SALTWATER INTRUSION IN THE FLORIDAN AQUIFER IN WALTON, OKALOOSA AND SANTA ROSA COUNTIES, FLORIDA

WESTERN MODEL DOMAIN

FINAL REPORT

Submitted To:

Northwest Florida Water Management District
81 Water Management Drive
Havana, FL 32333

Submitted By:

HydroGeoLogic, Inc.
1155 Herndon Parkway, Suite 900
Herndon, VA 20170

May, 2005

SALTWATER INTRUSION IN THE FLORIDAN AQUIFER IN WALTON, OKALOOSA AND SANTA ROSA COUNTIES, FLORIDA

WESTERN MODEL DOMAIN

FINAL REPORT

In Response To

Northwest Florida Water Management District
81 Water Management Drive
Havana, FL 32333

Prepared By

HydroGeoLogic, Inc.
1155 Herndon Parkway, Suite 900
Herndon, VA 20170

Professional Engineer:
Varut Guvanasen
License No. 49883
Date: 8/22/2005

SEAL

May, 2005

TABLE OF CONTENTS

Page

1.0 INTRODUCTION....1-1

2.0 MODEL CONCEPTUALIZATION 2-1
2.1 FLOW REGIME OF THE FLORIDAN AQUIFER SYSTEM....2-1
2.2 WATER QUALITY OF THE LOWER FLORIDAN AQUIFER....2-3
2.3 WATER QUALITY OF THE UPPER FLORIDAN AQUIFER 2-3
2.4 WATER QUALITY CHANGES IN THE UPPER FLORIDAN AQUIFER FROM PRE-DEVELOPMENT CONDITIONS....2-4
2.5 WATER QUALITY VARIATIONS WITH DEPTH WITHIN THE FLORIDAN AQUIFER SYSTEM....2-5

3.0 NUMERICAL MODEL DEVELOPMENT FOR THE WESTERN MODEL....3-1
3.1 CODE SELECTION....3-1
3.2 CONCEPTUAL MODELING FRAMEWORK....3-1
3.2.1 Sub-Floridan System....3-2
3.3 MODEL DOMAIN....3-4
3.4 FINITE-ELEMENT MESH DESIGN 3-4
3.5 MODEL BOUNDARY CONDITIONS....3-5
3.5.1 Bottom Boundary....3-5
3.5.2 Top Boundary....3-6
3.5.3 Lateral Boundary Conditions....3-6
3.6 MODEL PARAMETERIZATION....3-6

4.0 MODEL CALIBRATION....4-1
4.1 PRE-DEVELOPMENT MODEL CALIBRATION....4-1
4.1.1 Grid Sensitivity....4-3
4.2 POST-DEVELOPMENT SIMULATION FROM 1942 TO 1998....4-3
4.2.1 Post-Development Regional MODFLOW Simulation....4-4
4.2.2 Post-Development Results–Simulated Water Levels and Darcy Velocities....4-4
4.2.3 Post-Development Results–Simulated Chloride Concentrations....4-5
4.2.4 Post-Development Results – Flow Sensitivity of Sub-Floridan Boundary Heads....4-6

5.0 MODEL SENSITIVITY ANALYSIS....5-1
5.1 PRE-DEVELOPMENT MODEL SENSITIVITIES....5-2
5.2 POST-DEVELOPMENT MODEL SENSITIVITIES....5-3

6.0 MODEL PREDICTIVE SIMULATION....6-1

7.0 SUMMARY AND CONCLUSIONS....7-1

TABLE OF CONTENTS (continued)

Page

8.0 REFERENCES..8-1

APPENDIX A EQUIVALENT FRESHWATER HEAD AND CHLORIDE CONCENTRATION PLOTS

LIST OF TABLES

Table 2.1	Variation of Chloride Content with Depth for the FREEPORT REMOTE OBS (7233) Well
Table 2.2	Variation of Chloride Content with Depth for the WRP LOWER FLRD TEST (7260) Well
Table 2.3	Variation of Chloride Content with Depth for the NWFWMD TIGER POINT (7686) Well
Table 4.1	Water Balance for Pre-Development Conditions
Table 4.2	Chloride Balance for Pre-Development Conditions
Table 4.3a	Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958
Table 4.3b	Pumping for the Transient Post-Development DSTRAM Simulation 1959–1969
Table 4.3c	Pumping for the Transient Post-Development DSTRAM Simulation 1970–1982
Table 4.3d	Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998
Table 4.4	Water Balance for Post-Development (1998) Conditions
Table 4.5	Net Fluid flux for Pre-Development and 1998 Conditions
Table 4.6	Chloride Balance for Post-Development (1998) Conditions
Table 5.1	Model Parameter Changes Applied to the Sensitivity Simulations and the Resulting Statistics
Table 5.2	1998 Head Observations, Upper Floridan Aquifer
Table 5.3	1998 Head Observations, Lower Floridan Aquifer
Table 5.4	Post-Development Chloride Observations, Upper Floridan Aquifer
Table 5.5	Post-Development Chloride Observations, Lower Floridan Aquifer
Table 5.6	Nodes Representing Upper Floridan Aquifer Approximately 3 Miles Offshore
Table 5.7	Nodes Representing Lower Floridan Aquifer near Bucatunna Clay Pinchout
Table 5.8	Elements Representing Intermediate System, Near Shore Gulf of Mexico and Choctawhatchee Bay
Table 5.9	Elements Representing Upper Floridan Aquifer Approximately 3 Miles Offshore
Table 5.10	Elements Representing Lower Floridan Aquifer near Bucatunna Clay Pinchout
Table 5.11	Summary of 1998 Model Sensitivity Results for Upgradient Saltwater Interface Areas
Table 5.12	Sensitivity of Upper Floridan Aquifer Groundwater Seepage Velocity in Offshore Areas
Table 5.13	Sensitivity of Lower Floridan Aquifer Groundwater Seepage Velocity near the Bucatunna Clay Pinchout
Table 5.14	Sensitivity of Intermediate System Groundwater Seepage Velocity in the Bay and Near Shore Gulf of Mexico Areas
Table 6.1	Water Balance for Predictive Simulation at 2050 Conditions
Table 6.2	Chloride Balance for Predictive Simulation at 2050 Conditions

LIST OF FIGURES

Figure 1.1 General Location Map with Reference Wells in Region II
Figure 3.1 Conceptual Model for Groundwater Flow and Solute Transport
Figure 3.2 Modeling Domain and Finite Element Mesh for Chloride Intrusion Simulation of the Western Model
Figure 3.3 Vertical Discretization along Y-Z Cross-Section at X=505327 m
Figure 3.4 Conceptual Diagram of Boundary Conditions Applied along a Typical North-South Section
Figure 3.5 Prescribed Normalized Concentrations along Lateral Boundaries in the Upper Floridan Aquifer for the Western Model
Figure 3.6 Prescribed Normalized Concentrations along Lateral Boundaries in the Lower Floridan Aquifer for the Western Model
Figure 3.7 Equivalent Freshwater Head Boundary Conditions along the Bottom of the Model Domain
Figure 3.8 Chloride Concentration Conditions along the Bottom of the Model Domain
Figure 3.9 Equivalent Freshwater Head Boundary Conditions along the Top of the Model Domain
Figure 3.10 Horizontal Hydraulic Conductivity of the Upper Floridan Aquifer as Obtained from the District's Regional MODFLOW Groundwater Flow Model
Figure 3.11 Horizontal Hydraulic Conductivity of the Lower Floridan Aquifer as Obtained from the District's Regional MODFLOW Groundwater Flow Model
Figure 3.12 Vertical Hydraulic Conductivity of the Lowest Sub-Floridan DSTRAM Model Layer
Figure 3.13 Vertical Hydraulic Conductivity of the Bucatunna Clay Model Layer as Obtained from the District's regional MODFLOW Groundwater Flow Model
Figure 4.1 Pre-Development Equivalent Freshwater Head for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)
Figure 4.2 Pre-Development Equivalent Freshwater Head for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)
Figure 4.3 Pre-Development Environmental Head for Cross-Section A-A'
Figure 4.4 Pre-Development Environmental Head for Cross-Section B-B'
Figure 4.5 Pre-Development Environmental Head for Cross-Section C-C'
Figure 4.6 Pre-Development Chloride Concentration for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)
Figure 4.7 Pre-Development Chloride Concentration for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)
Figure 4.8 Pre-Development Chloride Concentration for Cross-Section A-A'
Figure 4.9 Pre-Development Chloride Concentration for Cross-Section B-B'
Figure 4.10 Pre-Development Chloride Concentration for Cross-Section C-C'
Figure 4.11 Pre-Development Darcy Velocities for the Upper Floridan Aquifer (Elemental Layer 15)

LIST OF FIGURES (continued)

Figure 4.12 Pre-Development Darcy Velocities for the Lower Floridan Aquifer (Elemental Layer 6)
Figure 4.13 Pre-Development Vertical Darcy Velocities for the Intermediate System (Elemental Layer 19)
Figure 4.14 Pre-Development Vertical Darcy Velocities for the Bucatunna Clay Confining Unit and Middle Portion of the Undifferentiated Floridan Aquifer System (Elemental Layer 11)
Figure 4.15 Pre-Development Vertical Darcy Velocities for the Sub-Floridan (Elemental Layer 2)
Figure 4.16 Pre-Development Darcy Velocities for Cross-Section A-A'
Figure 4.17 Pre-Development Darcy Velocities for Cross-Section B-B'
Figure 4.18 Pre-Development Darcy Velocities for Cross-Section C-C'
Figure 4.19 Pre-Development Equivalent Freshwater Head for the Upper Floridan Aquifer Grid Sensitivity (Nodal Layer 16, mid-aquifer)
Figure 4.20 Pre-Development Equivalent Freshwater Head for the Lower Floridan Aquifer Grid Sensitivity (Nodal Layer 7, mid-aquifer)
Figure 4.21 Pre-Development Chloride Concentration for the Upper Floridan Aquifer Grid Sensitivity (Nodal Layer 16, mid-aquifer)
Figure 4.22 Pre-Development Chloride Concentration for the Lower Floridan Aquifer Grid Sensitivity (Nodal Layer 7, mid-aquifer)
Figure 4.23 Total Pumping Withdrawals Applied to the Western Model Domain
Figure 4.24 1998 Equivalent Freshwater Head for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)
Figure 4.25 1998 Equivalent Freshwater Head for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)
Figure 4.26 1998 Environmental Head for Cross-Section A-A'
Figure 4.27 1998 Environmental Head for Cross-Section B-B'
Figure 4.28 1998 Environmental Head for Cross-Section C-C'
Figure 4.29 1998 Darcy Velocities for the Upper Floridan Aquifer (Elemental Layer 15)
Figure 4.30 1998 Darcy Velocities for the Lower Floridan Aquifer (Elemental Layer 6)
Figure 4.31 1998 Vertical Darcy Velocities for the Intermediate System (Elemental Layer 19)
Figure 4.32 1998 Vertical Darcy Velocities for the Bucatunna Clay Confining Unit and Middle Portion of the Undifferentiated Floridan Aquifer System (Elemental Layer 11)
Figure 4.33 1998 Vertical Darcy Velocities for the Sub-Floridan (Elemental Layer 2)
Figure 4.34 1998 Darcy Velocities for Cross-Section A-A'
Figure 4.35 1998 Darcy Velocities for Cross-Section B-B'
Figure 4.36 1998 Darcy Velocities for Cross-Section C-C'
Figure 4.37 Water Level Location Map
Figure 4.38 Yellow River – Lower Floridan NWF ID 3555 Water Level
Figure 4.39 Navarre Cement Plant NWF ID 1839 Water Level
Figure 4.40 EAFB Metts Tower NWF ID 3642 Water Level

LIST OF FIGURES (continued)

Figure 4.41 Mary Esther #2 NWF ID 2035 Water Level
Figure 4.42 EAFB Field #5 NWF ID 3923 Water Level
Figure 4.43 Beal Cemetery – Lower Floridan NWF ID 2173 Water Level
Figure 4.44 Okaloosa County School Board NWF ID 1894 Water Level
Figure 4.45 Destin Water #1 NWF ID 1687 Water Level
Figure 4.46 EAFB – Postil Point NWF ID 2994 Water Level
Figure 4.47 1998 Chloride Concentration for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)
Figure 4.48 1998 Chloride Concentration for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)
Figure 4.49 Pre-Development and 1998 Chloride Concentrations for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)
Figure 4.50 Pre-Development and 1998 Chloride Concentrations for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)
Figure 4.51 1998 Chloride Concentration for Cross-Section A-A'
Figure 4.52 1998 Chloride Concentration for Cross-Section B-B'
Figure 4.53 1998 Chloride Concentration for Cross-Section C-C'
Figure 4.54 Santa Rosa County Mean Chloride Concentration in the Floridan Aquifer System 1998 – 2000
Figure 4.55 Okaloosa County Mean Chloride Concentration in the Floridan Aquifer System 1998 – 2000
Figure 4.56 Chloride Concentration Profile Location Map
Figure 4.57 Tiger Point Concentration Profile
Figure 4.58 Yellow River Concentration Profile
Figure 4.59 Navarre Beach Concentration Profile
Figure 4.60 Lisa Jackson Park Concentration Profile
Figure 4.61 Beal Cemetery Concentration Profile
Figure 4.62 EAFB Field 4 Concentration Profile
Figure 4.63 Destin Concentration Profile
Figure 4.64 1990 MODFLOW Simulation Head for the Upper Florida Aquifer (Layer 3)
Figure 4.65 1990 MODFLOW Simulation Head for the Lower Floridan Aquifer (Layer 5)
Figure 4.66 1990 Equivalent Freshwater Head for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)
Figure 4.67 1990 Equivalent Freshwater Head for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)
Figure 4.68 1990 Equivalent Freshwater Head for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer) Reduced Flow from Bottom
Figure 4.69 1990 Equivalent Freshwater Head for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer) Reduced Flow from Bottom
Figure 5.1 RMS and Mean Head Change from Pre-Development Base Case for the Upper and Lower Floridan Aquifers Combined
Figure 5.2 RMS and Mean Chloride Change from Pre-Development Base Case for the Upper Floridan Aquifer

LIST OF FIGURES (continued)

Figure 5.3 RMS and Mean Chloride Change from Pre-Development Base Case for the Lower Floridan Aquifer
Figure 5.4 RMS and Mean Chloride Change from Pre-Development Base Case for the Upper Floridan Aquifer at Select Nodes 3 Miles Offshore

Figure 5.5 RMS and Mean Chloride Change from Pre-Development Base Case for the LowerFloridan Aquifer at Select Nodes near the Bucatunna Clay Pinchout
Figure 5.6 RMS and Mean Head Error for the Upper and Lower Floridan Aquifers Combined
Figure 5.7 RMS and Mean Head Change from Post-Development Base Case for the Upper and Lower Floridan Aquifers Combined
Figure 5.8 RMS and Mean Chloride Error for the Upper Floridan Aquifer
Figure 5.9 RMS and Mean Chloride Error for the Lower Floridan Aquifer
Figure 5.10 RMS and Mean Chloride Change from Post-Development Base Case for the Upper Floridan Aquifer
Figure 5.11 RMS and Mean Chloride Change from Post-Development Base Case for the Lower Floridan Aquifer
Figure 5.12 RMS and Mean Drawdown from Pre-Development to 1998 for the Upper and Lower Floridan Aquifers Combined
Figure 5.13 RMS and Mean Chloride Change from Pre-Development to 1998 Conditions for the Upper Floridan Aquifer
Figure 5.14 RMS and Mean Chloride Change from Pre-Development to 1998 Conditions for the Lower Floridan Aquifer
Figure 5.15 Selected Locations for Assessment of Model Results (with Location Reference Number)
Figure 6.1 Predictive Simulation Equivalent Freshwater Head at Year 2050 for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)
Figure 6.2 Predictive Simulation Equivalent Freshwater Head at Year 2050 for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)
Figure 6.3 Predictive Simulation Darcy Velocity at Year 2050 for the Upper Floridan Aquifer (Elemental Layer 15, mid-aquifer)
Figure 6.4 Predictive Simulation Darcy Velocity at Year 2050 for the Lower Floridan Aquifer (Elemental Layer 6, mid-aquifer)
Figure 6.5 Pre-Development and 2050 Predictive Simulation Chloride Concentrations for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)
Figure 6.6 Pre-Development and 2050 Predictive Simulation Chloride Concentrations for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)
Figure 6.7 2050 Predictive Simulation Chloride Concentrations for Cross-Section A-A’
Figure 6.8 2050 Predictive Simulation Chloride Concentrations for Cross-Section B-B’
Figure 6.9 2050 Predictive Simulation Chloride Concentrations for Cross-Section C-C’
Figure 6.10 Concentration Profile at Tiger Point for Pre-Development, 1998 and 2050 Simulations

LIST OF FIGURES (continued)

Figure 6.11 Concentration Profile at Yellow River for Pre-Development, 1998 and 2050 Simulations
Figure 6.12 Concentration Profile at Navarre Beach for Pre-Development, 1998 and 2050 Simulations
Figure 6.13 Concentration Profile at Lisa Jackson Park for Pre-Development, 1998 and 2050 Simulations
Figure 6.14 Concentration Profile at Beal Cemetery for Pre-Development, 1998 and 2050 Simulations
Figure 6.15 Concentration Profile at EAFB Field 4 for Pre-Development, 1998 and 2050 Simulations
Figure 6.16 Concentration Profile at Destin for Pre-Development, 1998 and 2050 Simulations

This page was intentionally left blank.

FINAL REPORT
SALTWATER INTRUSION IN THE FLORIDAN AQUIFER IN WALTON, OKALOOSA AND SANTA ROSA COUNTIES, FLORIDA

1.0 INTRODUCTION

The Northwest Florida Water Management District (NWFWMD or the District) has the primary objective of protecting its water resources within the framework of consistently increasing demands for potable water since pre-development times. Among the concerns, is the increased likelihood for induced intrusion of saltwater in the Floridan Aquifer caused by withdrawals from the Floridan Aquifer System. The potential processes of deterioration of water quality in the Upper Floridan Aquifer include: 1) inland movement of saline water from parts of the aquifer underlying the Gulf of Mexico; 2) upward movement of saline water from the lower limestone of the Floridan Aquifer through or around the Bucatunna Clay confining bed; 3) downward movement of saline water in coastal areas or bays, through the Intermediate System; 4) upconing of poor quality water from the base of the upper Floridan Aquifer; and 5) combinations of the above. Saltwater intrusion models of the Floridan Aquifer System in the region are therefore developed in this work to help quantify the effects of pumping on the saltwater / fresh water regime and guide withdrawal operations that protect the resource.

The District's most recent groundwater flow model encompassing Escambia, Santa Rosa, Okaloosa, Walton, and parts of Bay, Washington, and Holmes counties is taken as the starting point for developing the saltwater intrusion models of the region (see Figure 1.1). The associated modeling report (HydroGeoLogic, 2000) details the flow model conceptualization, site geology and hydrogeology, model results and sensitivity analysis. For the current study, groundwater flow and saltwater transport within the Floridan Aquifer System are first examined to develop a preliminary conceptualization of the dynamics of the system, as noted in Section 2 of the report. The conceptual model is then used to develop numerical models for saltwater intrusion within the system. Due to computational concerns, two models are developed for the region. The first model encompasses coastal Escambia, Santa Rosa and Okaloosa Counties and is termed the Western Model. The second model encompasses coastal Okaloosa, Walton, and parts of Bay and Washington counties and is termed the Eastern Model. Subsequent sections of this report focus on development of the Western Model. Section 3 discusses the numerical model development for the Western Model, Section 4 addresses calibration of the Western Model for pre- and post-development conditions, Section 5 reports on the sensitivity analyses for saltwater intrusion in the Western Model domain, and Section 6 addresses the predictive simulations and the predictive sensitivity analysis for the Western Model.

This page was intentionally left blank.

