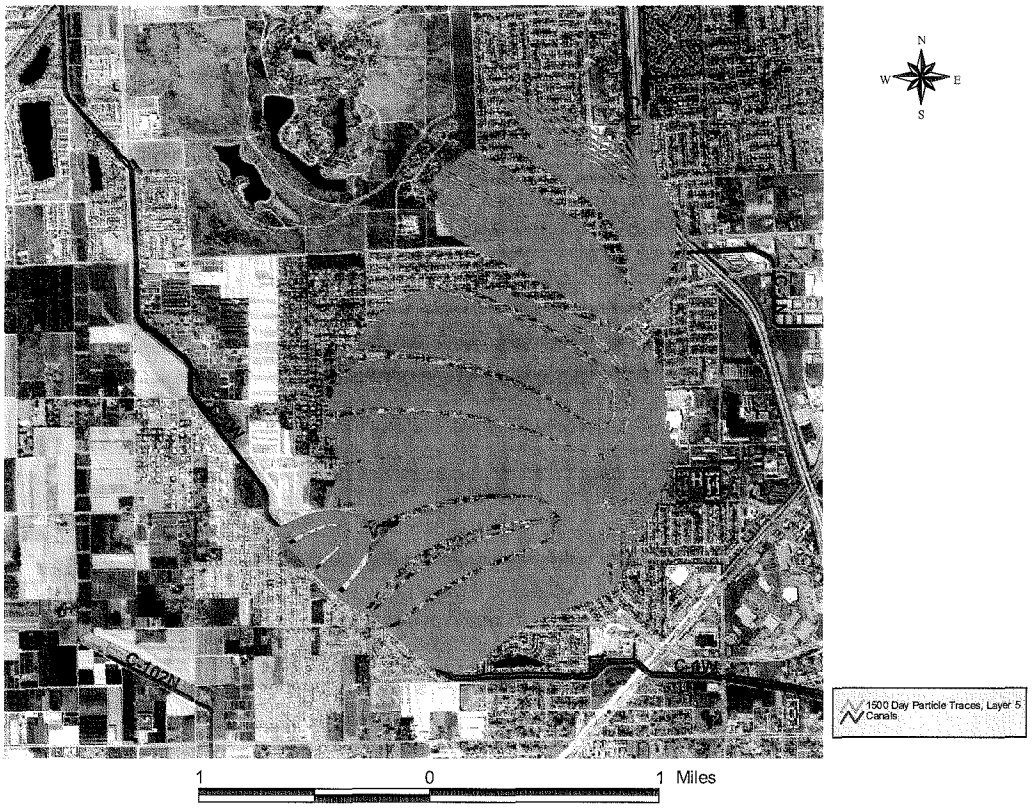


Figure 18-g. Sensitivity of 1500 day capture zone particle traces when recharge rate was 0.438 inches/year.