2.0 MODEL CONCEPTUALIZATION

Groundwater in coastal aquifers flows towards the coast from higher potentiometric elevations that occur inland. Saltwater, however, having higher density than fresh water, has the tendency to intrude inland creating a wedge of saltwater in the lower portion of these aquifers. Pumping of a coastal aquifer further induces saltwater intrusion from the coast and can also cause upconing of saline waters from the underlying wedge of salt water. The interplay of forces governing fresh-water flow and saltwater intrusion may be examined by conducting an analysis of saltwater intrusion using a density-dependent flow and transport model. The flow model accounts for groundwater flow subject to additional density effects due to salinity of water. The transport model for saltwater addresses the movement and location of chlorides within the system subject to anthropogenic and pumping stresses. The movement and location of chlorides affects the density term in the flow model, thereby creating a coupling between flow and salt transport, which is solved by a density-dependent flow and transport model.

A density-dependent flow and transport model needs to be initiated via a set of assumptions regarding the state of the system before pumping was initiated in the aquifer. This is the pre-development state of the system whereby aquifer heads reflect the potentiometric surface prior to any withdrawals from the aquifer, and aquifer chloride concentrations reflect the saltwater present in the domain prior to any pumping of the system. To allow for a reproducible initial condition that does not reflect saltwater movement resulting from applied boundary conditions (aside from the pumping stresses), it is assumed that the saltwater is in an equilibrium state prior to development of the aquifer. Thus, it is conceptualized that the pre-development state is at hydrostatic conditions with the existing saltwater within the domain. Pumping is then applied to this system in a transient mode, to reflect the pumping that occurred in the aquifer from pre-development conditions, to the current time. The model then simulates the changes in head and in chloride concentrations through the simulation domain to provide the post-development state of the system which reflects the current conditions. A calibrated post-development model may then be used to examine the sensitivity of the model to unknown or uncertain parameters, and to conduct predictive simulations that reflect anticipated development of the water resource, or reflect managed development of the aquifer.

Groundwater flow and saltwater intrusion in coastal Escambia, Santa Rosa, Okaloosa, Walton and Bay counties are examined further in this Section, to determine the conceptual model of the Floridan Aquifer in the region.

2.1 FLOW REGIME OF THE FLORIDAN AQUIFER SYSTEM

Several studies have been conducted since the early 1960s that examine the geology and hydrogeology of the study region and that examine the flow behavior within the aquifer systems via numerical modeling of groundwater flow. The District's latest model for groundwater flow in the region is reported in HydroGeoLogic, (2000) which details the conceptualized hydrogeology, stratigraphy, potentiometric and recharge conditions of the subsurface aquifers in the study area. This model is used as the basis for further conceptualizing the saltwater system being investigated here. A general location map of the study area is provided in Figure 1.1. Flow regime conceptualization is described in Section 3.2.

Barraclough and Marsh (1962) provide the early descriptions of water quality and subsurface hydrology within the region. Even then, there were concerns of the possibility of deterioration of water quality within the system caused by water level declines within the Floridan Aquifer – by as much as 95 feet in the Fort Walton Beach coastal area between 1936 and 1957.

Trapp et al. (1977) and Barr et al. (1985) show the estimated generalized pre-development potentiometric surface for the upper limestone of the Floridan Aquifer in Okaloosa and Walton counties. Water that recharges the aquifer in the northern regions of these counties (and further north where the Floridan Aquifer outcrops in Alabama), flows generally southwards to discharge points near the coast. A tongue of hard water extending south from central Okaloosa County between Crestview and Destin is coincident with a zone of higher transmissivities along which relatively more flushing occurred in pre-development times. In Santa Rosa and southwestern Okaloosa counties, water contains mainly sodium-bicarbonate-chloride resulting from ion exchange with clay minerals that are more abundant to the west (with associated reduced transmissivities) and the Bucatunna Clay unit that subdivides the Floridan Aquifer into its upper and lower limestones. The Floridan Aquifer ultimately discharges into Choctawhatchee River, Choctawhatchee Bay, and the Gulf of Mexico. Water levels during pre-development conditions within the Floridan Aquifer System were above land surface in coastal regions, with most coastal wells being artesian. The Intermediate System confining unit overlying the Floridan Aquifer thickens from east to west with vertical hydraulic conductivities decreasing from east to west along the coastal regions. This causes greater confinement with associated increased heads towards the west and relatively lower heads in coastal Walton and Bay counties, where the potential for discharge is greater. Thus, there was a general southeastward direction of flow within the Floridan Aquifer System across Choctawhatchee Bay during pre-development conditions. In Santa Rosa and southwestern Okaloosa counties, the pre-development head gradient was generally southwards towards the Gulf of Mexico.

Trapp et al. (1977) and Barr et al. (1985) also show the post-development water levels, and the net water level declines from pre-development conditions. Pumping centers around the Fort Walton Beach metropolitan area caused water level declines of greater than 100 ft from pre-development conditions by 1978. Flow of water from recharge areas to the north is still in a southerly direction. However, the large cone of depression in the Fort Walton Beach area for post-development conditions changes the flow patterns in coastal regions, with westward gradients across Choctawhatchee Bay and landward gradients from the Gulf of Mexico. The (slightly south-) westward direction of flow across Choctawhatchee Bay caused by the cone of depression induces fresh-water flow from upland regions, while the landward gradients create a potential for lateral intrusion of saltwater from the Gulf of Mexico. Furthermore, water levels in coastal regions are now below sea level, with potential for saltwater entering the Floridan Aquifer System from the relatively leaky Intermediate System under Choctawhatchee Bay or under the Gulf of Mexico in eastern regions of the domain adjacent to Walton and Bay counties. Ryan et al. (1998) shows the progression of water level declines below sea level from 1974 through 1995. Water level declines around the center of depression are asymmetric, with larger declines to the west where the transmissivity of the upper limestone of the Floridan Aquifer is lower due to more extensive presence of clays. Furthermore, the Intermediate System is leakier to the east, which facilitates relatively greater energy dissipation into Choctawhatchee Bay and the Gulf of Mexico.

The lower portions of the Floridan Aquifer behave in a hydraulically similar manner to the upper limestone in the eastern regions of the domain, where the Bucatunna Clay unit is absent. In Santa Rosa and western Okaloosa counties, however, the Bucatunna Clay unit is thick and hydraulic connection between the underlying Lower Floridan Aquifer and the Upper Floridan Aquifer is very weak. Deep well injection sites in Santa Rosa County have created a potentiometric mound within the Lower Floridan Aquifer with flow gradients out towards the Gulf of Mexico for post-development conditions. Thus landward movement of saltwater in the Lower Floridan Aquifer is hydraulically not possible in the western portions of the domain.

2.2 WATER QUALITY OF THE LOWER FLORIDAN AQUIFER

The chloride content of the lower limestone of the Floridan Aquifer has been interpreted by Barr et al. (1985) for Okaloosa and Walton counties, based on limited available sampling of the Lower Floridan Aquifer. The 250-ppm isochlor is as much as 10 miles inland (north) of Fort Walton Beach and south of Valparaiso and Niceville in Okaloosa County. Chlorides in the Lower Floridan Aquifer are least inland near the Okaloosa/Walton county line with the 250-ppm isochlor probably underlying Choctawhatchee Bay. Further east in Walton County, the chlorides are more inland with the 250-ppm isochlor lying south of Freeport. The 3,000-ppm isochlor is interpreted to be inland in southeastern regions of Walton County and in southwestern regions of Okaloosa County. Further west in Santa Rosa County, the chloride trend within the Lower Floridan Aquifer continues inland with chlorides of about 3,200 ppm at the Yellow River Lower Floridan well and about 6,000 ppm at the Monsanto North Monitoring well. Saline and fresh water are presumed to be in equilibrium within the Lower Floridan Aquifer, however, pumping could upset this equilibrium. The salinity in the aquifer reflects the existence of residual seawater that has not been completely flushed from the aquifer by fresh water, which forms a wedge above the saline water due to its lower density. The available data is insufficient to make a detailed determination of areal or temporal changes in water quality, however, these chloride levels should be similar between pre- and post-development conditions.

2.3 WATER QUALITY OF THE UPPER FLORIDAN AQUIFER

The chloride content of water in the upper limestone of the Floridan Aquifer as interpreted by Barraclough and Marsh (1962) ranges from 2 to over 2,000 ppm across the area. Trapp et al. (1977) and Barr et al. (1981) show a similar trend of low chlorides inland that increase towards the coast. A long-term chloride analyses of the upper limestone indicates only slight changes in chloride levels throughout the domain (Trapp et al., 1977; Barr et al., 1985) and current chloride levels generally reflect pre-development conditions. Saline water occurs in the upper limestone beneath the mainland in a large portion of coastal Walton County and in portions of coastal Santa Rosa County. Chloride content is low between Crestview, DeFuniak

Springs, Freeport and Valparaiso, and increases in a southwesterly direction and towards the coast. The 250-ppm isochlor underlies Escambia Bay and East Bay in the upper limestone, with concentrations up to 2,000 ppm near Pensacola Beach. Eastward along the coastline in Santa Rosa County, chloride levels decrease. Navarre Beach wells show between 100 and 200 ppm of chlorides. The southwesterly decrease in transmissivity along the coastline and distance from recharge areas to the north affect the degree of flushing. Further east of the Santa Rosa/Okaloosa county line, the chloride content shoreward of the Gulf of Mexico is below drinking water standards.

The high chlorides in the upper limestone under the eastern portions of Choctawhatchee Bay are probably representative of pre-development conditions. The Intermediate Confining unit in the region is extremely leaky, allowing for hydraulic connection of water between the upper limestone and the Bay or the Gulf of Mexico. Furthermore, the transmissivity of the upper limestone in the region is relatively low, allowing for little movement of water from the region, with associated minimal flushing. North of Choctawhatchee Bay, chloride concentrations are low. Pratt et al. (1996) provides a closer examination of spatial trends of chloride behavior in the vicinity of Choctawhatchee Bay. Between Destin and the vicinity of Morris Lake, chloride concentrations are low. In fact, the area from central Okaloosa County through Destin and Moreno Point has the lowest sodium, chloride, and dissolved solids concentrations of any area along the coastline. This coincides with the high transmissivity zone containing hard water discussed earlier, which, presumptively, facilitates significant flushing. Chloride concentrations are the highest between Morris Lake and Seagrove Beach, with sodium to chloride ratios representing diluted seawater conditions. Flushing of seawater in this region was minimal probably due to the lower transmissivity of the upper limestone in the vicinity. East of Seagrove Beach, towards Inlet Beach, chloride content in the upper limestone again decreases.

2.4 WATER QUALITY CHANGES IN THE UPPER FLORIDAN AQUIFER FROM PRE-DEVELOPMENT CONDITIONS

Regionally, water quality in the area has not changed significantly since pre-development times. McKinnon and Pratt (1998) have compiled water quality variation information for all significant wells in the domain, indicating negligible changes in most wells. Trapp et al. (1977) and Barr et al. (1985) show changes of chloride concentration with time at various wells within Walton and Okaloosa counties to be small over decades. Consistent trends in chloride level changes are, however, noted at several locations. The Selma Madara well to the south of Freeport, on the northern edge of Choctawhatchee Bay shows a decreasing trend in chlorides from 237 ppm in 1968 to 150 ppm in 1978 to 110 ppm in 1979 to about 100 ppm by 1988. This decline may be due to induced bulk motion of Floridan Aquifer water into the southern Okaloosa County cone of depression, which transports higher quality water to the south and west, from areas hydraulically upgradient. Similar decreasing temporal trends for chloride concentrations are noted for wells along the northern shore of Choctawhatchee Bay in Walton County (Barr et al., 1985) and for the Point Washington well. The Bridgetender well in the eastern portion of Choctawhatchee Bay shows an increasing temporal trend, probably caused by induced leakage through the Intermediate System or lateral motion induced as a result of depression of water levels in the Floridan Aquifer due to pumping. South of the eastern portions of Choctawhatchee Bay, wells show an increasing trend in chlorides over time (FCSC #4, #10, #11). This is most likely caused by upconing of saltwater that lies in the Floridan Aquifer at depth. Further west, the Destin wells DWU #2, #3, and #4 also show slight increases in chloride from 1993 through 1998. Further west along the coastline are the Eglin Air Force Base wells where chloride concentrations sampled recently by the District show no significant changes compared to data from the 1960s. These wells are furthest south in Okaloosa County and are situated between the deepest part of the potentiometric surface depression and the Gulf of Mexico. Thus, they would likely be first affected by lateral migration of saline water from the south. The lack of chloride increase in these wells indicates that the saltwater resides sufficiently far offshore in this region so as to not have an immediate impact on withdrawal wells. The high transmissivity zone of hard water in upland regions likely causes a larger degree of flushing in the vicinity, with larger fluxes from the north than from the south of the cone of depression. The FWB #6, #7 and #10 wells in Ocean City show a decreasing trend in chlorides over time. These wells also reside within the high transmissivity zone, but are landward of the cone of depression. The higher flow caused by pumping likely creates a larger degree of flushing in the vicinity, causing the noted decrease in chlorides. Further west, the Navarre Beach wells #1, #2, and #3 show increasing chloride trends with time, probably caused by upconing and the induced lateral bulk motion of more saline water as a result of pumping.

2.5 WATER QUALITY VARIATIONS WITH DEPTH WITHIN THE FLORIDAN AQUIFER SYSTEM

Water quality variations with depth within the region have been presented by Pratt et al. (1996) and Barr et al. (1985). The DWU #5 Lower Floridan test well in Destin shows chloride concentrations of about 50 ppm above the Bucatunna Clay (depth of around 825 feet). Concentrations increase to over 660 ppm beneath the Bucatunna Clay at a depth of 911 feet, further increasing to almost 2,000 ppm at a depth of 1,123 feet. A regression line fitted to these samples for sodium to chloride ratio shows their proximity to the seawater dilution line. Water in the Lower Floridan Aquifer is most likely relic seawater. This relationship to seawater is also noted at the NWFWMD 331-98 test well where the Bucatunna Clay is absent. At NWFWMD 331-98 test well, chloride concentrations are around 550 ppm in the upper portions and around 3,100 ppm in the lower portions of the Floridan Aquifer. The EAFB Field 4 Lower Floridan well shows chloride contents of 8.7 and 410 ppm for sampling intervals of 940-1,015 feet and 940-1,380 feet, respectively. Dissolved solids content and sodium concentrations also increase with depth indicating the stratification of fresh water over saline water. No Bucatunna Clay is present at this location. The Beal Cemetery Lower Floridan well in Fort Walton Beach shows chlorides of 810 ppm and 1,600 ppm from intervals of 1,020-1,060 feet and 1,020-1,200 feet, respectively, within the Lower Floridan Aquifer, with associated increases in total dissolved solids content and sodium concentrations. The Camp Rucker Floridan well in Walton County shows dissolved chloride contents of 28 ppm, from depths of 201-900 feet showing the water to be potable in this region from the lower portions of the Floridan Aquifer.

More detailed vertical sampling of water quality from the lower limestone is provided for the Freeport Remote Observation well (Table 2.1), for the WRP Lower Floridan test well (Table

2.2), and for the NWFWMD Tiger Point well (open to the upper limestone and the top of the Bucatunna Clay) in Table 2.3 (Pratt, personal communication). The Freeport Remote Observation well shows minimal chloride levels to a depth of 600 feet. Further below, chlorides rapidly increase with increasing depth, up to 9,000 ppm at the bottom of the well (777 feet below land surface). Thus, high chlorides are noted in the base of the Floridan Aquifer System. The WRP Lower Floridan test well in Destin, sampled only within the lower limestone at discrete intervals, shows chlorides increasing with depth from 1,200 ppm at a depth of about 930 feet to 16,900 ppm at a depth of around 1,400 feet. The chloride sampling discussed above indicates that there is considerable stratification of chlorides within the Floridan Aquifer System in Walton and Okaloosa counties. The Bucatunna Clay (where it exists) enhances the stratification by restricting movement of saline water from the deeper regions. Finally, the NWFWMD Tiger Point well, with samples from the lower portions of the upper limestone and the top of the Bucatunna Clay, shows chlorides increasing from around 350 ppm at a depth of 1,200 feet to around 600 ppm at a depth of 1,300 feet below land surface. Thus, the chloride stratification in the upper limestone in the west is not as significant as that in the Lower Floridan Aquifer or in the undifferentiated Floridan Aquifer in the east.

This page was intentionally left blank.

3.0 NUMERICAL MODEL DEVELOPMENT FOR THE WESTERN MODEL

3.1 CODE SELECTION

The DSTRAM code was selected for this study. DSTRAM is an acronym for Density-dependent Solute Transport Analysis finite-element Model (Huyakorn and Panday, 1994), which simulates density-dependent flow of water and solute transport in porous media. The code is designed specifically for complex situations where the flow of groundwater is influenced significantly by variations in solute concentration. The groundwater flow equation is therefore coupled with the solute transport equation for saltwater that accounts for advection and anisotropic dispersion. DSTRAM allows for complex hydrostratigraphy and heterogeneity in defining the aquifer materials, and provides several options for applying boundary conditions for flow and salt transport suitable for coastal systems including steady and transient prescribed heads, prescribed concentrations, prescribed fluid and solute fluxes, and spring, river, drain, and other general head boundary conditions with associated mass-flux solute transport boundary conditions. In addition, DSTRAM provides output for equivalent fresh-water heads (that includes the density effects of saltwater and is therefore the horizontal driving force for flow), environmental heads (the driving force for vertical flow), chloride concentrations, chloride isochlor elevations, velocity vectors and component fluid and solute mass balance fluxes which are useful in investigating saline intrusion characteristics and simulation convergence and accuracy. Therefore, DSTRAM possesses all the capabilities necessary for the current modeling effort.

3.2 CONCEPTUAL MODELING FRAMEWORK

The conceptual model adopted for quantitative analysis of groundwater flow and salt transport in coastal Santa Rosa and Okaloosa Counties is illustrated in Figure 3.1. The active domain of the saltwater intrusion model comprises the Upper and Lower Floridan Aquifer units separated by the Bucatunna Clay, and overlain by the Intermediate System, and underlain by the sub-Floridan System. Prescribed heads in the Surficial Aquifer System drive flow into or out of the Upper Floridan Aquifer through the Intermediate System as the top boundary condition. These heads are obtained from the District's MODFLOW groundwater flow model study (HydroGeoLogic, Inc., 2000) in landward portions of the domain, where the inflow of water is assumed to be free of chlorides. Lateral boundary conditions in upland regions are also obtained from the District's groundwater flow model to drive fresh water into the Upper and Lower Floridan aquifers across the local saltwater intrusion model's northern, eastern and western landward boundaries. Off the coast, and in the Gulf of Mexico, the lateral boundary is assumed to be at hydrostatic equilibrium, with chloride concentrations of seawater. The increasing weight of seawater with depth causes saltwater to intrude landward, in deeper regions of the aquifers. The sub-Floridan System is included as a confining unit, with prescribed heads and sea-water chloride concentrations at the bottom which may intrude into the domain resulting from pumping of the Upper and Lower Floridan aquifers. The system is assumed to be at equilibrium for pre-development conditions, whereby saltwater intrusion is a consequence of the balance of forces resulting from higher potential of fresh water from upland regions balancing the larger weight forces caused by density effects of saltwater from the Gulf. Pumping is then applied to this system in a transient manner, to note the resulting change in chloride concentrations throughout the domain for post-development conditions. Transient post-development boundary conditions for the lateral upland boundaries are extracted from the associated MODFLOW transient groundwater flow model which is of more regional extent, to account for effects of pumping that are outside of the current saltwater intrusion model boundaries. The post-development state is then used as initial conditions to determine the effects of future pumping on saltwater intrusion in the system.

The sub-Floridan System is included in the conceptualization for the density-dependent solute transport model in order to increase saltwater intrusion in the domain, which was otherwise significantly under-predicted as compared to field data, in preliminary simulations that neglected its presence. A further discussion on the sub-Floridan System is therefore provided here since it is not previously discussed in the flow model where it is neglected due to its low conductivity and associated lack of impact to the flow domain of the Upper and Lower Floridan aquifers.

3.2.1 Sub-Floridan System

The sub-Floridan System consists of Claiborne Group (Middle Eocene) sediments. The upper portion of the Claiborne Group is composed of glauconitic, arenaceous limestone grading into a calcareous sandstone and calcareous shale with increasing depth (Chen, 1965). The sub-Floridan System is incorporated into the model using three elemental layers. Specified head and specified concentration boundary conditions are provided along the bottom boundary as a source of saltwater. The District reviewed geophysical logs from oil and gas test wells which provide information regarding layers within the sub-Floridan System. The information included thickness and relative hydraulic conductivity of the sub-Floridan System layers. These logs also provide formation resistivity and in some cases porosity data for the Lower Floridan Aquifer and the sub-Floridan System. The District used this data to calculate the resistivity of the formation water (Rw) which was in turn used to estimate chloride concentration within the Lower Floridan Aquifer and-the sub-Floridan System. The calculated chloride concentration and spatial trends in the resistivity of the formation water were used to establish spatial trends in sub-Floridan water quality and provide the basis for estimating the specified concentration to be applied to the sub-Floridan System.

Analysis of the logs showed the sediments directly beneath the Lower Floridan Aquifer to consist of relatively permeable sandy carbonates with porosity 5 to 10 percent lower than that of the Lower Floridan Aquifer. Permeability appears to be significantly less than that of the Lower Floridan Aquifer but significantly higher than that of a typical confining unit. This relatively permeable section ranges from approximately 250 ft thick in the southwest to 600 ft thick in the northeast portion of the DSTRAM domain. Underlying this relatively permeable interval is a layer of very low hydraulic conductivity sediments. The low hydraulic conductivity is clearly indicated by the total lack of an invasion profile on the formation resistivity logs and the response of the spontaneous potential (SP) log.

After reviewing logs and other information pertaining to the sub-Floridan System, the District provided layer elevations and hydraulic conductivity values for the three layers of elements representing the sub-Floridan System. The relatively permeable section of the sub-Floridan System was split into two equally thick layers. The uppermost layer was assigned a horizontal hydraulic conductivity (Kh) of 1 ft/d with the underlying layer assigned a Kh of 0.5 ft/d. The horizontal to vertical anisotropy was set to 35:1. The lowermost layer simulated represented the underlying, very low permeability material and was assigned a thickness of 30 ft. The lowermost layer Kh varied from $7x10^{-4}$ ft/d to $7x10^{-5}$ ft/d, southwest to northeast and the horizontal to vertical anisotropy was set to 35:1.

The specified concentration field developed by the District for the bottom of the model domain was based on the geophysical logs. Formation water resistivity (Rw) was calculated using the Archie equation with formation resistivity (Ro) obtained from the logs. A cementation exponent (m) of 1.5 was used and porosity (ϕ) was assumed to be 0.20. Rw was calculated based on the following equation (Dresser Atlas, 1983).

$$Rw = Ro\ \phi^{m}$$

Rw was then used to estimate chloride concentration using an empirical relationship developed by Kwader (1982). Kwader established the following relationship for Floridan Aquifer formation waters.

$$\text{Chloride (ppm)} = (3{,}100 / Rw) - 200$$

For the range of values analyzed, the chloride concentration calculated using Kwader's relationship was essentially equal to the values obtained using standard conversion factors which convert Rw to ppm NaCl. The chloride concentrations were then converted to percent sea water.

Logs show the concentration in the bottom of the more permeable section of the sub-Floridan System to be approximately 0.2 that of seawater in the northeastern portion of the DSTRAM model domain rapidly increasing to 1.0 in a southwestern direction. In the far southern and western portion of the domain logs indicate the concentration in this interval is equal to that of seawater or perhaps even slightly greater. The specified concentration distribution applied in the model ranged from 0.1 in the northeast, and rapidly increased to 1.0 in a southwesterly direction. Maximum concentration of 1.0 was applied to approximately 90% of the model domain. The specified concentration boundary was adjusted during the pre-development model calibration process.

Data is not available for the head in the sub-Floridan System. The specified head values were based on the conceptual model of the flow system. In the coastal area of Okaloosa and Santa Rosa Counties an upward gradient is expected to exist, thus allowing for limited flow of saline ground water from the Claiborne Group into the Lower Floridan Aquifer. The DSTRAM model applies this specified head beneath the lower-most model layer which represents a 30-ft thick confining unit. The initial specified head was set to the simulated Lower Floridan

Aquifer head plus 5 ft. The head differential was adjusted during the pre-development model calibration process. The calibrated pre-development model head gradient is upward and increases from less than 5 ft in the northeast to 25 ft along the southern model boundary.

3.3 MODEL DOMAIN

The saltwater intrusion modeling domain for the Western Model is shown in Figure 3.2. The study area was selected after careful consideration of the groundwater flow system within the region of interest, the modeling objectives, and the computational requirements of the DSTRAM computer code. In general, an optimal mix of the following specific objectives and constraints was sought:

- The model boundaries should correspond to the degree possible to naturally occurring, known boundary conditions.

- Computational time for the various simulation scenarios, and therefore the number of active model nodes, had to be commensurate with the available computational resources and data availability.

The final model domain used in the analysis encompasses the southern half of Santa Rosa and Okaloosa counties. In general, the model extends in an east-west direction from the eastern border of Okaloosa County to the western boundary of Santa Rosa County. In the north-south direction, the domain extends approximately 15 miles landward, and 25 miles into the Gulf of Mexico. In UTM zone 16 projection (datum: NAD83) coordinates, the lower-left-hand corner of the model grid is located at x = 484,000.0 m and y = 3,323,500.0 m.

3.4 FINITE-ELEMENT MESH DESIGN

The hydrogeologic units that are active for the saltwater intrusion study include the Intermediate System, the Upper Floridan Aquifer, the Bucatunna Clay confining unit, the Lower Floridan Aquifer, and the sub-Floridan System. Each unit is discretized into multiple layers to simulate density-dependent groundwater flow and solute transport processes that occur in the vertical and horizontal directions. In the horizontal (x-y) plane, the grid is rectangular with 145 columns and 71 rows of elements (146 columns and 72 rows of nodes) for a total of 10,295 elements per layer and 10,512 nodes per layer. The discretization is at a maximum of 12,310 ft near the boundaries of the model, and at a minimum of 1,300 ft encompassing Fort Walton Beach and Destin. The finest discretization is used where the largest variations in chloride concentrations are expected, and larger cells sizes are used in the four corners of the domain where concentration variation was expected to be relatively small.

The DSTRAM orthogonal curvilinear mesh option was used to discretize the model domain on the vertical (z) dimension. A curvilinear mesh is one where the gridline columns and/or rows do not remain parallel over their entire length. This option permits a grid to be developed that conforms to the changing geometry of the various hydrogeological units. This option was invoked because there are significant dips and variations in the thickness of all hydrogeological units within the domain, and slopes of the various hydrogeological units could have an influence upon the density-dependent groundwater flow field. The vertical grid along cross-section x = 505327.0 m is illustrated in Figure 3.3. Vertically, the domain is discretized into 20 elemental (21 nodal) layers with three elemental layers representing the Intermediate System, five elemental layers representing the Upper Floridan Aquifer, three elemental layers representing the Bucatunna Clay, six elemental layers representing the Lower Floridan Aquifer, and three elemental layers representing the sub-Floridan System. The grid contains a total of 205,900 elements and 220,752 nodes. The vertical grid spacing varies from 6.6 ft to 456.1 ft, with a finer spacing adjacent to hydrogeological unit boundaries to capture possible sharp variations in chlorides across units. The stratigraphic elevations of the various units are taken from the groundwater flow model (HydroGeoLogic, Inc., 2000) for consistency between models.

3.5 MODEL BOUNDARY CONDITIONS

This section describes the boundary conditions that are used for both groundwater flow and chloride concentrations at the bottom, top, and sides of the three-dimensional model domain. A conceptual diagram of the boundary conditions applied along a typical north-south section is presented in Figure 3.4. The lateral concentration boundary conditions are indicated in Figures 3.5 and 3.6. Note that a chloride concentration boundary condition is applied to all prescribed head nodes and DSTRAM provides a zero-concentration-gradient boundary condition to allow for a natural outflow boundary at outflow nodes.

In this section, reference is frequently made to a normalized concentration or a relative concentration. Normalized concentration is a dimensionless number that varies from 0 to 1. It is obtained by dividing a given concentration by the maximum concentration in the system. For example, if the maximum concentration in the model domain is 19,000 mg/L, and at some point a concentration of 5,000 mg/L occurs, then the normalized concentration at that point would be (5,000 mg/l divided by 19,000 mg/L) 0.263. In this study, the maximum concentration of chloride was assumed to be 19,000 mg/L (equal to that of seawater).

3.5.1 Bottom Boundary

The bottom boundary of the model corresponds to the units below the Lower Floridan Aquifer that contain deep brines which may potentially up-cone into the Floridan Aquifer System through the sub-Floridan unit. Little is known about the aquifer at this depth, and hence the bottom boundary head and chloride values are provided such that the system behavior mimics known chloride behavior within the Floridan Aquifer System. The head values along the bottom of the domain are provided such that an upward gradient exists for underlying saltwater to potentially move into the domain of interest through the overlying low conductivity sub-Floridan System in coastal and offshore regions. Figure 3.7 shows the equivalent fresh-water head values prescribed along the bottom boundary of the model. The chloride values are supplied along the bottom to represent seawater concentrations beneath the Gulf of Mexico, with values declining northeastward in inland regions of the domain as noted in Figure 3.8.

3.5.2 Top Boundary

The top boundary of the model corresponds to the top of the Intermediate System. The top boundary beneath the bay or gulf is assigned constant head values equal to -0.025*T (where T is the elevation with respect to sea level of the Intermediate System top) to allow for equivalent fresh-water heads (due to density considerations) to drive water in/out across the Intermediate confining unit. Otherwise, the prescribed heads along the top boundary are interpolated from the pre-development regional flow model. This prescribed head boundary is held constant for the post-development and predictive simulations as the maximum simulated transient head change for the top layer of the regional flow model through 1998 is less than approximately 1 ft. Equivalent fresh-water head values applied to the top boundary of the model are shown in Figure 3.9. The top boundary beneath the bay or gulf is assigned a constant normalized concentration equal to 1.0 (equal to that of seawater). Otherwise, the prescribed normalized concentrations along the top boundary are set to zero, which represents fresh water in the Sand-and-Gravel Aquifer.

3.5.3 Lateral Boundary Conditions

Flow boundary conditions along the lateral boundaries of the domain are prescribed head conditions. On three of the four lateral boundaries (i.e., the north, east and west) prescribed heads were interpolated from the regional MODFLOW groundwater flow model. For pre-development conditions, the pre-development steady-state MODFLOW model is used, while for post-development conditions, these heads are obtained from a transient simulation of the regional MODFLOW groundwater flow model. The southern boundary is assigned constant heads equal to 0.025*Z (where Z is depth below sea level of the respective boundary node) to allow for a vertical gradation of the equivalent fresh-water heads due to density considerations. The multiplying factor of 0.025 assumes that a uniform normalized chloride concentration of C=1 exists from top to bottom along the southern boundary.

Prescribed normalized concentration boundary conditions are assigned along the lateral boundaries of the Upper Floridan Aquifer and Lower Floridan Aquifer as shown in Figures 3.5 and 3.6, respectively. The northern boundary conditions represent predominantly fresh water in the Floridan Aquifer System, while the southern boundary conditions represent seawater in the Gulf. The eastern and western boundary conditions represent the existing chloride distribution within the respective aquifers. This chloride distribution is assumed to prevail from pre-development to current conditions, and is therefore applied to both pre- and post-development model simulations.

3.6 MODEL PARAMETERIZATION

The flow domain of the DSTRAM saltwater intrusion model for the Western Model was initially parameterized from the pre-development regional MODFLOW groundwater flow model. Horizontal hydraulic conductivity values for the Upper and Lower Floridan aquifers were obtained from the associated transmissivity divided by thickness of the respective units of the MODFLOW model, as depicted in Figures 3.10 and 3.11, respectively. Horizontal hydraulic conductivity values for the Bucatunna Clay and for the Intermediate System were also obtained from the associated transmissivity divided by the thickness of the respective units of the MODFLOW model. The Bucatunna Clay horizontal conductivity value thus obtained is on the order of 10^{-5} ft/d. The sub-Floridan System was initially parameterized as discussed in Section 3.2.1 with a varying hydraulic conductivity for the lowest sub-Floridan model layer as noted in Figure 3.12, and uniform values of 0.5 ft/d and 1 ft/d for the overlying sub-Floridan model layers 2 and 3, respectively. A horizontal to vertical anisotropy of 35:1 was provided for all units. The vertical hydraulic conductivity of the Bucatunna Clay model layer is given in Figure 3.13.

Model parameterization and boundary conditions were transferred from the regional MODFLOW model into the DSTRAM framework and a flow simulation was first conducted to ensure that the data transfer was correct. Head values obtained from the flow simulation were in close agreement with the MODFLOW model ensuring the integrity of the data. Density-dependent transport was then turned on within DSTRAM with the appropriate transport boundary conditions as conceptualized earlier. Preliminary sensitivity simulations were used to determine transport parameters that simulated realistic chloride distributions. Effective porosity was set to 0.25. The longitudinal dispersivity was set to 100 ft. The transverse dispersivity was set to 20 ft. The vertical longitudinal dispersivity was set to 10 ft and the vertical transverse dispersivity was set to 1 ft. The molecular diffusion was set to 0.001 ft^2/d for the bottom layer of the sub-Floridan System and for the Bucatunna Clay confining unit. In the remaining parts of the model, the molecular diffusion was set to 0.0 ft^2/d.

This page was intentionally left blank.

4.0 MODEL CALIBRATION

The density-dependent saltwater intrusion model was calibrated in two phases corresponding to the pre-development and post-development conceptualizations. For the pre-development phase, the saltwater intrusion model parameterization and boundary conditions were first developed from the associated pre-development regional MODFLOW groundwater flow model (HydroGeoLogic, Inc., 2000), and initial tests were conducted on transport parameter values and on the conceptualization of the sub-Floridan model boundary to note saltwater intrusion behavior. Flow parameter values were also adjusted in the process to note saltwater intrusion effects. However, the flow-field calibration was altered minimally as noted by head distributions of the saltwater intrusion model as compared to the District's regional MODFLOW flow model. Once the estimated pre-development chloride distribution was achieved by the model, transient post-development simulations were conducted to simulate head and chloride concentrations from year 1942 (approximate time of the pre-development state) through 1998. The simulated hydraulic heads and chloride concentrations were compared to field data measured in more recent times.

4.1 PRE-DEVELOPMENT MODEL CALIBRATION

The pre-development saltwater intrusion model is developed as an extension of the regional MODFLOW groundwater flow model. Early stages of model development did not consider the sub-Floridan System, instead providing a no-flow boundary along the bottom as in the flow model. That model significantly under-predicted the distribution of saltwater known to exist in the Lower Floridan Aquifer. The sub-Floridan System was then included in the conceptualization to act as a source of chlorides as supported by existing data. An examination of the sub-Floridan System properties was then conducted by the District to provide a reasonable parameterization. This allowed for more chlorides to enter the Lower Floridan Aquifer, however, the model was still unable to simulate the vertical concentration gradients known to exist. In order to increase the vertical concentration gradients, two changes were made to the preliminary pre-development DSTRAM model:

- The horizontal hydraulic conductivity (Kh) of the Lower Floridan Aquifer was decreased in the lower portion of the aquifer and increased in the upper portion of the aquifer so that the overall transmissivity was not changed. The six elemental layer Kh values were scaled by 0.2, 0.4, 0.8, 1.2, 1.6, and 1.8 from bottom to top. The existence of significantly higher hydraulic conductivity in the upper portion of the Lower Floridan Aquifer has been demonstrated at several locations (Merritt, 1984).

- The Lower Floridan Aquifer vertical hydraulic conductivity was set equal to the preliminary DSTRAM model Kh divided by 1000.

This conceptualization provided for appropriate vertical gradients within the Lower Floridan Aquifer, however, intrusion of saltwater in the Upper Floridan Aquifer was also low. In order to increase saltwater intrusion in the Upper Floridan Aquifer, the Bucatunna Clay confining unit hydraulic conductivity was increased by a factor of 10 from the preliminary pre-development DSTRAM model. The Kh was assigned $7x10^{-5}$ ft/d with the horizontal to vertical anisotropy remaining at 35:1. These updated values are more representative of the mean value obtained from laboratory analysis of core samples from the Bucatunna Clay. The increase in hydraulic conductivity of the Bucatunna Clay allows for adequate intrusion of saline water into the Upper Floridan Aquifer while having essentially no effect on the simulated heads. Calibration also included adjusting the specified head values at the bottom of the domain to allow adequate intrusion of saltwater into the domain at a given areal location. The bottom boundary heads depicted in Figure 3.7 represent the final calibrated values for the Western Model.

The calibrated pre-development saltwater intrusion simulation for the Western Model reasonably depicts the state of the system in 1942, as understood from available data. The model is discretized as discussed in Section 3.4 with boundary conditions supplied as explained in Section 3.5, and parameterization as discussed in Section 3.6, along with the calibration adjustments discussed above. The pre-development equivalent freshwater heads are similar to the pre-development regional MODFLOW model heads. Figures 4.1 and 4.2 present the pre-development equivalent freshwater heads in the Upper Floridan Aquifer and Lower Floridan Aquifer, respectively. The groundwater generally flows southeast across the model domain. Figures 4.3, 4.4, and 4.5 present the pre-development environmental heads for three north-south vertical cross-sections. Section A-A' is along grid column 19, B-B' is along grid column 73 and C-C' is along grid column 124. The groundwater generally flows south in the Upper Floridan Aquifer and Lower Floridan Aquifer and the groundwater flows upward in the Intermediate System, Bucatunna Clay confining unit, and sub-Floridan System. The pre-development chloride concentrations in the Upper Floridan Aquifer and Lower Floridan Aquifer are shown in Figures 4.6, and 4.7, respectively. Figures 4.8, 4.9, and 4.10 present the pre-development chloride concentrations for three north-south vertical cross-sections. These figures show the highest chloride concentrations in the sub-Floridan System and also show large vertical concentration gradients across the Bucatunna Clay confining unit and Lower Floridan Aquifer.

The pre-development Darcy velocities in the Upper Floridan Aquifer and Lower Floridan Aquifer are shown in Figures 4.11 and 4.12, respectively. The Darcy flow directions are perpendicular to the equivalent freshwater head contours of Figures 4.1 and 4.2. The northeast quadrant of the Upper Floridan Aquifer contains the highest Darcy velocities. Figures 4.13, 4.14, and 4.15 present the pre-development vertical Darcy velocities in the Intermediate System, Bucatunna Clay confining unit, and sub-Floridan System, respectively. In each figure, groundwater flow is upward over most of the domain. Figures 4.16, 4.17, and 4.18 present the pre-development Darcy velocities for three north-south vertical cross-sections. The figures show the groundwater flowing south in the Upper Floridan Aquifer and Lower Floridan Aquifer and flowing upward in the Intermediate System, Bucatunna Clay confining unit, and sub-Floridan System.

The pre-development water balance is shown in Table 4.1. Most of the inward water flow enters the northern and western boundaries. Approximately 37% of the total inward water flow enters the southern boundary or the eastern boundary. Smaller amounts of water enter the top and bottom boundaries. Most of the outward water flow exits the eastern and western boundaries. Approximately 44% of the total outward water flow exits the southern or top boundary. Smaller amounts of water exit the model along the northern and bottom boundaries.

The pre-development chloride balance is shown in Table 4.2. Most of the inward advective flux enters the southern and western boundaries. Approximately 9% of the total inward advective flux enters the bottom boundary. Most of the outward advective flux exits the western, eastern, and southern boundaries. Smaller advective flux exits the northern, bottom, and top boundaries. Most of the inward dispersive flux enters the southern boundary.

4.1.1 Grid Sensitivity

A grid sensitivity model was constructed from the pre-development DSTRAM model. Each element in the model was divided into four elements in the horizontal (x-y) plane. The sensitivity model grid is rectangular with 290 columns and 142 rows of elements (291 columns and 143 rows of nodes) in the horizontal plane for a total of 41,180 elements per layer. The sensitivity model grid has 20 elemental layers, which are identical to the pre-development model.