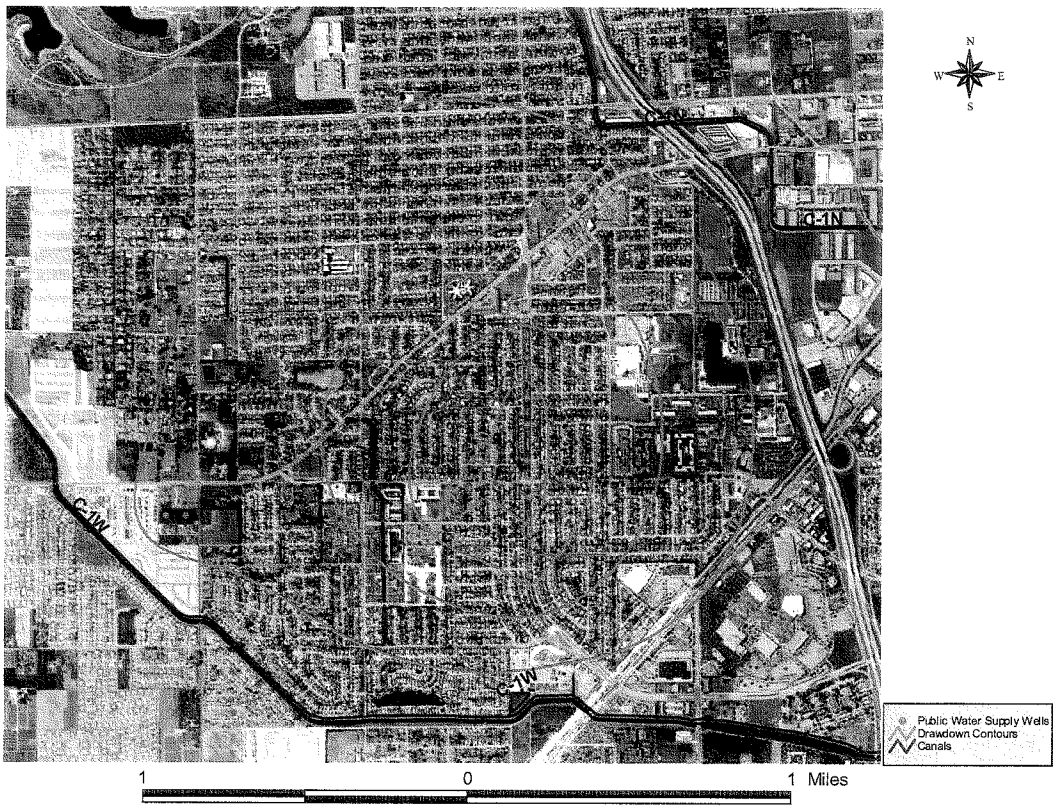


Figure 18-h. Sensitivity to drawdown when recharge rate was 0.438 inches/year.