Figures 4.19 and 4.20 compare the pre-development equivalent freshwater heads for coarse and fine grids in the Upper Floridan Aquifer, and Lower Floridan Aquifer, respectively. The equivalent freshwater heads are very similar throughout the model domain. Figures 4.21 and 4.22 compare the pre-development chloride concentrations in the Upper Floridan Aquifer and Lower Floridan Aquifer, respectively. In general, the grid sensitivity model exhibits a slightly less disperse chloride distribution. The fine grid model simulates lower concentrations in the fresher portions of the model domain and higher concentrations in the saltier portion of the domain. The pre-development chloride concentrations are slightly lower for the fine grid simulation in the vicinity of ground water withdrawals. The grid sensitivity shows that grid refinement has a small effect on the pre-development results.

4.2 POST-DEVELOPMENT SIMULATION FROM 1942 TO 1998

The post-development transient saltwater intrusion model approximates groundwater flow and chloride transport from 1942 to 1998. The post-development simulation incorporated 107 wells. Table 4.3a, 4.3b, 4.3c, and 4.3d lists the wells and the annual average daily rate of pumping. Figure 4.23 presents a plot of the total pumping withdrawals within the western model domain area. Transient flux boundary conditions were assigned to 265 nodes of the DSTRAM model on nodal layers 14-18 to represent the transient buildup of pumping in these wells. Transient specified head boundary conditions were assigned to the western, northern, and eastern lateral boundaries. These specified heads were changed at the beginning of each year to match the heads in the post-development regional MODFLOW simulation (discussed in the next section). The bottom, top, and southern boundary conditions were the same as in the pre-development model. Pre-development conditions were used as initial conditions, effective porosity was set to 0.25 and specific storage was set equal to the regional MODFLOW model storativity (10^{-4}) divided by the cell thickness. Specific storage ranged from $8x10^{-8}$ 1/ft to

$3x10^{-6}$ 1/ft. The post-development simulation used 703 time steps with a maximum time step of 30 days. The initial time step size was one day.

4.2.1 Post-Development Regional MODFLOW Simulation

The post-development regional MODFLOW model simulates transient groundwater flow conditions from 1942 to 1998. The pre-development regional MODFLOW model results were utilized as initial conditions. Post-development conditions were simulated using 57 one-year stress periods. The District provided well injection/extraction boundary conditions for each stress period. The specified head, recharge, river, drain, and general-head boundary conditions were identical to the pre-development regional MODFLOW model. Each stress period used an initial time step size of one day and a maximum time step size of 30 days. The specific yield was 0.25 and the storativity value was 10^{-4}. Results of this simulation provide transient lateral landward boundary conditions for the DSTRAM model.

4.2.2 Post-Development Results–Simulated Water Levels and Darcy Velocities

The DSTRAM saltwater intrusion model simulates transient flow and chloride transport conditions from 1942 to 1998. The 1998 post-development equivalent freshwater heads in the Upper Floridan Aquifer and Lower Floridan Aquifer are shown in Figures 4.24 and 4.25, respectively. The groundwater flows inward towards the extraction wells and the Lower Floridan Aquifer has one injection well in the northwest corner of the model. Figures 4.26, 4.27, and 4.28 present the 1998 post-development environmental heads for three north-south vertical cross-sections. Compared to the pre-development simulation (Figures 4.3, 4.4, and 4.5), groundwater flow has reversed direction in the Upper Floridan Aquifer and in the Intermediate System in offshore areas. Groundwater flow has also reversed direction in Lower Floridan Aquifer for cross-sections B-B' and C-C' in offshore areas. Cross-sections B-B' and C-C' also have a large upward head gradient across the sub-Floridan System.

The 1998 post-development Darcy velocities in the Upper Floridan Aquifer and Lower Floridan Aquifer are shown in Figures 4.29 and 4.30, respectively. The Darcy flow directions are perpendicular to the equivalent freshwater head contours in Figures 4.24 and 4.25. The Darcy velocities are higher than the pre-development Darcy velocities (Figures 4.11 and 4.12). Figures 4.31, 4.32, and 4.33 present the 1998 post-development vertical Darcy velocities in the Intermediate System, Bucatunna Clay confining unit, and sub-Floridan System, respectively. Compared to the pre-development simulation (Figures 4.13, 4.14, and 4.15), groundwater flow has reversed direction in the Intermediate System and Darcy velocities have increased in the Bucatunna Clay confining unit and sub-Floridan System. Figures 4.34, 4.35, and 4.36 present the 1998 post-development Darcy velocities for three north-south vertical cross-sections. The figures also show the reversed flow direction in offshore areas and the Intermediate System compared to pre-development conditions as well as higher Darcy velocities in inland areas and in the Bucatunna Clay confining unit and the sub-Floridan System when compared to the pre-development simulation.

The post-development water balance is shown in Table 4.4. Compared to the pre-development simulation, the flow of water through the model has doubled. The northern boundary has the highest inward water flow rate (24% of the total) and the bottom boundary has one of the lowest flow rates (11% of the total). Pumping has the highest outward flow rate (58% of the total). Smaller amounts of water exit the model along the northern, bottom, and top boundaries.

Table 4.5 provides the net boundary flow for both the pre-development and post-development simulations, and the change in flow rate for each of the boundaries. The top model boundary provided 38% of the inflow induced by the post-development pumping stress. The northern and eastern boundaries provided for 17% and 16% respectively. The bottom, western and southern boundaries provide for the remainder of the pumping induced inflow.

The simulated water levels were compared to observed water levels at the nine wells shown in Figure 4.37. Figures 4.38 through 4.46 compare the MODFLOW and DSTRAM simulated heads to the observed water levels from 1942 to 1998. The simulated water levels decrease from 1942 to 1998 and are consistent with observed water level trends. The simulated water levels are lower than observed water levels at EAFB Metts Tower and higher than observed water levels at Mary Esther #2, Okaloosa County School Board, and EAFB – Postil Point. The DSTRAM simulated heads are 5 ft to 10 ft higher than the MODFLOW simulated heads. Post-development sensitivity analysis in Section 4.2.4 investigates the difference in the DSTRAM and MODFLOW simulated heads.

4.2.3 Post-Development Results–Simulated Chloride Concentrations

The 1998 post-development chloride concentrations in the Upper Floridan Aquifer and the Lower Floridan Aquifer are shown in Figures 4.47 and 4.48, respectively. Chloride concentrations are very similar to the pre-development concentrations (Figures 4.6 and 4.7). A comparison between the pre-development chloride concentrations and the 1998 post-development chloride concentrations in the Upper Floridan Aquifer and Lower Floridan Aquifer is shown in Figures 4.49 and 4.50, respectively. Figure 4.49 shows the minimal change in chloride concentrations in the Ft. Walton Beach area, which is consistent with historical observations. Figure 4.50 shows the change in chloride concentrations in the Lower Floridan Aquifer. Figures 4.51, 4.52, and 4.53 present the 1998 post-development chloride concentrations for three north-south vertical cross-sections. The figures show that the pumping induced inward flow from the top model boundary has caused higher chloride concentrations in the top nodal layer.

The post-development chloride balance is shown in Table 4.6. Flux rates are larger than the pre-development flux rates. Most of the inward advective flux enters the southern, western and top boundaries. Approximately 15% of the total inward advective flux enters the bottom boundary. Smaller advective flux enters the northern boundary. Most of the outward advective flux exits the southern and western boundaries. Smaller advective flux exits the northern, bottom, and top boundaries. Most of the inward dispersive flux enters the southern boundary. Most of the outward dispersive flux exits the top boundary.

Observed chloride concentrations for Santa Rosa County and Okaloosa County are shown in Figures 4.54 and 4.55, respectively. The simulated 1998 chloride concentrations in the Upper

Floridan Aquifer (shown in Figure 4.47) are consistent with the mean chloride concentrations for 1998 to 2000. The simulated chloride concentrations were compared to observed concentrations at the seven wells shown in Figure 4.56. Figures 4.57 through 4.63 compare the DSTRAM simulated concentrations to the observed concentrations. The simulated chloride concentrations increase only slightly from 1942 to 1998 and is barely noticeable in the figures. This is consistent with observed concentration trends.

4.2.4 Post-Development Results – Flow Sensitivity of Sub-Floridan Boundary Heads

The 1990 post-development MODFLOW heads in the Upper Floridan Aquifer and Lower Floridan Aquifer are shown in Figures 4.64 and 4.65, respectively. Figures 4.66 and 4.67 show the 1990 DSTRAM equivalent freshwater heads in the same two aquifers. Comparing the DSTRAM and MODFLOW heads, the DSTRAM equivalent freshwater heads are 5 ft higher in the Upper Floridan Aquifer and 10 ft higher in the Lower Floridan Aquifer at Ft. Walton Beach. There are two major differences between the DSTRAM and MODFLOW models:

1) The DSTRAM model has fresh water moving south and up over the saltwater wedge, while the MODFLOW model does not have the saltwater wedge. DSTRAM equivalent freshwater heads reflect the additional density caused by the presence of saltwater.

2) The DSTRAM model has saltwater entering the bottom boundary, while the MODFLOW model has a no-flow bottom boundary.

To investigate the impact of saltwater entering the bottom boundary of the DSTRAM model, the post-development DSTRAM model was modified to reduce flow from the bottom boundary. The horizontal and vertical hydraulic conductivities were set to 10^{-14} ft/d for the bottom three elemental layers that represent the sub-Floridan System. Figures 4.68 and 4.69 show the 1990 equivalent freshwater heads in the Upper Floridan Aquifer and Lower Floridan Aquifer, respectively, for the reduced flow from bottom simulation. The reduced flow from the bottom boundary caused a decrease in heads in the Upper Floridan Aquifer and Lower Floridan Aquifer and the equivalent freshwater heads are similar to the MODFLOW heads. This suggests that the sub-Floridan System saltwater source leads to the 5 to 10 foot head difference between the DSTRAM and MODFLOW simulated 1990 water levels.

This page was intentionally left blank.

5.0 MODEL SENSITIVITY ANALYSIS

Parameter sensitivity analysis is conducted to quantify uncertainty in the calibrated model resulting from uncertainty in estimates of aquifer parameters, stresses and boundary conditions. The analysis establishes the effect of model parameter uncertainty on both the model calibration and results. The effect of parameter changes can then be categorized in a manner that identifies the predictive capability of the calibrated model. The effects of various model parameters on the calibrated model are examined by comparing observed head and chloride values to the simulated values resulting from a specific parameter change. Parameters to be investigated and their associated range of variation were selected in consultation with the District and are considered as important parameters governing saltwater intrusion within the domain.

The sensitivity analysis helps identify intrusion characteristics critical to the water supply system of the region and is used to assess model conclusions. ASTM (1994) standards were applied to categorize parameter sensitivity in a qualitative manner into one of four categories or types. Type I parameter sensitivities are those which cause insignificant changes in calibration residuals and model predictions. Type I parameter sensitivity is of no concern because, regardless of the parameter value (within the range tested), the model prediction remains the same. Type II parameter sensitivities are those which cause a significant change in model calibration and result in insignificant change in the model predictions. Type II parameter sensitivity is also of no concern because, regardless of the change in model parameter, the model prediction remains the same. Type III parameter sensitivities are those which result in a significant change to calibration residuals, as well as to model predictions. Type III parameter sensitivity is of no concern because, even though the model's conclusions change as a result of variation of model input, the resultant model becomes un-calibrated. Type IV parameter sensitivities are those which cause an insignificant change in the model calibration and a significant change in the model's conclusions. Type IV parameter sensitivities exhibit greater uncertainty because, over the range of parameter values in which the model can be considered calibrated, the model predictions change. Additional data collection and model calibrations efforts are required to reduce this uncertainty.

A total of 15 sensitivity simulations were performed. Each sensitivity simulation consisted of applying a specified parameter change to the calibrated model input file and running this modified model to steady-state conditions, for establishing the effect of the parameter change on the pre-development distribution of heads and chlorides. Subsequently, transient pumpage was applied to the modified model, establishing the effect of the parameter change on the post-development (1998) head and chloride distribution. Table 5.1 includes a list of parameter changes applied to each of the 15 sensitivity simulations and the resulting calibration statistics. The conclusions assessed include: chloride change from pre-development to 1998 for the Upper Floridan Aquifer; ground-water seepage velocities in areas where saline water is known to exist; chloride concentrations offshore beneath the Gulf of Mexico; and total chloride mass contained within the model domain. Equivalent freshwater head and chloride plots of the equilibrated pre-development model and simulated 1998 conditions for the base case and each of the 15 sensitivity simulations are provided in Appendix A.

5.1 PRE-DEVELOPMENT MODEL SENSITIVITIES

Figure 5.1 presents the RMS and mean head difference ($\mu_{sim.\ pre\text{-}dev.\ hd} - \mu_{sim.\ sensitivity\ hd}$) calculated using the pre-development base case and each of the respective sensitivity simulations. Model error was not calculated for the pre-development sensitivities due to the very limited availability of pre-development observations. Instead the RMS and mean head change from the base case pre-development model was calculated. The change was calculated at the model nodes specified in Tables 5.2 and 5.3, which are critical locations for the system in terms of drawdown. These are the same nodes used to calculate the post-development (1998) head error and for the error statistics in Table 5.1. For the range of parameter variations selected for this study, the vertical hydraulic conductivity of the Intermediate System is the most sensitive with respect to head. Increasing the Intermediate System vertical hydraulic conductivity by an order-of-magnitude (Case 3b) results in a mean head decline of 8.49 ft (RMS = 10.44 ft) from base-case results. Decreasing it by an order-of-magnitude (Case 3a) results in a mean head increase of 4.09 ft (RMS = 5.06 ft). For the remainder of the parameter variations, simulated pre-development heads are relatively insensitive.

The RMS and mean chloride difference ($\mu_{sim.\ pre\text{-}dev.\ Cl} - \mu_{sim.\ sensitivity\ Cl}$) for the pre-development sensitivity simulations are presented in Figure 5.2 (Upper Floridan Aquifer) and Figure 5.3 (Lower Floridan Aquifer). In calculating the RMS and mean chloride change from the base case pre-development model, model nodes specified in Tables 5.4 and 5.5 were used which are critical locations for the system in terms of chloride intrusion. These are the same nodes used to calculate the post-development (1998) chloride error and for the calibration statistics in Table 5.1. Increasing the vertical hydraulic conductivity of the sub-Floridan System by an order-of-magnitude (Case 5b) causes the largest deviation from base-case results for both Upper and Lower Floridan Aquifer statistics. The next largest effect on chlorides within the Upper and Lower Floridan aquifers results from lowering the aquifer material permeabilities by half (Case 2a), and from increasing the bottom boundary specified head value by 10 ft (Case 6b). Cases 5b and 6b yield greater solute flux into the domain, with attendant concentration increases. These increases propagate into the Upper Floridan Aquifer. Case 2a yields a more sluggish flow system and greater solute retention, compared to the base case.

Specific model conclusions that were examined include pre-development head and chloride values for the Upper Floridan Aquifer approximately 3 miles offshore and head and chloride values for the Lower Floridan Aquifer near the Bucatunna Clay pinchout. These two areas are of interest because saline water is known to occur within the Floridan Aquifer at these general locations and under current conditions both of these areas are up-gradient of coastal withdrawal wells.

No information is available regarding the saltwater distribution within the Upper Floridan Aquifer offshore of Okaloosa and Santa Rosa counties. The model does, however, provide a prediction regarding the distribution of saltwater in these areas. Those predictions are examined here to allow an assessment of the significance of model uncertainty on simulated chloride concentrations in offshore areas. Also, the saline water known to exist in the Lower Florida Aquifer in the Ft. Walton area under both pre-development and current conditions is within 100 vertical feet of the bottom of many of the area's major production wells. The saltwater is confined beneath the Bucatunna Clay, which prevents upconing. However, the Bucatunna Clay pinches out in the vicinity of, or just to the north of the EAFB Main Base. Model results in both of these areas are important for assessing the sustainability of ground water resources.

The sensitivity of simulated heads and chloride concentrations at these locations were calculated at five selected nodes representing each of these locations. Figure 5.4 presents the RMS and mean chloride difference between the pre-development base case and each of the respective sensitivity simulations for the selected Upper Floridan Aquifer offshore nodes (Table 5.6). Figure 5.5 presents the RMS and mean chloride difference for the selected Lower Floridan Aquifer nodes (Table 5.7).

Chlorides concentrations offshore in the Upper Floridan Aquifer are most sensitive to an order-of-magnitude increase in the Intermediate System vertical hydraulic conductivity (Case 3b) with little sensitivity for the remaining cases. Increasing the Intermediate System vertical hydraulic conductivity lowers head in the Upper Floridan Aquifer moving the saltwater interface closer to shore. Case 3b shows a significant change in the model conclusions, predicting that the saltwater is closer to shore, compared to the base case. However, the simulation also results in a significant change in the head calibration, indicating a Type III sensitivity. As per ASTM (1994) guidelines, a Type III sensitivity is of no concern because, even though the model's conclusions change as a result of the variation of the input, the parameters used in the simulation cause the model to become un-calibrated.

From Figure 5.5 it is noted that increasing the sub-Floridan System vertical hydraulic conductivity by an order-of-magnitude (Case 5b) creates the greatest change in Lower Floridan Aquifer chlorides near the Bucatunna Clay pinchout. Case 5b yields greater solute flux into the domain, with attendant concentration increases. Case 5b is also a Type III sensitivity, due to the significant effect of the parameter change on the chloride calibration statistics.

5.2 POST-DEVELOPMENT MODEL SENSITIVITIES

Figure 5.6 presents the RMS and mean head error ($\mu = \Sigma[hd_{1998obs} - hd_{1998sim}]/n_{obs}$) in the Upper and Lower Floridan aquifers for the base-case 1998 simulation and the various sensitivity simulations. Head observations for 1998 are given in Table 5.2 and 5.3. Figure 5.7 presents the RMS and mean head difference between the post-development base case and each of the respective sensitivity simulations. Horizontal hydraulic conductivity of the Upper and Lower Floridan aquifers is the most sensitive parameter with respect to system head. Decreasing Floridan Aquifer conductivities by half (Case 2a) yields a simulated 1998 mean head 33.48 ft lower than the base case (RMS = 40.76 ft). Other cases with fairly high head sensitivities include increasing the Intermediate System conductivity (Case 3b), increasing Floridan Aquifer conductivities (Case 2b) and increasing sub-Floridan System conductivities (Case 5b). These three cases all result in higher simulated 1998 heads, compared to the base case. Mean head increases range from 11.16 to 15.38 ft.

Figures 5.8 and 5.9 present the RMS and mean chloride errors for the base-case 1998 simulation and all sensitivity simulations in the Upper and Lower Floridan aquifers, respectively. Post-development chloride observations are given in Tables 5.4 and 5.5. Figures 5.10 and 5.11 present the RMS and mean chloride difference between the base-case 1998 simulation and each of the respective sensitivity simulations. The largest concentration error for both Upper and Lower Floridan aquifers occurs for Case 5b whereby the sub-Floridan System vertical hydraulic conductivity value is increased by an order-of-magnitude. This allows more mass flux into the model domain. Figures 5.8 and 5.9 show relatively small (insignificant) change to the simulated chloride error for several of the sensitivity simulations. The sensitivity response is similar to the respective pre-development cases of Figures 5.2 and 5.3, indicating that chloride placement at pre-development times is the key factor in minimizing the post-development chloride error rather than chloride movement from pre- to post-development times.

The RMS and simulated mean drawdown ($\mu=\Sigma[hd_{pre\text{-}dev.sim}-hd_{1998sim}]/n_{obs}$) of the Floridan Aquifer System is given in Figure 5.12, for the base case and all sensitivity simulations. The calculated RMS and mean drawdown is for the Upper and Lower Floridan aquifers combined. Drawdown was calculated at the nodes used to calculate post-development, 1998 head error. Node locations are given in Tables 5.2 and 5.3. The least amount of drawdown is noted for an increase in the Intermediate System vertical hydraulic conductivity by an order-of-magnitude. This sensitivity more effectively dissipates pumping stress into the overlying boundary condition, resulting in less aquifer drawdown. The most drawdown is noted for a decrease in horizontal aquifer hydraulic conductivity values by a factor of 0.5 (Case 2a).