Sensitivity Analysis on Evapotranspiration Rates

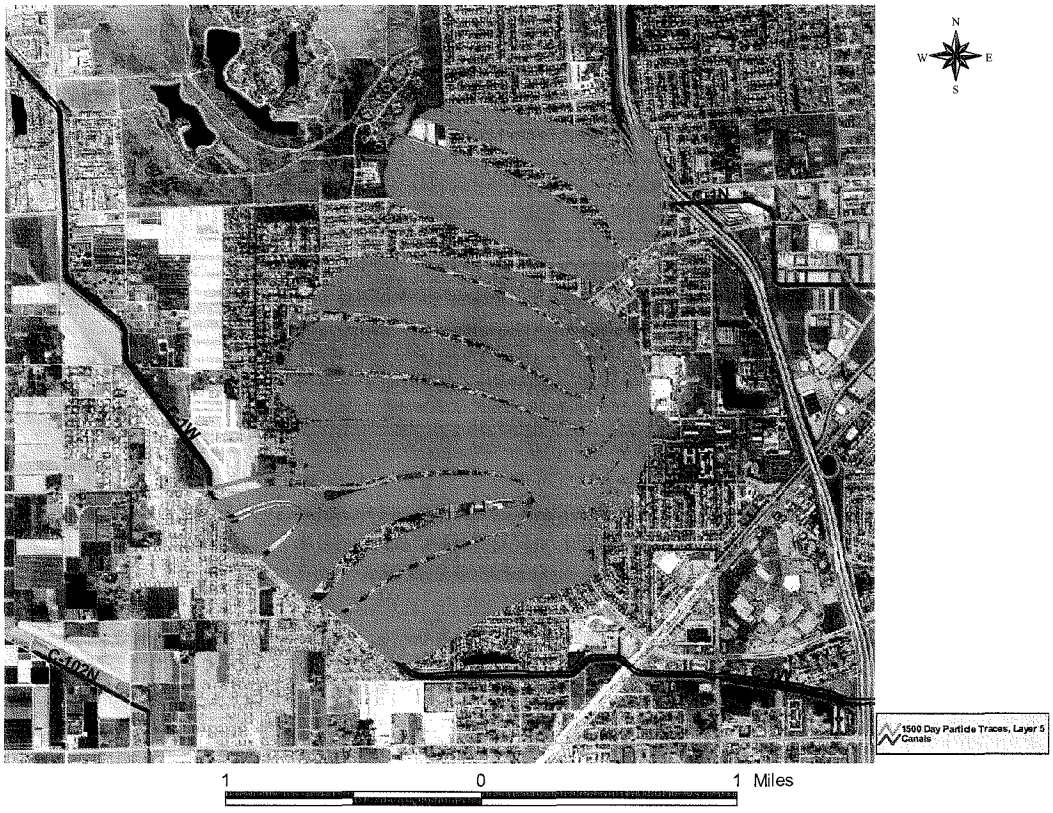


Figure 19-a. Sensitivity of 1500 day capture zone particle traces when ET rate was 87.6 inches/year.

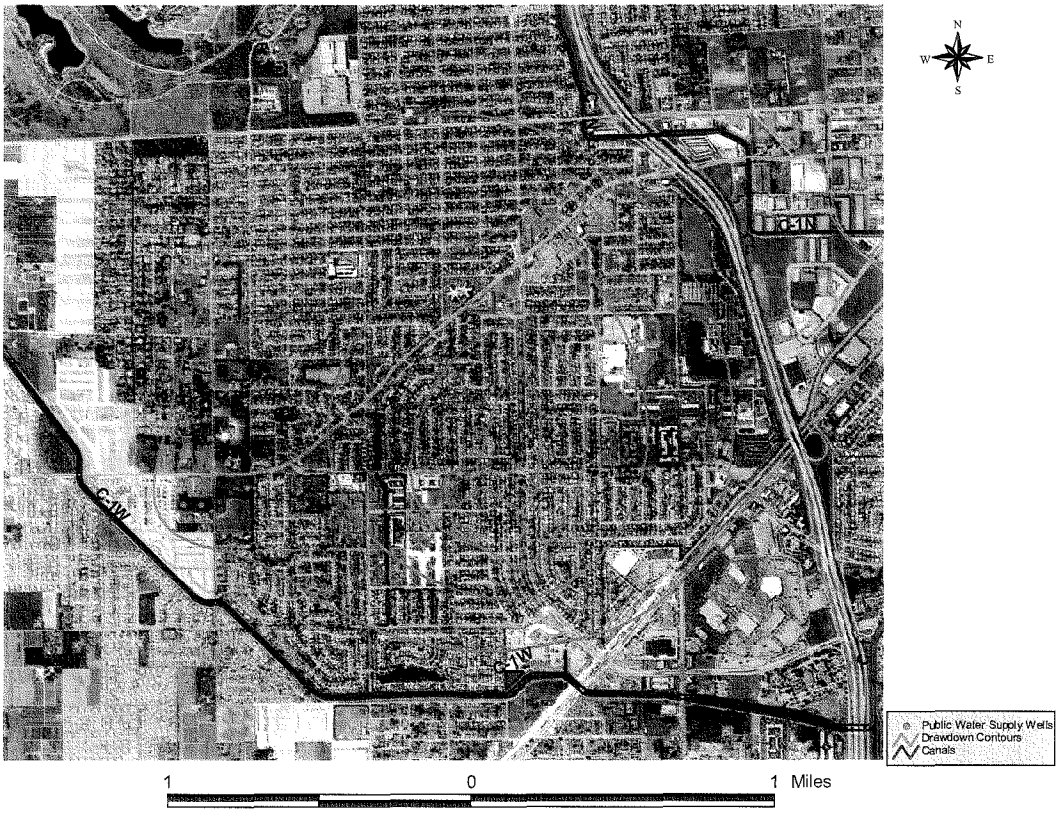


Figure 19-b. Sensitivity to drawdown when ET rate was 87.6 inches/year.