The change in RMS and mean chloride values from pre- to post-development conditions is shown for the Upper Floridan Aquifer (Figure 5.13) and for the Lower Floridan Aquifer (Figure 5.14) for the base case and the sensitivity simulations. These figures show the degree of intrusion that occurs as a result of the transient pumping history from pre- to post-development. “Observations” consist of simulated chlorides at the locations given in Tables 5.4 and 5.5. For both the Upper and Lower Floridan aquifers, the transient pumping history imparts very little increase in the simulated chloride concentrations at the observation points. This is consistent with existing observations which show little chloride change with time. It is important, however, to note the limited number of historical chloride observations, and more importantly, that the existing chloride observations are biased, in that they represent the freshest portion of the flow system. Regarding these chloride sensitivity simulations for the Upper Floridan Aquifer, all 15 sensitivities may be categorized as either Type I or II.

The least chloride intrusion in the Upper Floridan Aquifer occurs for sensitivity Case 7a whereby molecular diffusion of all layers was set to zero. The most Lower Floridan Aquifer chloride intrusion occurs for Case 5b, whereby the vertical hydraulic conductivity of the sub-Floridan System is increased by an order-of-magnitude. The least Lower Floridan Aquifer chloride intrusion occurs for Case 5a, whereby the sub-Floridan System vertical hydraulic conductivity is decreased by an order-of-magnitude.

Specific post-development model conclusions that were examined include seepage velocities, head and chloride values for the Upper Floridan Aquifer approximately 3 miles offshore; seepage velocities, head and chloride values for the Lower Floridan Aquifer near the Bucatunna Clay pinchout; and seepage velocities within the Intermediate System beneath the Choctawhatchee Bay and the near shore Gulf of Mexico. Model sensitivities were calculated at five selected nodes or elements in each of these three areas as shown in Figure 5.15. Additional node information is provided in Tables 5.6 and 5.7. Additional element information is provided in Tables 5.8, 5.9 and 5.10. Table 5.11 provides a summary of these model results. For each of these three areas, mean values of head, chloride and seepage velocity are presented.

The simulated ground water seepage velocities essentially represent the rate of saltwater intrusion at these specific locations. The seepage velocities are important conclusions of the model and are specifically examined here since the velocities directly influence the sustainability of current and future ground water withdrawal rates. Table 5.12 shows the sensitivity of the Upper Floridan Aquifer horizontal ground water seepage velocity and bearing in offshore areas to the various parameters, along with ASTM sensitivity type, as determined for the mean seepage velocity. The largest sensitivity is to porosity of the aquifer materials (Case 1a). The simulated change in aquifer porosity from 25% to 15% resulted in a 67% increase in seepage velocity. All other sensitivity cases resulted in seepage velocity change of less than 16%.

Table 5.13 shows the sensitivity of Lower Floridan Aquifer horizontal ground water seepage velocity near the Bucatunna Clay pinchout to the various parameters, along with ASTM sensitivity type, as determined for the mean seepage velocity. Again, sensitivity is highest to porosity (Case 1a), showing a 67% increase in seepage velocity. The seepage velocity near the Bucatunna Clay pinchout is also sensitive to increasing the sub-Floridan Aquifer vertical hydraulic conductivity value by an order-of-magnitude (Case 5b). Case 5b shows a 40% increase in the seepage velocity in this area. It is noted that Case 5b also shows the largest RMS and mean chloride errors among all simulations (Figures 5.8 and 5.9), causing the model to become un-calibrated (Type III sensitivity). All other sensitivity cases resulted in seepage velocity change of less than 19%.

Table 5.14 shows the sensitivity of vertical ground water seepage velocity through the Intermediate System in the bay and near-shore Gulf of Mexico, along with ASTM sensitivity type, as determined for the mean seepage velocity. Sensitivity is highest to the Intermediate System vertical hydraulic conductivity. The highest seepage rate occurs when the Intermediate System vertical conductivity is increased by a factor of 10 (Case 3b). It is lowest for the case where the vertical conductivity is decreased by a factor of 0.1 (Case 3a). Case 3b significantly increased the model head error (Figure 5.6) and indicates a Type III sensitivity. Case 3a caused an insignificant change in the head and chloride calibrations (Figures 5.7, 5.10 and 5.11) and a significant change in the conclusion (vertical seepage velocity lower than the base case simulation).

The seepage velocity through the Intermediate System is also sensitive to a decrease in aquifer horizontal hydraulic conductivity (Case 2a). The reduction of the hydraulic conductivity results in additional drawdown and an increase in gradients and seepage velocities. Case 2a results in a moderate change to the chloride calibration statistics, indicating Type III or Type IV sensitivity. The change in porosity from 25% to 15% (Case 1a) results in a significant change in the conclusions (increases the vertical seepage velocity by 67%) and has an insignificant affect on the calibration.

It is important to note that a porosity change from 25% to 15% results in a 67% increase in the seepage velocity (rate of saltwater intrusion) at each of the three locations identified above while producing an insignificant change in the model calibration. Thus the model exhibits a Type IV sensitivity to porosity, indicating uncertainty in the actual rate of intrusion. Case 1a demonstrates the actual rate of intrusion predicted by the base-case model may be up to 1.67 times the rate predicted by the base case model. However, Figure 5.13 shows no significant simulated chloride change occurred from pre-development to 1998 as a result of the lower porosity and associated change in seepage velocity.

This page was intentionally left blank.

6.0 MODEL PREDICTIVE SIMULATION

The calibrated base-case model was used to perform a predictive simulation starting from the 1998 post-development conditions. The predictive simulation assumes that the 1998 stress conditions are maintained for the next 52 years, from 1998 to 2050. Floridan Aquifer withdrawals were held constant at the 1998 rate based on the minimal increase in withdrawals for the period 1988 to 1998 (Figure 4.23), current increase utilization of alternative water sources (including the Sand-and-Gravel Aquifer, water reuse and water use conservation strategies) and the difficulty in predicting the demand through 2050.

The regional ground water flow model was run in steady-state mode applying 1998 withdrawals to provide the lateral (western, eastern and northern) boundary heads in the Upper and Lower Floridan aquifers. It was noted that the flow field equilibrated to its steady-state conditions within a couple of years. Therefore, applying the boundary conditions in a steady-state mode for 52 years is justified. Other boundary conditions are the same as for the calibration base case.

Figures 6.1, and 6.2 show the predicted equivalent freshwater head contours in the Upper and Lower Floridan aquifers for the predictive simulation (year 2050). These heads are similar to the post-development 1998 conditions of Figures 4.24 and 4.25. Darcy velocities in the Upper and Lower Floridan aquifers are shown in Figures 6.3 and 6.4, respectively. The Darcy velocities are similar to the post-development Darcy velocities (Figures 4.29 and 4.30). The water balance for the predictive simulation at 2050 is shown in Table 6.1. Flow of water through the model is similar to the post-development simulation case of Table 4.4.

Figures 6.5 and 6.6 show the 2050 predictive simulation chloride concentration contours in the Upper and Lower Floridan aquifers, respectively. Also shown are simulated pre-development chloride concentrations. The 2050 chloride concentrations are similar to the pre-development concentrations of Figures 4.6 and 4.7, although intrusion is noted for all layers. Figures 6.7, 6.8, and 6.9 present the chloride concentrations for three north-south vertical cross-sections for the 2050 predictive simulation. In all three vertical cross-sections flow from the top boundary has caused higher chloride concentrations in the Intermediate System, specifically noticeable with the 250, 100 and 50 mg/L contours. For the Upper Floridan Aquifer chloride observation sites (Table 5.4) the simulated mean chloride concentrations in pre-development, 1998 and 2050 are 127 mg/L, 130 mg/L and 135 mg/L, respectively.

The chloride balance for the predictive simulation at 52 years is shown in Table 6.2. The largest percent change in chloride flux is noted for the advective flux through the northern boundary where intrusion is noted in the western portions of the northern boundary. Most of the inward advective flux enters the northern and western boundaries, as compared to the southern and western boundaries for the post-development 1998 case. The inward flux through the bottom boundary is also larger than for post-development 1998 conditions though it is a smaller percent of the total. Most of the outward advective flux exits the eastern, western and southern boundaries with little flux exiting the northern, bottom, and top boundaries. Most of the inward dispersive flux enters the southern boundary. Most of the outward dispersive flux exits the top boundary.

The simulated chloride concentrations at pre-development, 1998 and 2050 are plotted for the seven wells shown in Figure 4.56. Figures 6.10 through 6.16 provide the concentrations profiles for wells at Tiger Point, Yellow River, Navarre Beach, Lisa Jackson Park, Beal Cemetery, EAFB Field 4, and Destin, respectively. These figures represent the change in chloride concentrations predicted by the base case model through 2050, assuming pumping is held constant at 1998 rates.

This page was intentionally left blank.

7.0 SUMMARY AND CONCLUSIONS

The construction, calibration, and predictive simulations with the Western Domain saltwater model provide significant insight into the dynamics of ground water flow and saltwater transport within the Floridan Aquifer System in this area. The model helps to fill in gaps in the data base regarding the likely location of saltwater in the subsurface and to quantify rates of saltwater intrusion. The following bulleted items summarize the key points and findings from this study.

- Significant development of the Floridan Aquifer as a source of water supply for coastal Santa Rosa, Okaloosa and Walton counties began in the 1940s.

- Prior to 1940, Floridan Aquifer water levels in coastal Santa Rosa and Okaloosa counties were between 50 ft and 60 ft above sea level. Fresh ground water flowed in a generally north to south direction, from inland to offshore, where it eventually discharged into the Gulf of Mexico.

- During the 1950s, as the water supply for this area was developed, ground water levels in Ft. Walton Beach declined to below sea level. Since this has occurred, ground water flow along the coast has reversed. Ground water now flows from offshore areas northward in the direction of coastal withdrawal wells.

- By 1998, ground water withdrawals in Santa Rosa, Okaloosa and Walton counties had risen to an average of 36 Mgal/d. This has caused Floridan Aquifer water levels along the coast to decline to more than 100 ft below sea level.

- The existing water quality monitoring system is not designed to detect intrusion because most of the monitoring points are either water supply wells or monitoring wells located far enough inland that they would not experience water quality degradation for some time.

- Floridan Aquifer water with chlorides in excess of the secondary drinking water standard of 250 mg/L is known to exist onshore in coastal Santa Rosa and Walton counties. Model simulations predict that water of similar quality lies within three miles south of Santa Rosa Island along most of coastal Okaloosa County.

- Model simulations indicate the principal pathways of saltwater intrusion are: lateral intrusion within the upper Floridan Aquifer from beneath the Gulf, lateral intrusion from the lower into the upper Floridan Aquifer around the edge of the Bucatunna Clay, and downward vertical leakage through the Intermediate System. Upward vertical leakage through the Bucatunna Clay is of lesser significance.

- Model simulations place the pre-development chloride distribution in locations consistent with historical observations. The pre-development chloride distribution for onshore areas is particularly sensitive to: decreasing the Floridan Aquifer horizontal hydraulic conductivity, increasing the sub-Floridan System vertical hydraulic conductivity, and increasing the hydraulic head applied to the sub-Floridan System.

- Beneath the Gulf of Mexico, the pre-development chloride distribution is most sensitive to an increase in the vertical hydraulic conductivity of the Intermediate System.

- Along the Bucatunna Clay pinchout, the pre-development chloride distribution is most sensitive to an increase in the vertical hydraulic conductivity of, and the hydraulic head applied to the sub-Floridan System.

- The simulated rate of saltwater intrusion (seepage velocity) during the transition from pre- to post-development conditions is particularly sensitive to the porosity of the Floridan Aquifer. Seepage velocities are important since they directly influence the sustainability of current and future ground water withdrawal rates. Floridan Aquifer porosity is not determinable by direct measurement, and thus, is subject to significant uncertainty.

- Although the response of water levels to a change in pumping or development is relatively fast (on the order of years or decades) the response of saltwater movement is much slower (on the order of decades or centuries). Therefore, saltwater will continue to move inland even though water levels may have stabilized following development of water supplies.

- Simulated post-development rates of saltwater intrusion within the Floridan Aquifer about three miles south of Santa Rosa Island are on the order of eight feet per year, toward the north.

- Simulated post-development rates of saltwater intrusion in the vicinity of the Bucatunna Clay pinchout are higher, on the order of 30 feet per year. Ground water in this area has chlorides as high as 1,000 mg/L.

- For the purpose of performing a long-term saltwater intrusion simulation, pumping was held constant between 1998 and 2050. As a result, heads, velocities and water balance at 2050 are similar to 1998 conditions. Simulation of a pumping increase over the 1998-2050 time interval would have shown greater rates of intrusion.

- Simulation of pumping at 1998 levels through 2050 shows a modest degree of lateral saltwater intrusion, south of Santa Rosa Island. During this time period, saltwater was simulated to partially penetrate the Intermediate System from the top.

- Although not specifically addressed in this report, leakage of saline water into the Floridan Aquifer via leaky, abandoned well casings can significantly shorten the timescales associated with noticeable water quality degradation.

- The saltwater intrusion model is regional in nature and therefore does not address localized saltwater intrusion problems that may result from undetected pockets of saltwater, heterogeneities that serve as conduits for saltwater flow, well construction problems, or improperly plugged boreholes which penetrate the Bucatunna Clay.

- All entities with responsibility related to the use and/or management of this resource need to continue and improve the monitoring of the Floridan Aquifer System for evidence of saltwater intrusion. This information will be critical for future efforts to refine this model and is necessary to timely adapt to the inevitable deterioration in water quality that will come as a result of continued resource utilization at or near current levels.

This page intentionally left blank.

8.0 REFERENCES

ASTM, 1994. Standard Guide for Conducting Sensitivity Analysis for a Ground-Water Flow Model Application, American Society for Testing and Materials, Publication D5611-94, 1-5.

Barr, D.E., L.R. Hayes, and T. Kwader, 1985. Hydrology of the Southern Parts of Okaloosa and Walton Counties, Northwest Florida, with Special Emphasis on the Upper Limestone of the Floridan Aquifer, U.S. Geological Survey, Water Resources Investigations Report 84-4305.

Barr, D.E., A. Maristany, and T. Kwader, 1981. Water Resources of Southern Okaloosa and Walton Counties, Northwest Florida, Northwest Florida Water Management District, Water Resources Assessment 81-1.

Barraclough, J.T., and O.T. Marsh, 1962. Aquifers and Quality of Ground Water along the Gulf Coast of Western Florida, Florida Geological Survey, Report of Investigations 29.

Chen, 1965. The Regional Lithostratigraphic Analysis of Paleocene and Eocene Rocks of Florida, Florida Geological Survey, Bulletin No. 45.

Dresser Atlas, 1983. Log Interpretation Charts.

Huyakorn, P.S., and S. Panday, 1994. DSTRAM: Density-Dependent Solute Transport Analysis Finite-Element Model, User's Manual, Version 4.1, HydroGeoLogic, Inc., Herndon, VA.

HydroGeoLogic, 2000. Modeling of Groundwater Flow in Walton, Okaloosa, Santa Rosa, and Escambia Counties, Florida, HydroGeoLogic, Inc., Herndon, Virginia.

Kwader, T., 1982. Interpretation of Borehole Geophysical Logs in Shallow Carbonate Environments and Their Application of Groundwater Investigations, Northwest Florida Water Management District, Water Resources Assessment 83-1.

McKinnon, E.C., and Pratt T.R., 1998 A Compilation of Water Quality and Pumpage Data for Select Wells in Santa Rosa, Okaloosa, Walton and Bay Counties, Florida, Northwest Florida Water Management District, Technical File Report 98-1.

Merritt, 1984. Digital Simulation of the Regional Effects of Subsurface Injection of Liquid Waste near Pensacola, Florida, U.S. Geological Survey, Water-Resources Investigations Report 84-4042.

Pratt, T.R., K.A. Milla, L.A. Clemens, and H. Roaza, 1996. Analysis of Ground Water Availability from the Floridan Aquifer, Southern Walton County, Florida, Northwest Florida Water Management District, Water Resources Special Report 96-2.

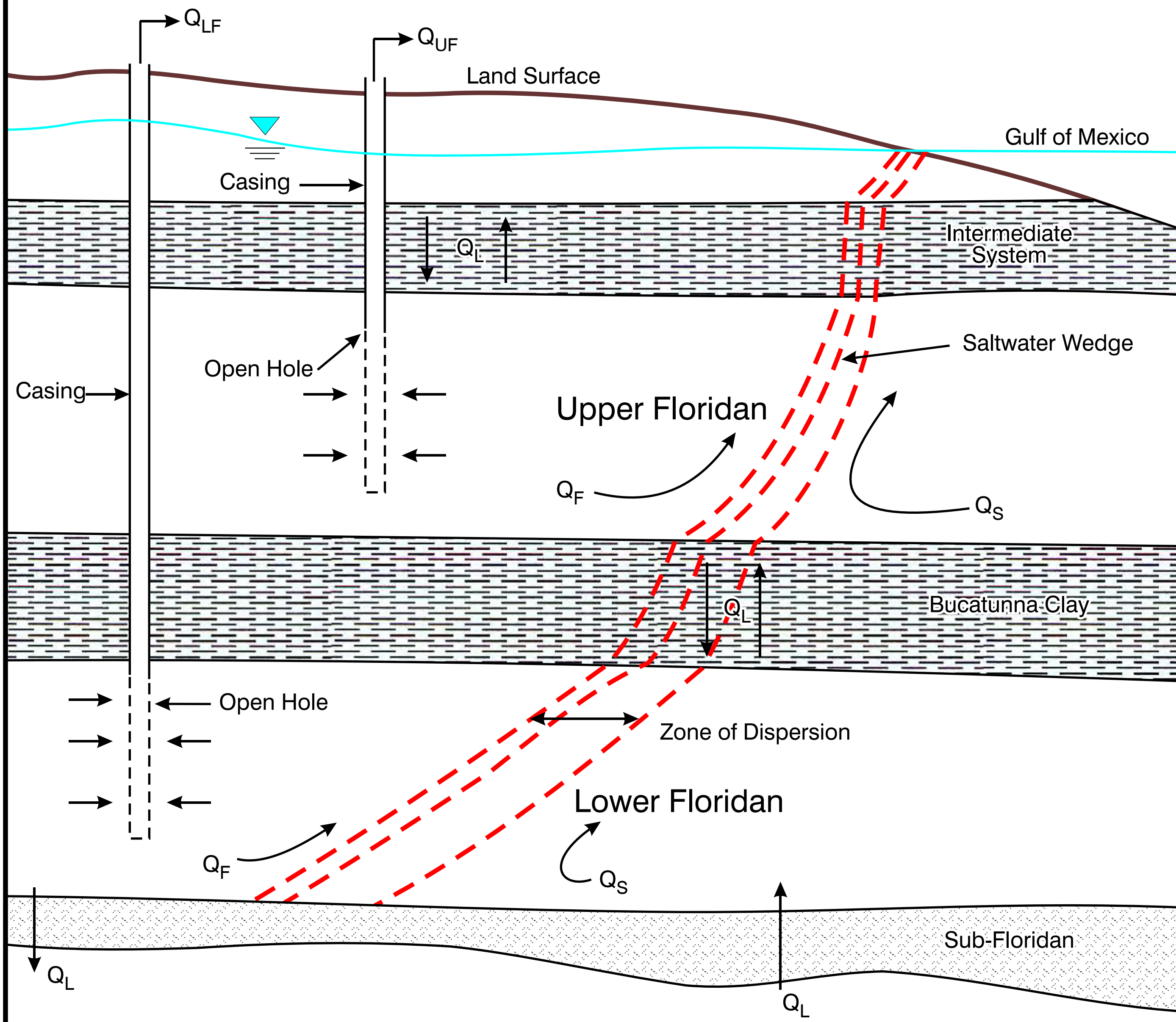
Ryan, P.L., T. Macmillan, T.R. Pratt, A.R. Chelette, C.J. Richards, R.A. Countryman, and G.L. Marchman, 1998. District Water Supply Assessment, Northwest Florida Water Management District, Water Resources Assessment 98-2.

Trapp, H., Jr., C.A. Pascale, and J.B. Foster, 1977. Water Resources of Okaloosa County And Adjacent Areas, Florida, U.S. Geological Survey, Water Resources Investigations Report 77-9.

FIGURES

Filename: X:\NWF002\003-07\General_Loc_Map.cdr
Project: NWF002-003-07
Created by: cfarmer 10/29/04
Revised: 08/22/05 asc
Source: HydroGeoLogic, Inc.

Figure 1.1
General Location Map with Reference Wells in Region II



Q_L = Predominantly vertical flow through confining units
Q_S = Flow of saltwater in aquifer units
Q_F = Flow of freshwater in aquifer units
Q_{UF} = Upper Floridan Aquifer pumping
Q_{LF} = Lower Floridan Aquifer pumping

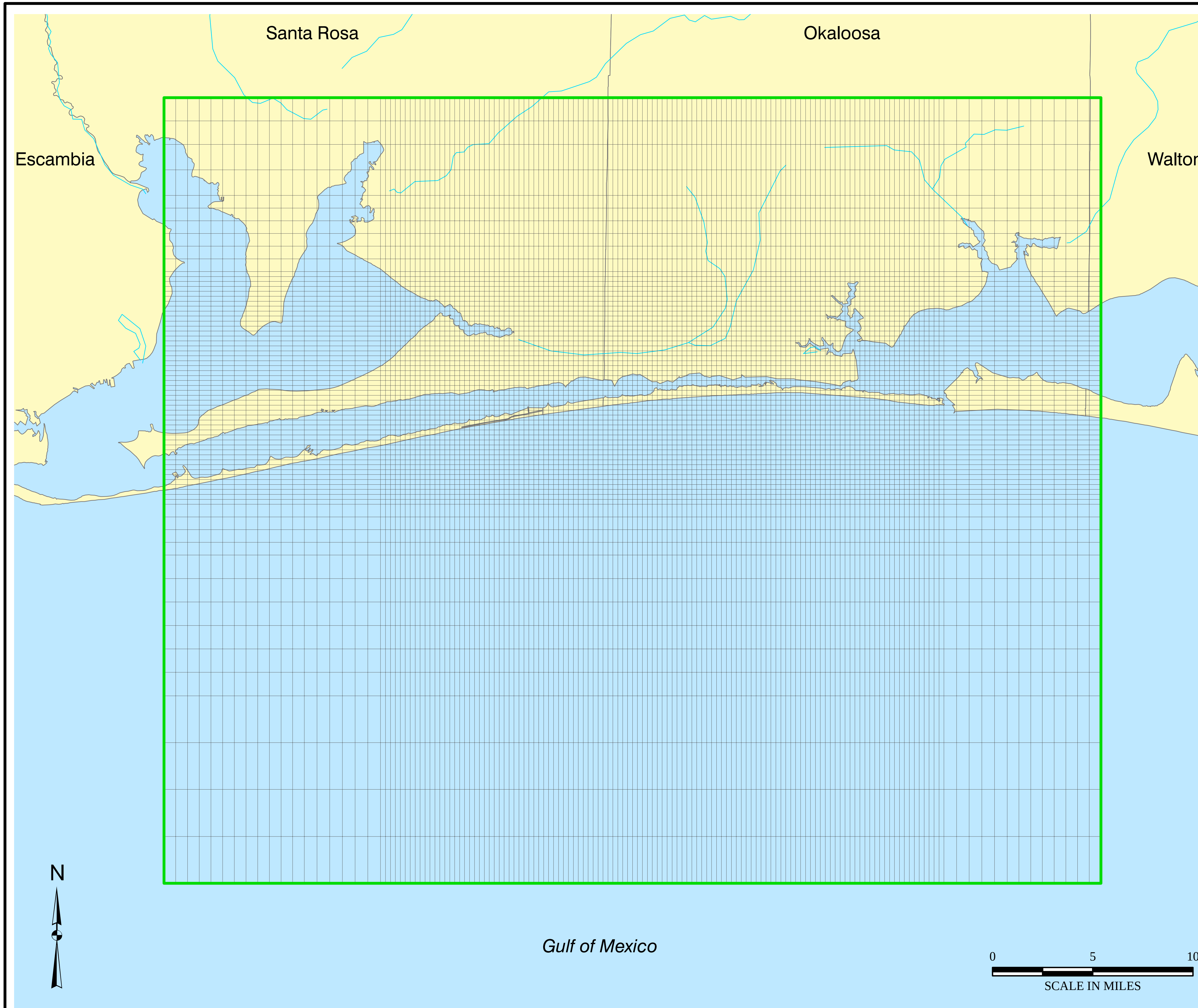
Not drawn to scale

Filename: X:\NWF002\003-07\Model.cdr
Project: NWF002-003-07
Created by: cfarmer 10/28/04
Revised:
Source: HydroGeoLogic, Inc.

Figure 3.1
Conceptual Model for Groundwater Flow and Solute Transport

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.2
Modeling Domain and Finite Element Mesh for Chloride Intrusion Simulation of the Western Model

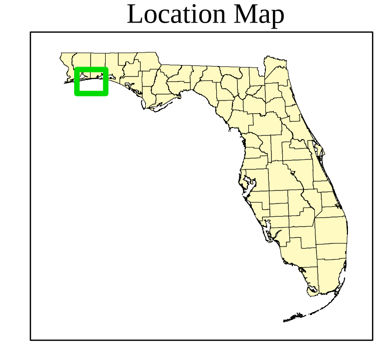


Northwest Florida Water Management District

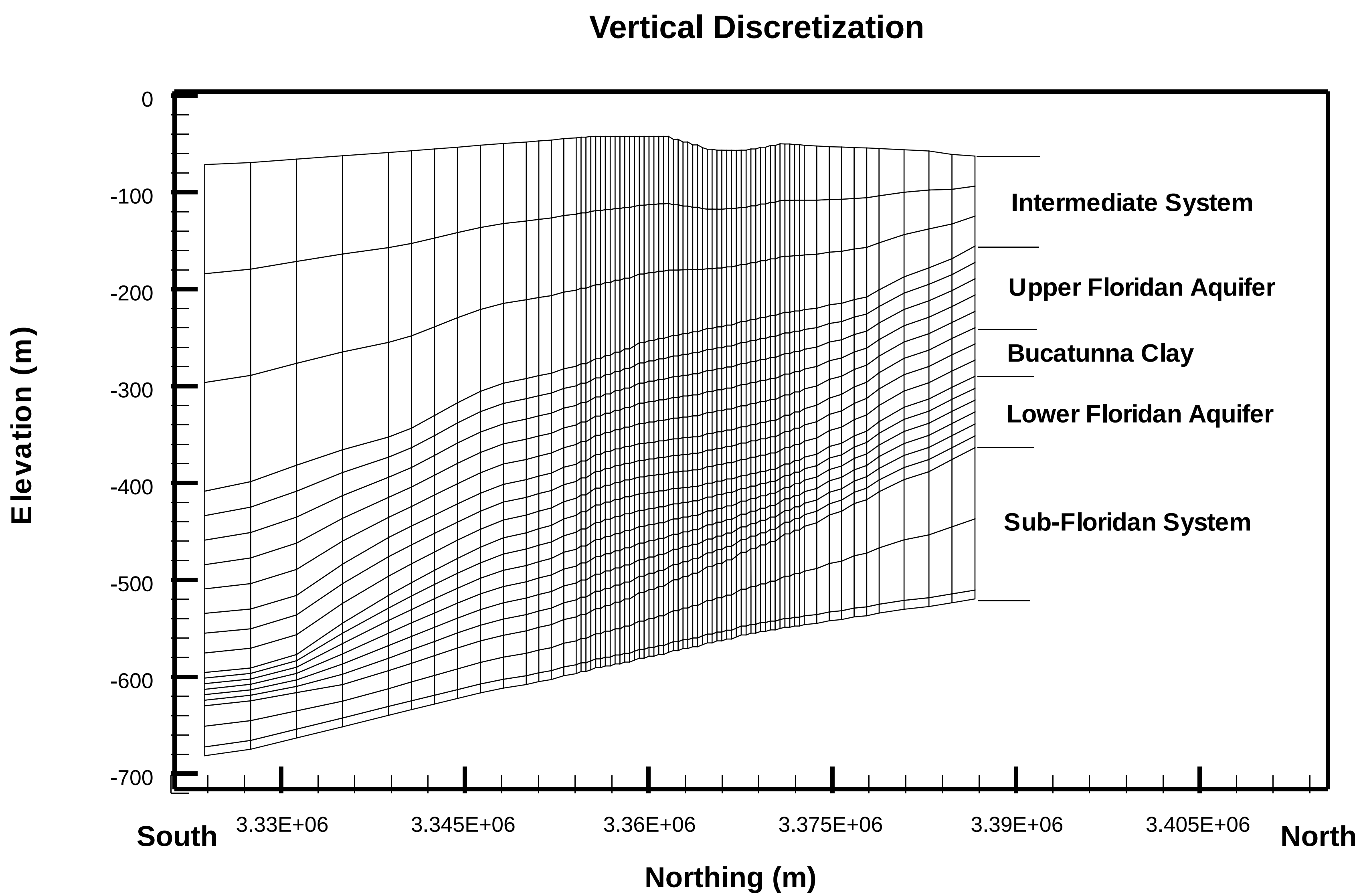
Legend

- County Boundary
- Hydrology
- Model Boundary
- Finite Element Mesh

Location Map



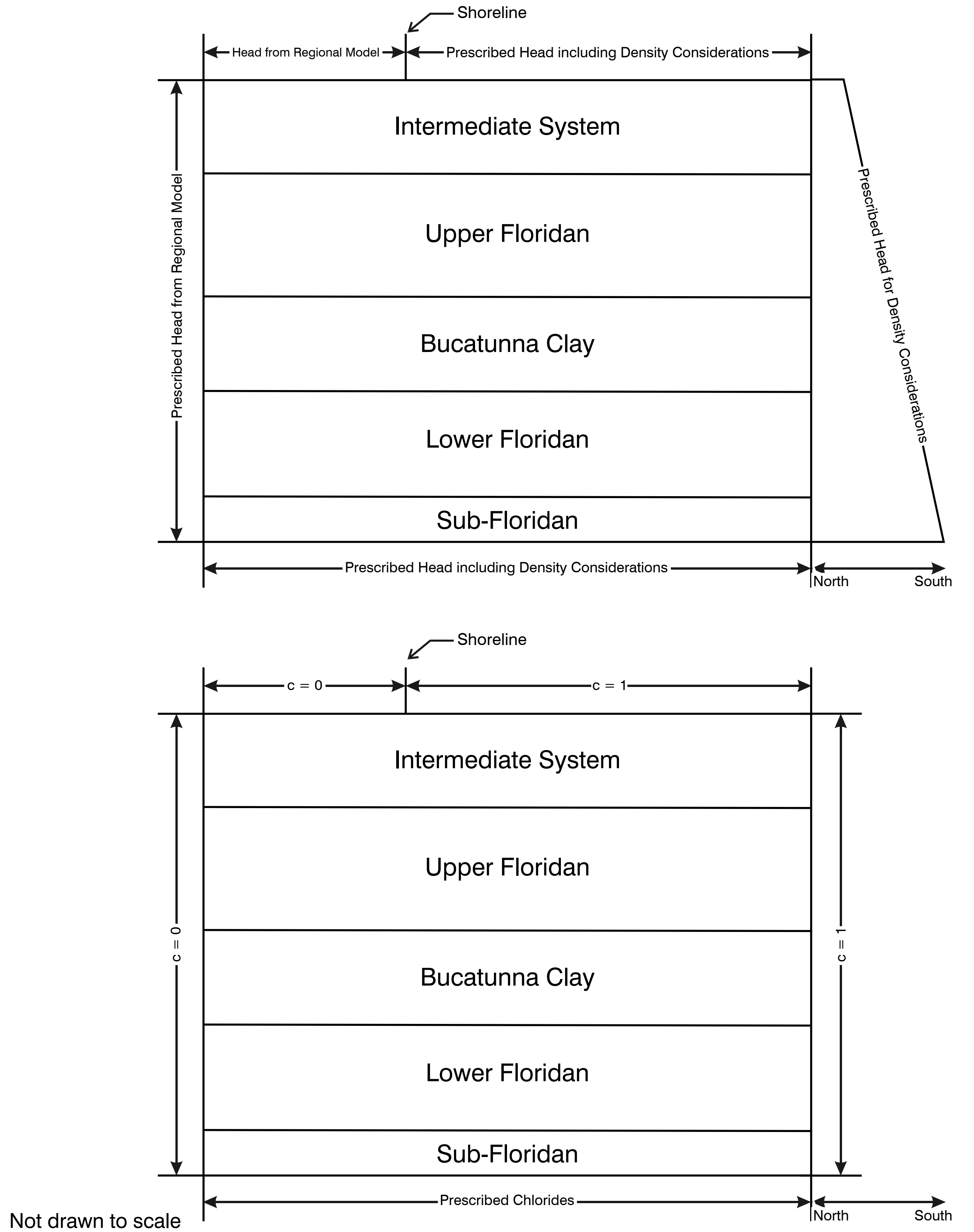
Filename: X:/NWF002/003-07/Report/Domain_Mesh.mxd
Project: NWF002-003-07
Revised: 07/20/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\vert_discretization.cdr
Project: NWF002-003-07
Created by: cfarmer 10/29/04
Revised: 07/18/05 asc
Source: HydroGeoLogic, Inc.

Figure 3.3
Vertical Discretization Along
y-z Cross-Section at x=505327m



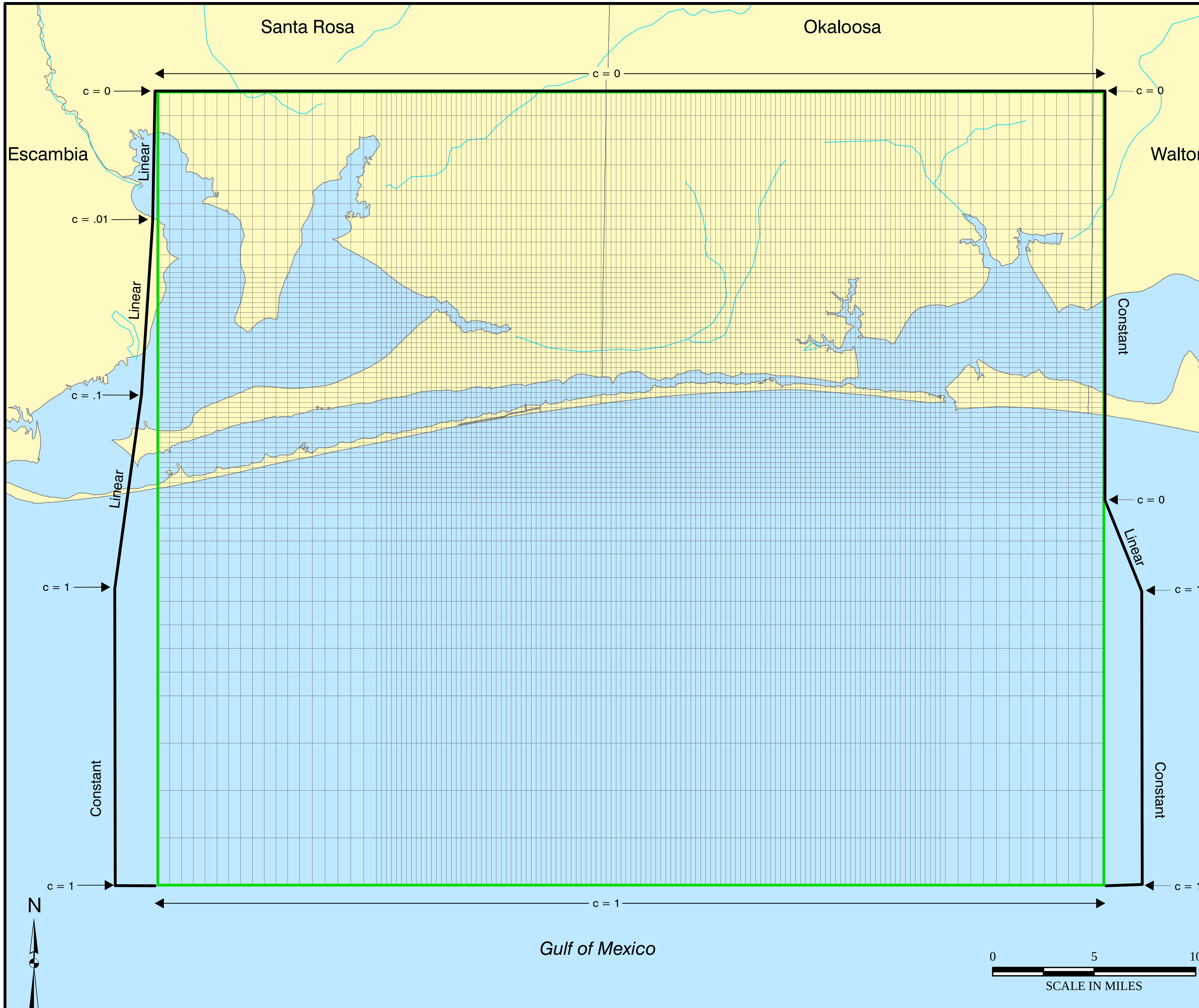
Filename: X:\NWF002\003-07\Diagram.cdr
Project: NWF002-003-07
Created by: cfarmer 10/28/04
Revised: 04/27/05 ASC
Source: HydroGeoLogic, Inc.