Figure 20-a: Shows 210 and 1500 days particle traces in layer 2.

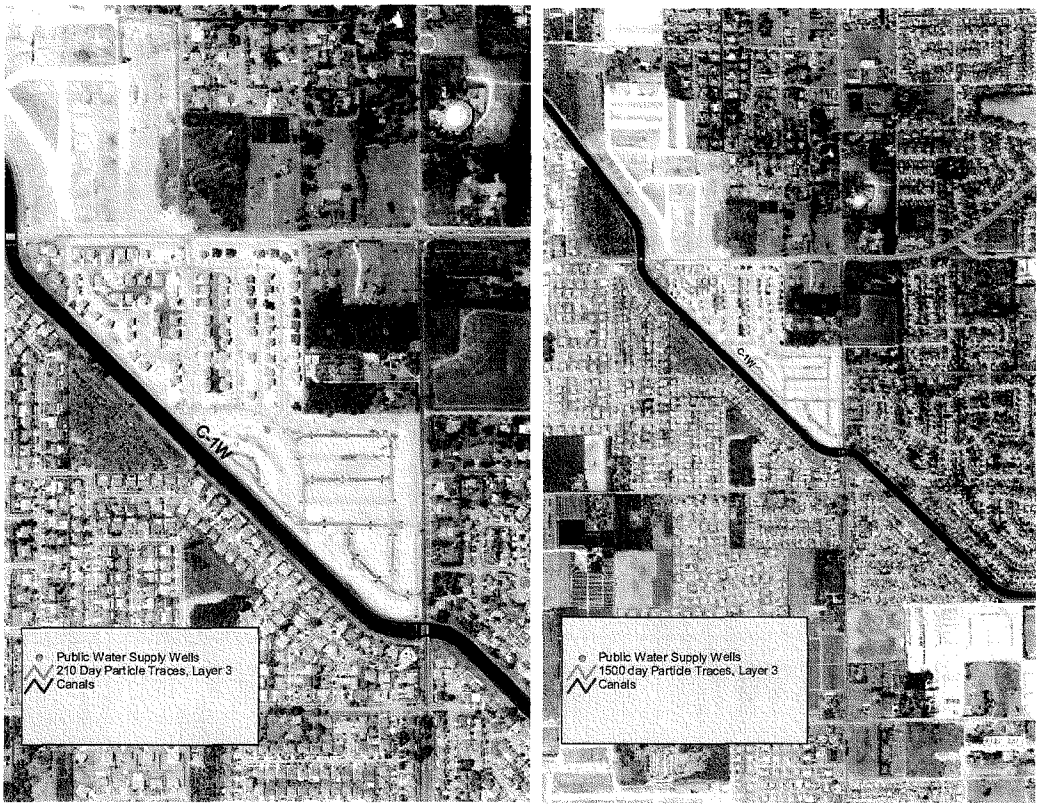


Figure 20-b: Shows 210 and 1500 days particle traces in layer 3.

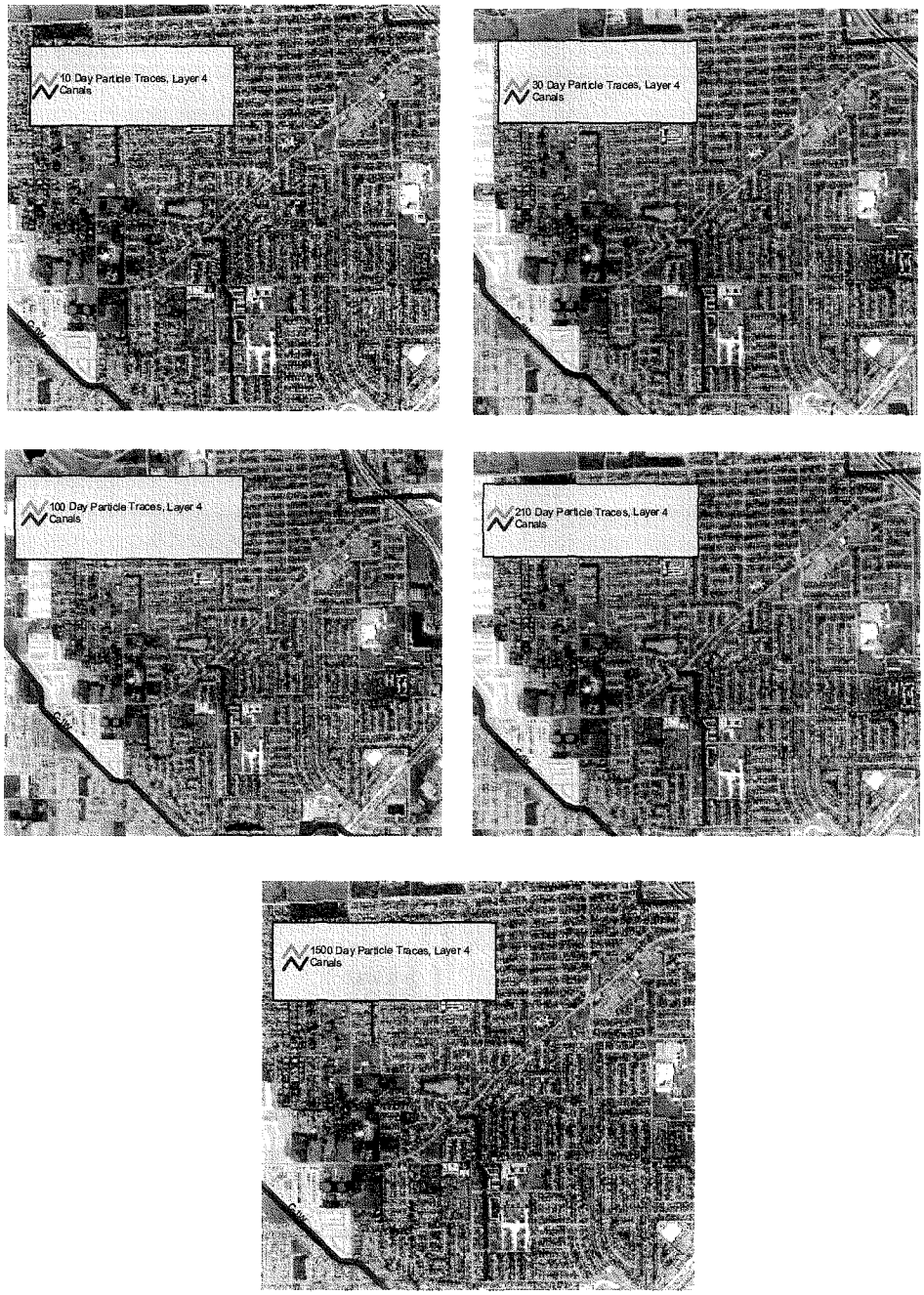


Figure 20-c: Shows 10, 30, 100, 210 and 1500 days particle traces in layer 4.