Figure 3.4
Conceptual Diagram of Boundary Conditions Applied along a Typical North-South Section

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.5
Prescribed Normalized Concentrations along Lateral Boundaries in the Upper Floridan Aquifer for the Western Model

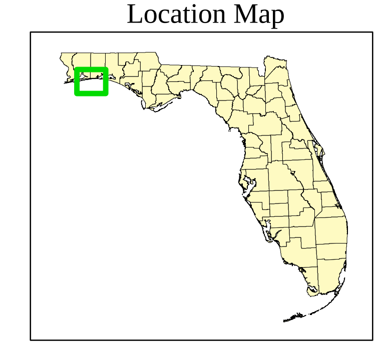
Northwest Florida Water Management District



Legend

County Boundary
Hydrology
Model Boundary
Finite Element Mesh

Location Map

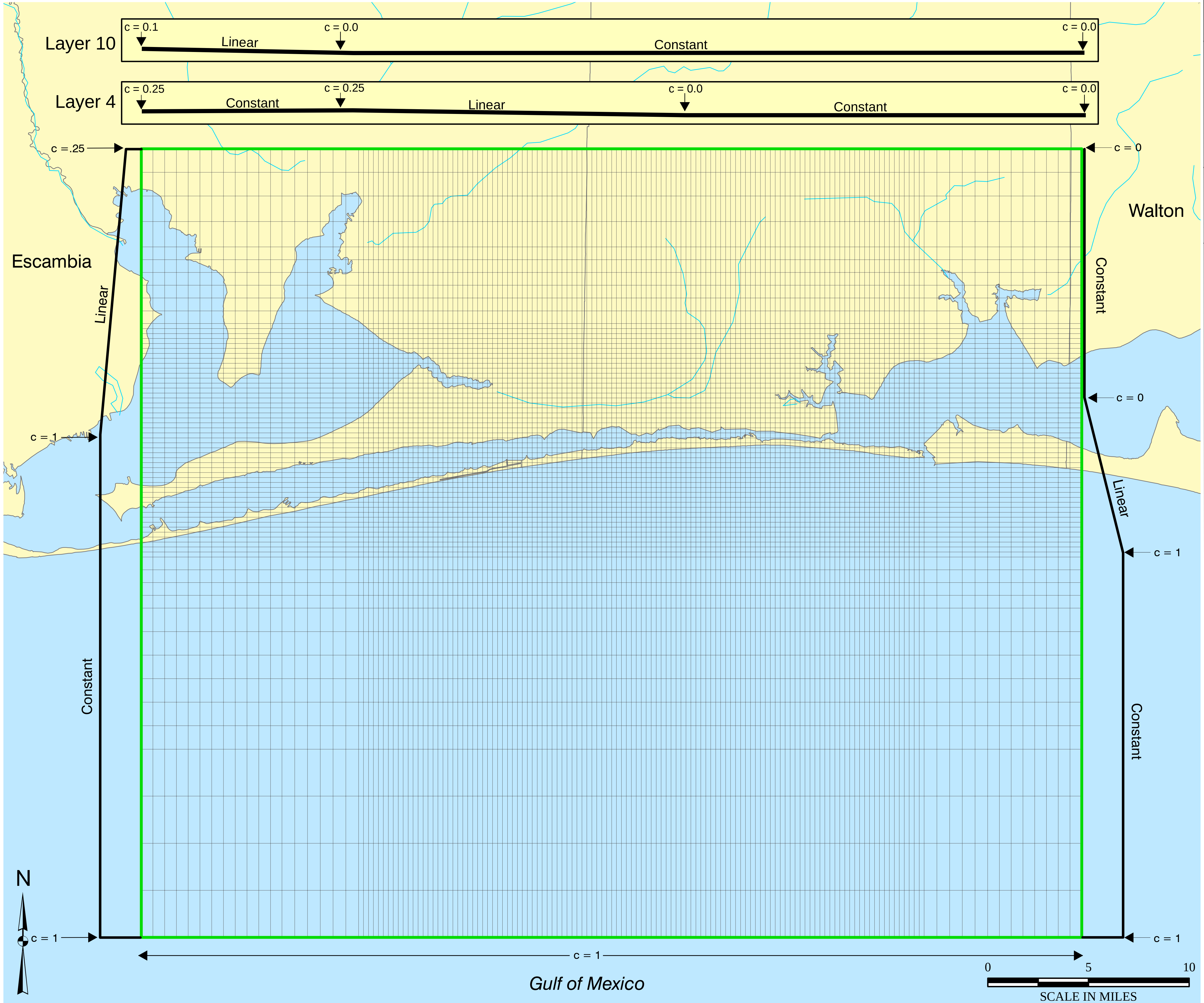


Filename: X:/NWF002/003-07/Report/LatBound_UFA.mxd
Project: NWF002-003-07
Revised: 07/20/05 ASC
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.6
Prescribed Normalized Concentrations along Lateral Boundaries in the Lower Floridan Aquifer for the Western Model

Northwest Florida Water Management District



Legend

County Boundary

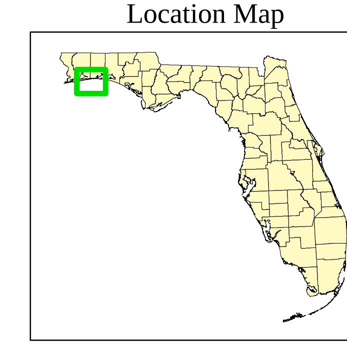
Hydrology

Model Boundary

Finite Element Mesh

Note:
West, south and east same for layers 4-10.
North set fresher for upper layers.

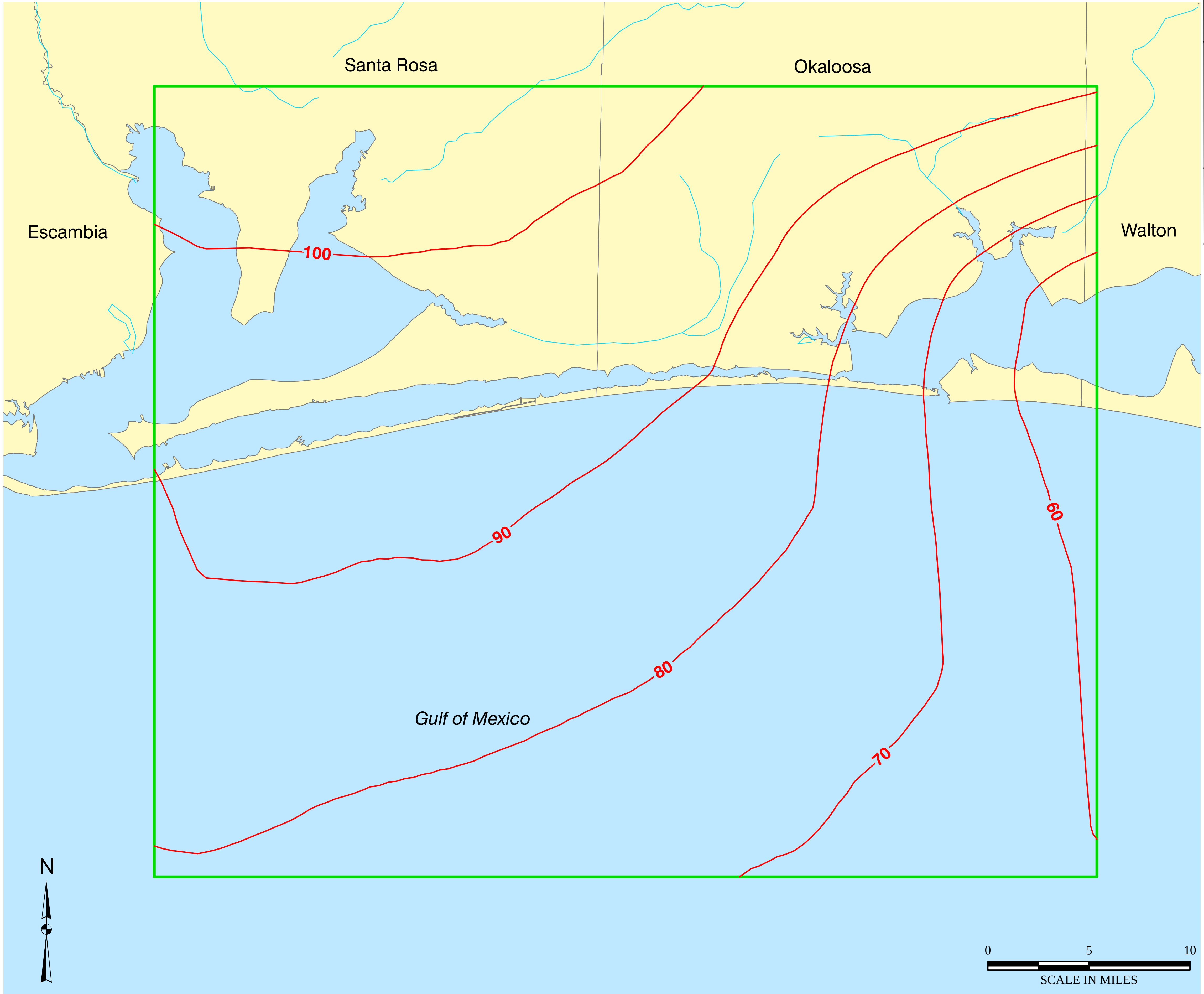
Location Map



Filename: X:/NWF002/003-07/Report/LatBound_UFA.mxd
Project: NWF002-003-07
Revised: 07/20/05 ASC
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.7
Equivalent Freshwater Head Boundary Conditions along the Bottom of the Model Domain



Northwest Florida Water Management District

Legend

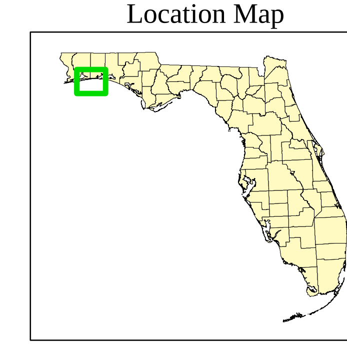
County Boundary

Hydrology

—80— Equivalent Freshwater Head (ft)
(nx, ny, nz) = (146,72,21)

Model Boundary

Location Map

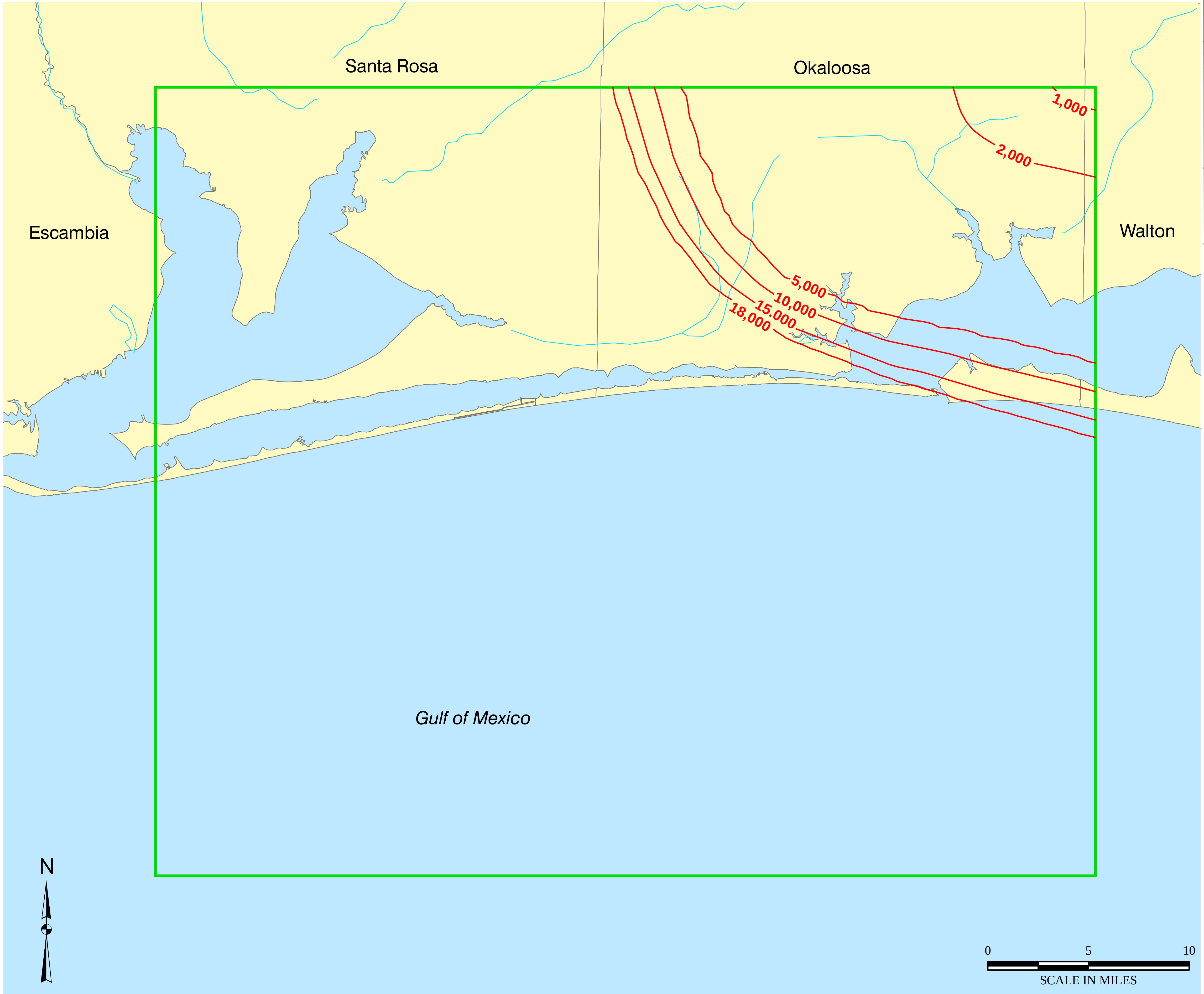


Filename: X:/NWF002/003-07/EFHBC_Bottom.mxd
Project: NWF002-004-06
Revised: 04/27/05 ASC
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.8
Chloride Concentration Conditions along the Bottom of the Model Domain

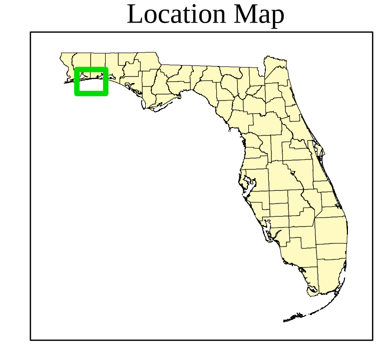
Northwest Florida Water Management District



Legend

- County Boundary
- Hydrology
- -5,000- Chloride Concentration (mg/l) (nx, ny, nz) = (146,72,21)
- Model Boundary

Location Map

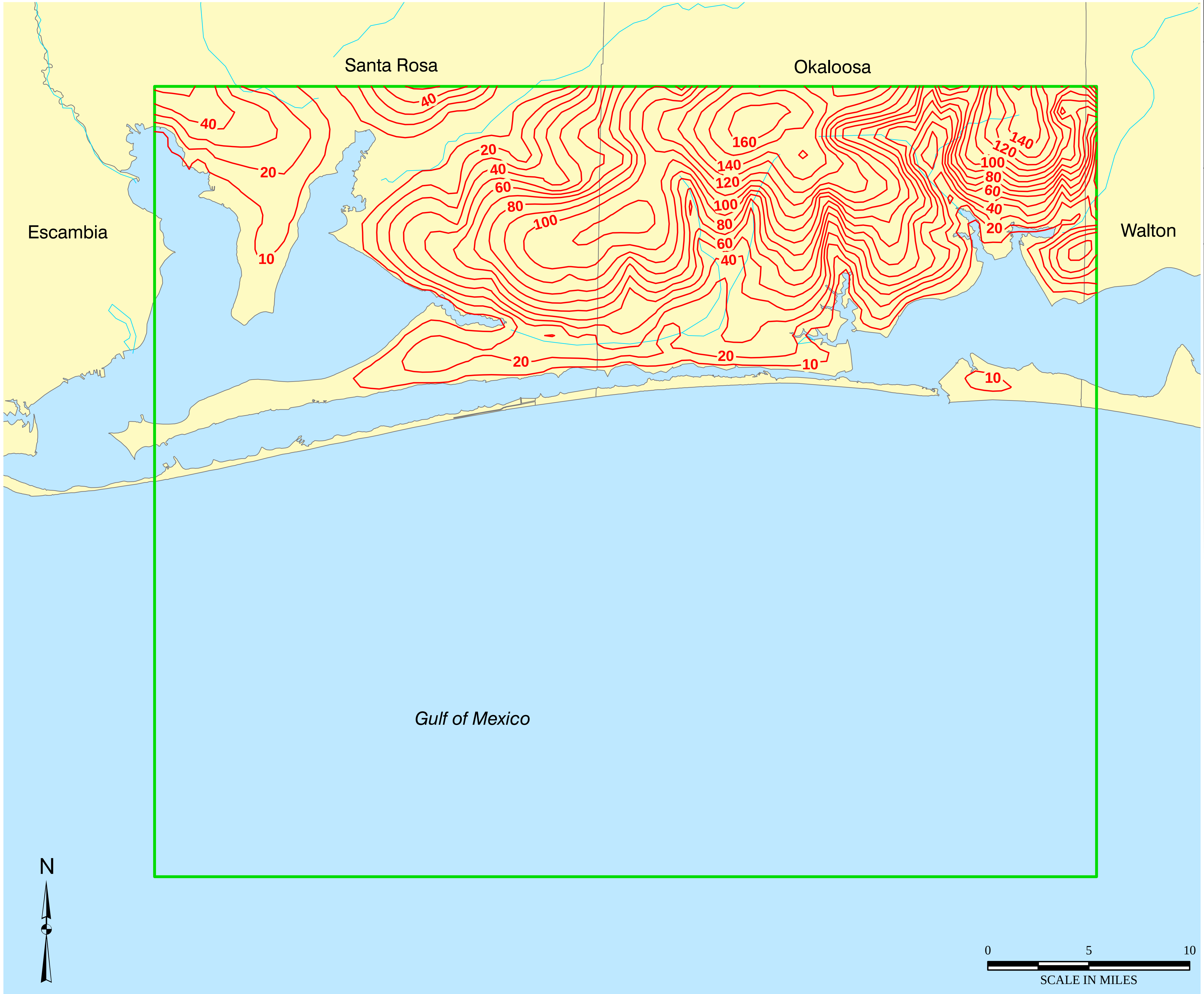


Filename: X:/NWF002/003-07/NCCC_Bottom.mxd
Project: NWF002-003-07
Revised: 07/19/05 ASC
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.9
Equivalent Freshwater Head Boundary Conditions along the Top of the Model Domain

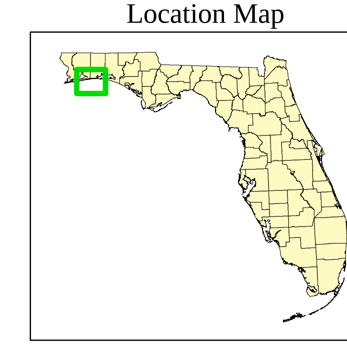
Northwest Florida Water Management District



Legend

- County Boundary
- Hydrology
- 60 Equivalent Freshwater Head (ft) (nx, ny, nz) = (146,72,21)
- Model Boundary

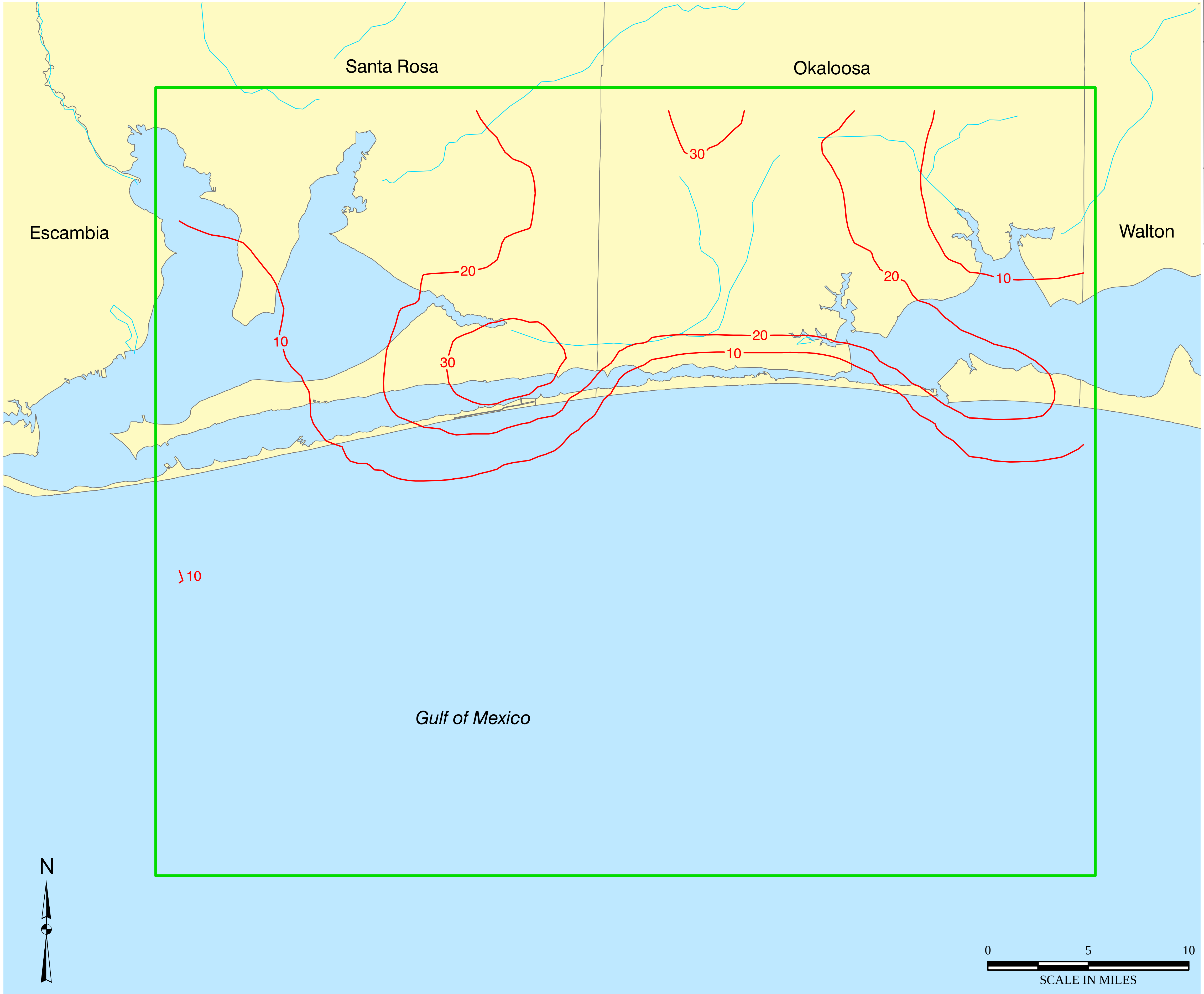
Location Map



Filename: X:/NWF002/003-07/Report/EFHBC_Top.mxd
Project: NWF002-003-07
Revised: 04/27/05 ASC
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.10
Horizontal Hydraulic Conductivity of the Upper Floridan Aquifer as Obtained from the District's Regional MODFLOW Groundwater Flow Model