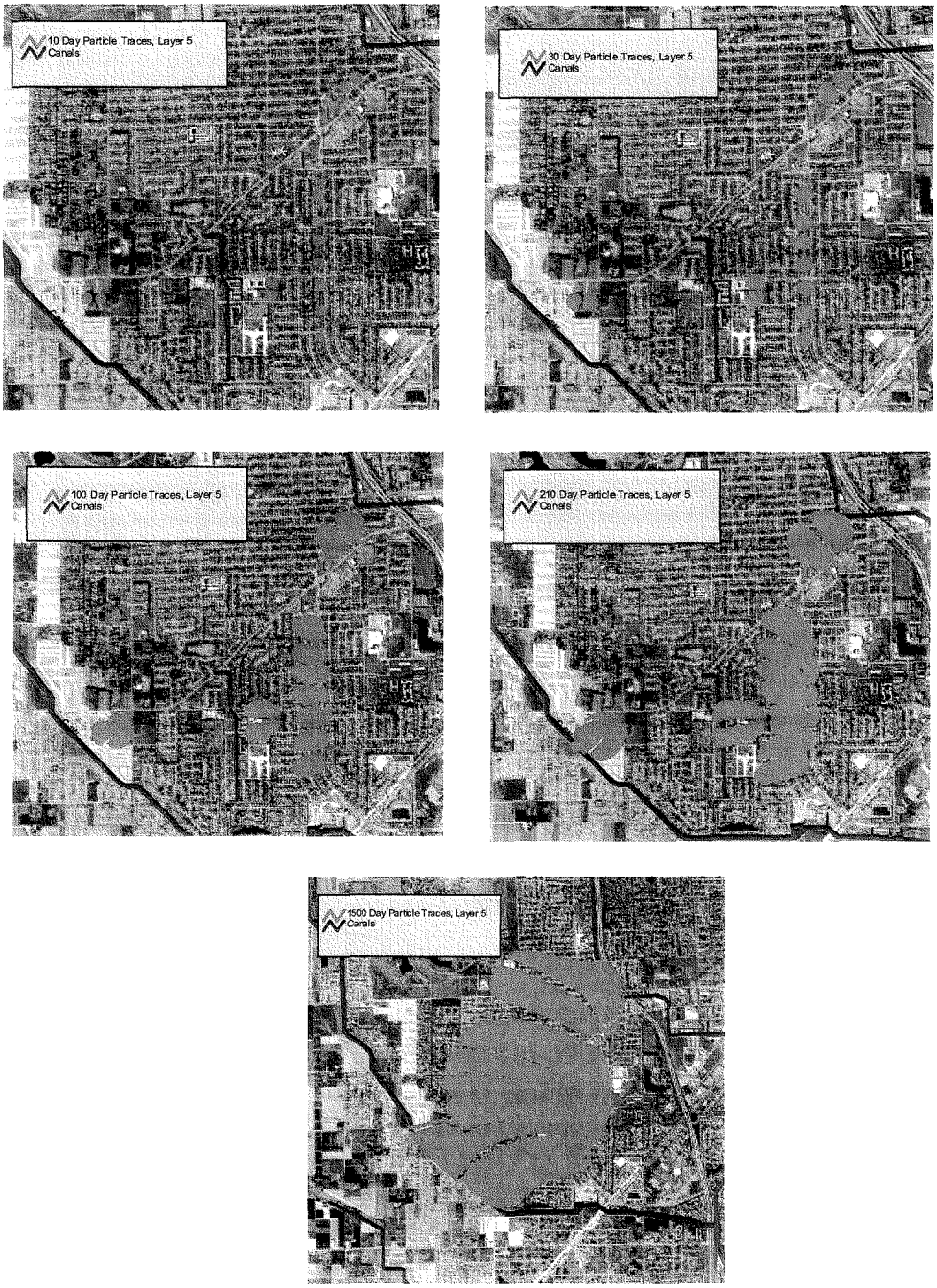


Figure 20-d: Shows 10, 30, 100, 210 and 1500 days particle traces in layer 5.

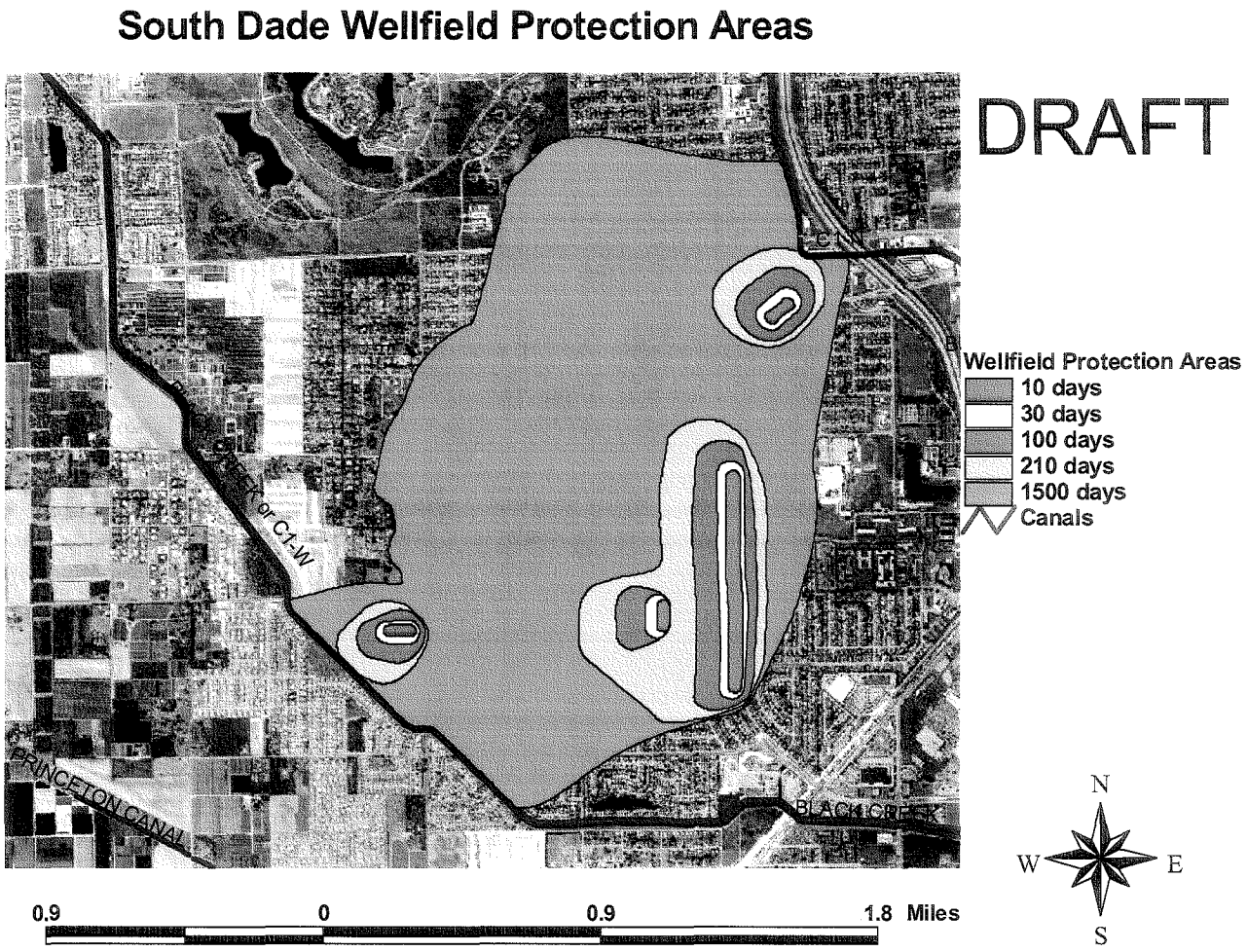
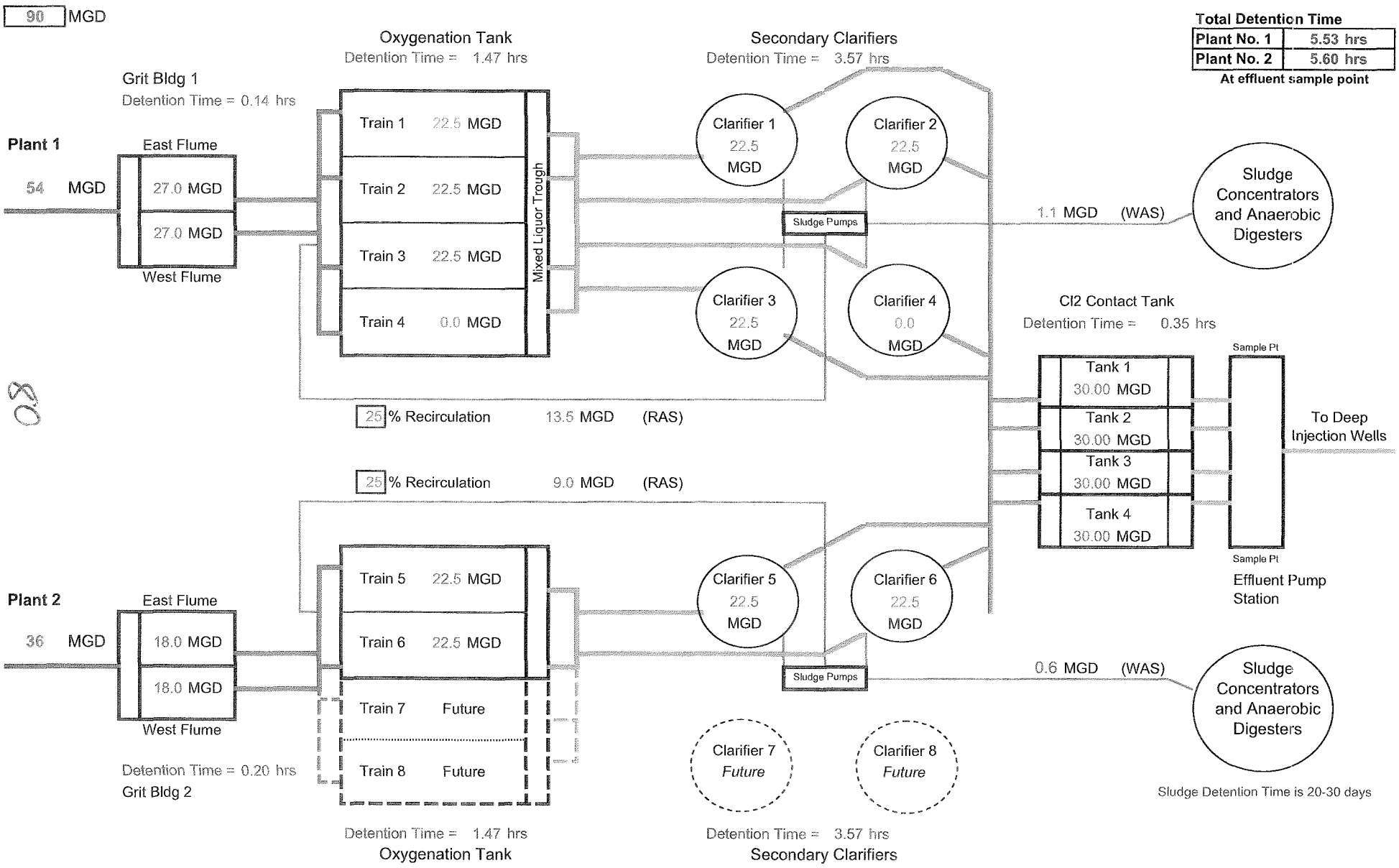


Figure 21: Shows polygons of 10, 30, 100, 210, and 1500 days wellfield protection areas.

Enter a desired flow rate for the South District Wastewater Treatment Plant. Process flow rates and detention times are displayed.



Please note process flow values are not limited to maximum design capacities.

MIAMI-DADE WATER AND SEWER DEPARTMENT	SOUTH DISTRICT WASTEWATER TREATMENT PLANT - PROCESS FLOW AND DETENTION TIME	02/09/2006 - 02/10/2006