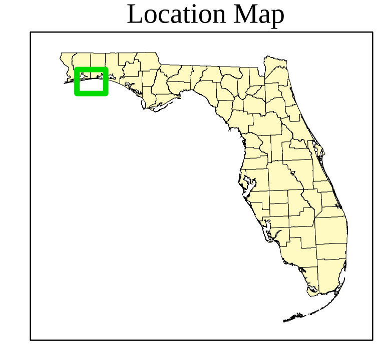


Northwest Florida Water Management District

Legend

- County Boundary
- Hydrology
- —10— Hydraulic Conductivity (ft/d)
- Model Boundary

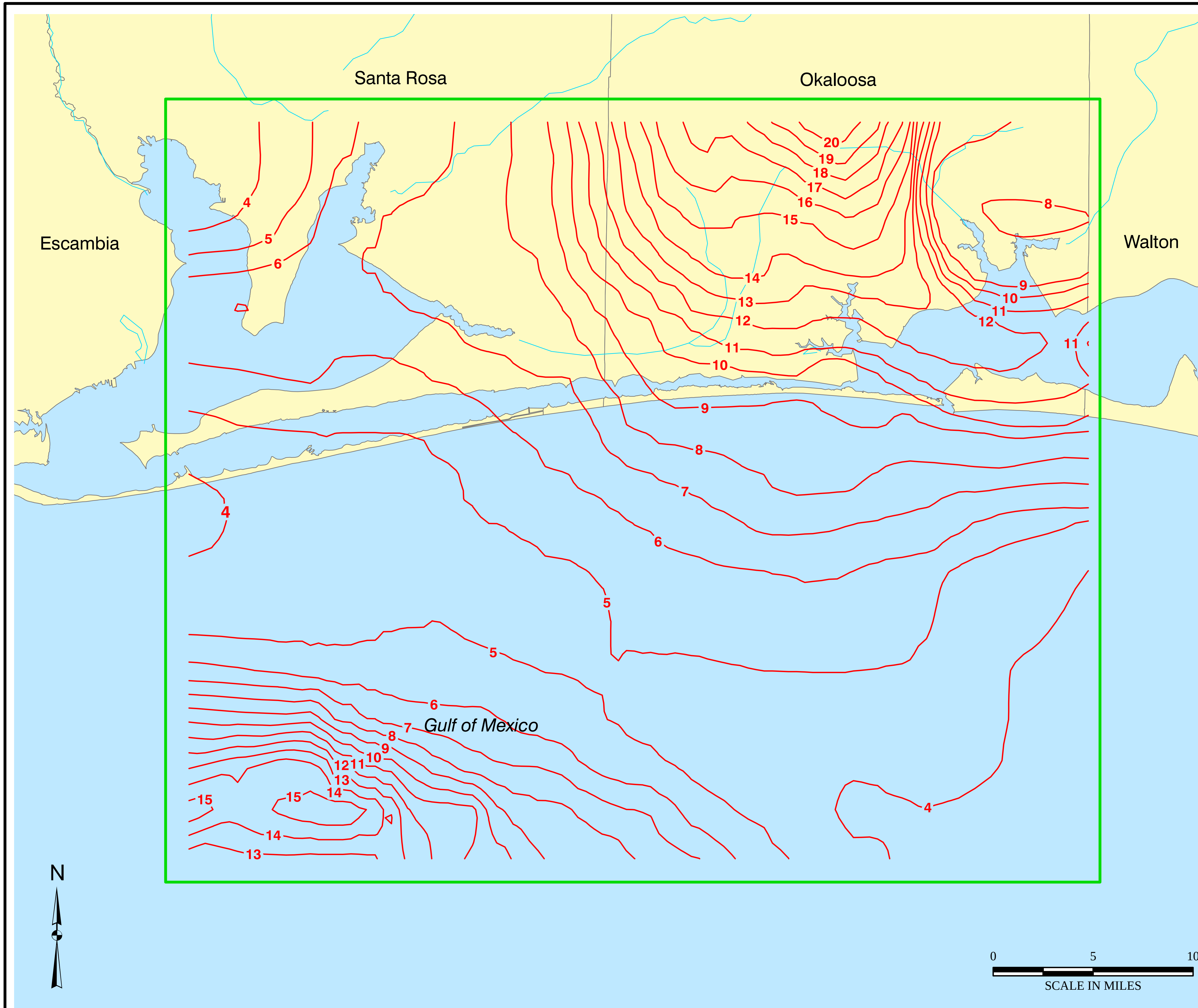
Location Map



Filename: X:/NWF002/003-07/Report/Kh_UFA.mxd
Project: NWF002-003-07
Revised: 07/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.11
Horizontal Hydraulic Conductivity of the Lower Floridan Aquifer as Obtained from the District's Regional MODFLOW Groundwater Flow Model

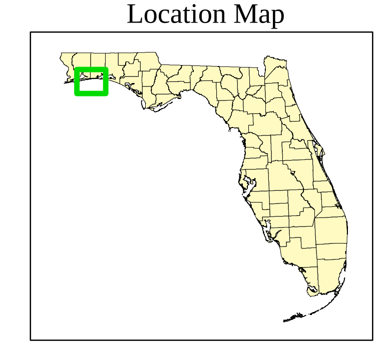


Northwest Florida Water Management District

Legend

- County Boundary
- Hydrology
- —10— Hydraulic Conductivity (ft/d)
- Model Boundary

Location Map

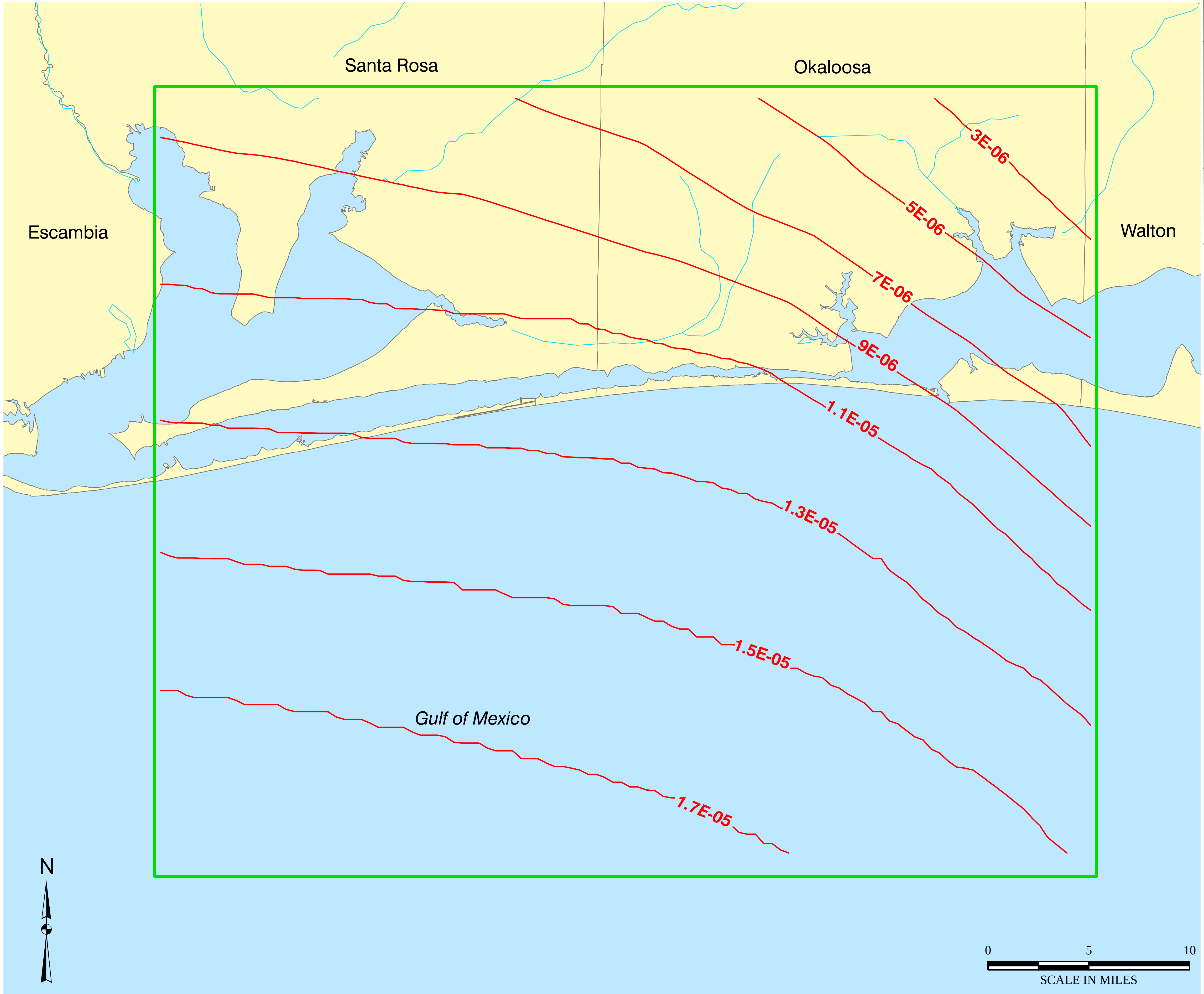


Filename: X:/NWF002/003-07/Report/Kh_LFA.mxd
Project: NWF002-003-07
Revised: 07/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 3.12
Vertical Hydraulic Conductivity of the Lowest Sub-Floridan DSTRAM Model Layer

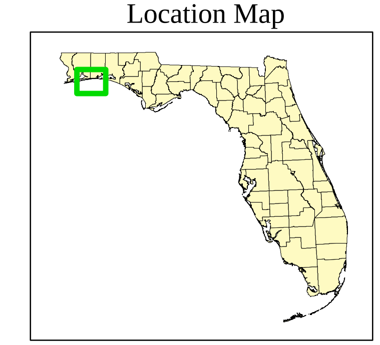
Northwest Florida Water Management District



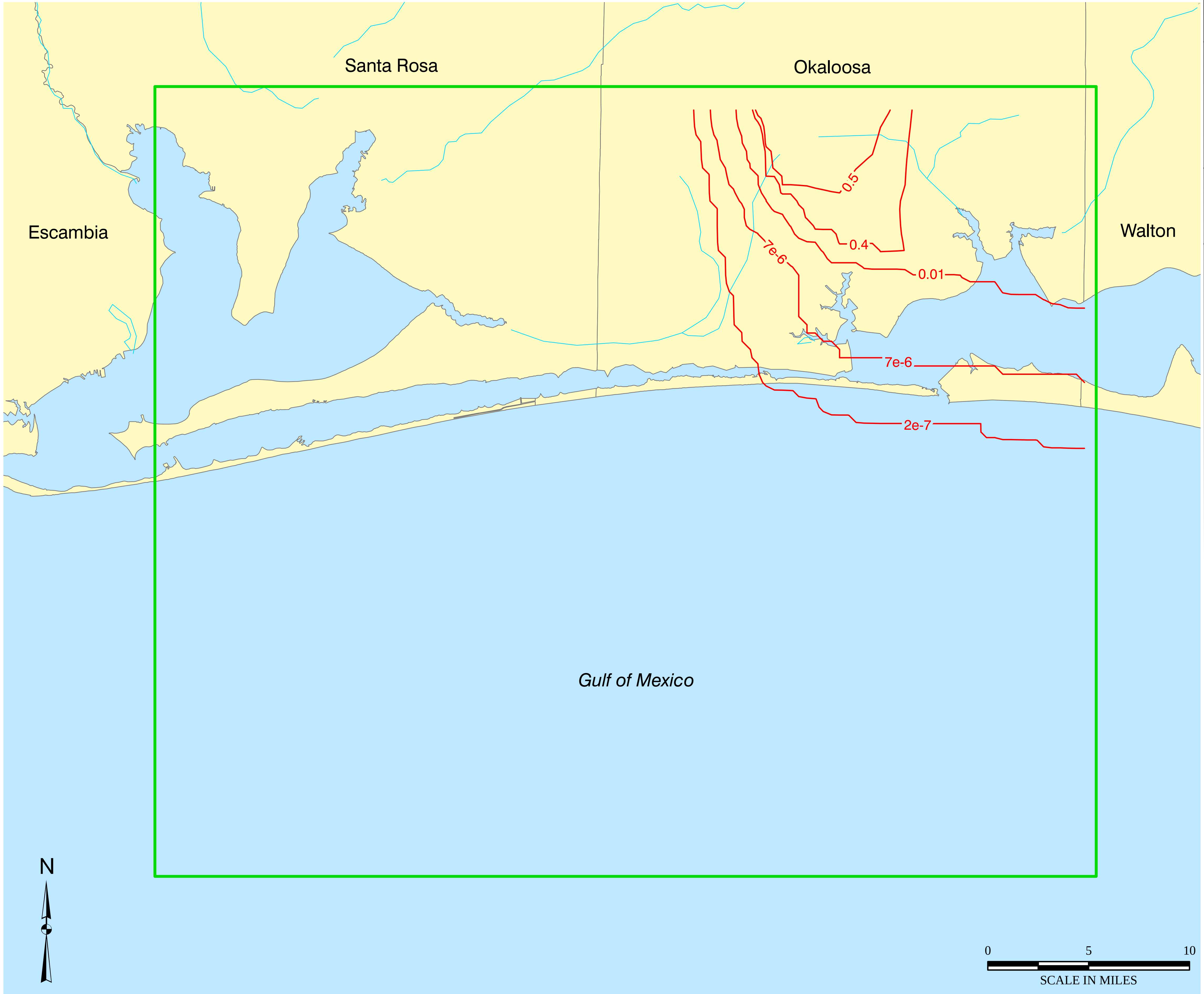
Legend

- County Boundary
- Hydrology
- 9E-06 Vertical Hydraulic Conductivity (ft/d)
- Model Boundary

Location Map



Filename: X:/NWF002/003-07/Kh_subFL.mxd
Project: NWF002-004-06
Revised: 04/19/05 TH
Map Source: HydroGeoLogic GIS Database 2002



HydroGeoLogic, Inc.—Northwest Florida Water Management District

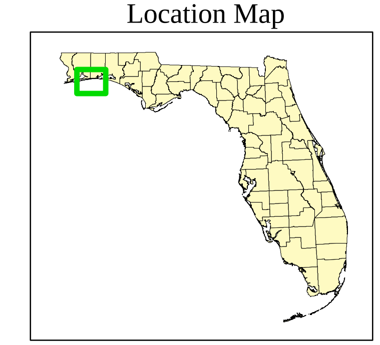
Figure 3.13
Vertical Hydraulic Conductivity of the Bucatunna Clay Model Layer as Obtained from the Districts Regional MODFLOW Groundwater Flow Model

Northwest Florida Water Management District

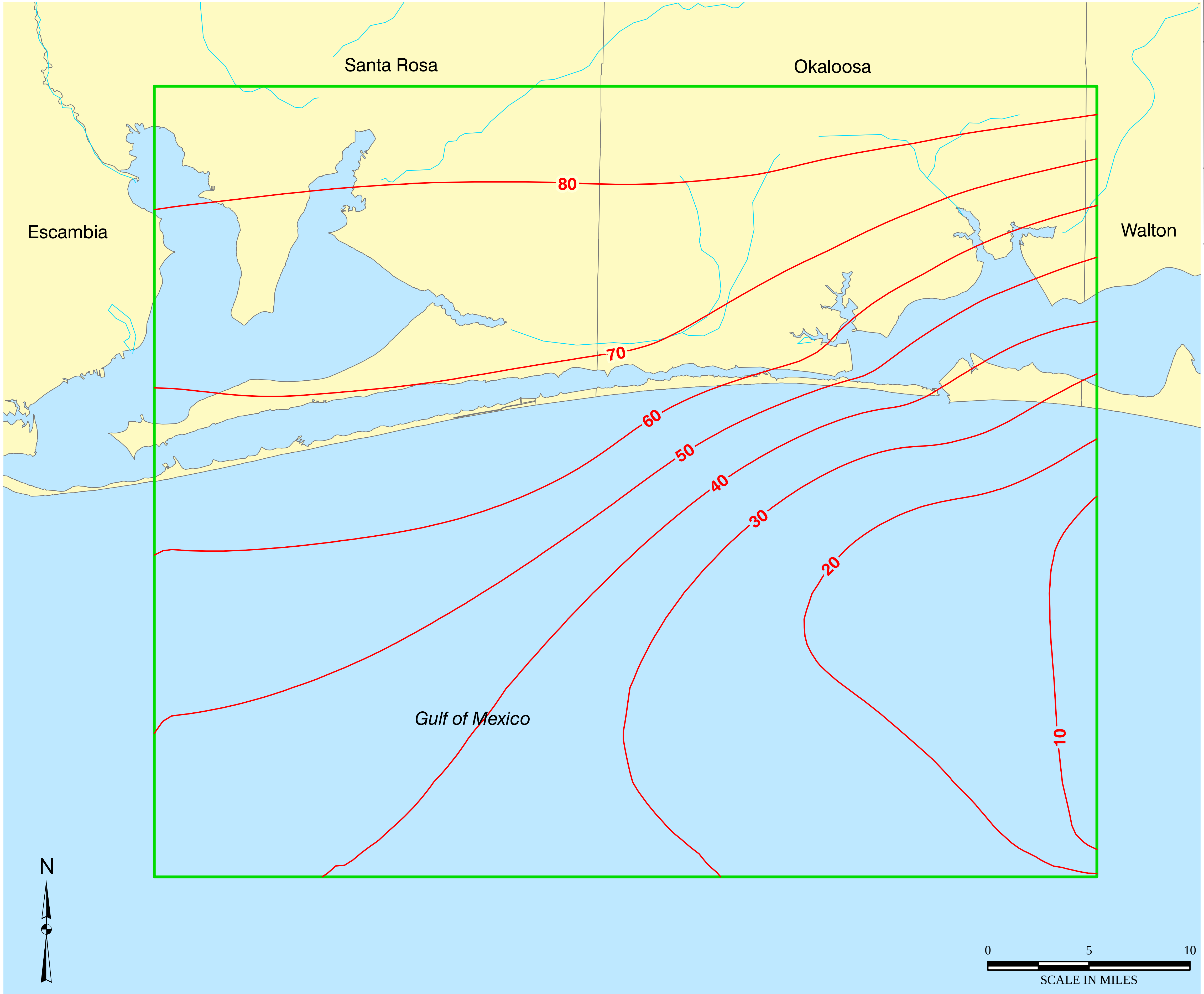
Legend

- County Boundary
- Hydrology
- Model Boundary
- –0.01– Vertical Hydraulic Conductivity (ft/d)

Location Map



Filename: X:/NWF002/003-07/Maps/ Verrtical_Hydr_Conduct-Bucatunna.mxd
Project: NWF002-003-07
Revised: 08/01/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.1
Pre-Development
Equivalent Freshwater Head for the Upper Floridan Aquifer
(Nodal Layer 16, mid-aquifer)

Northwest Florida Water Management District

Legend

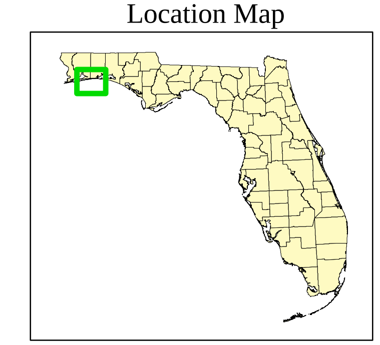
County Boundary

Hydrology

—50— Equivalent Freshwater Head (ft)

Model Boundary

Location Map

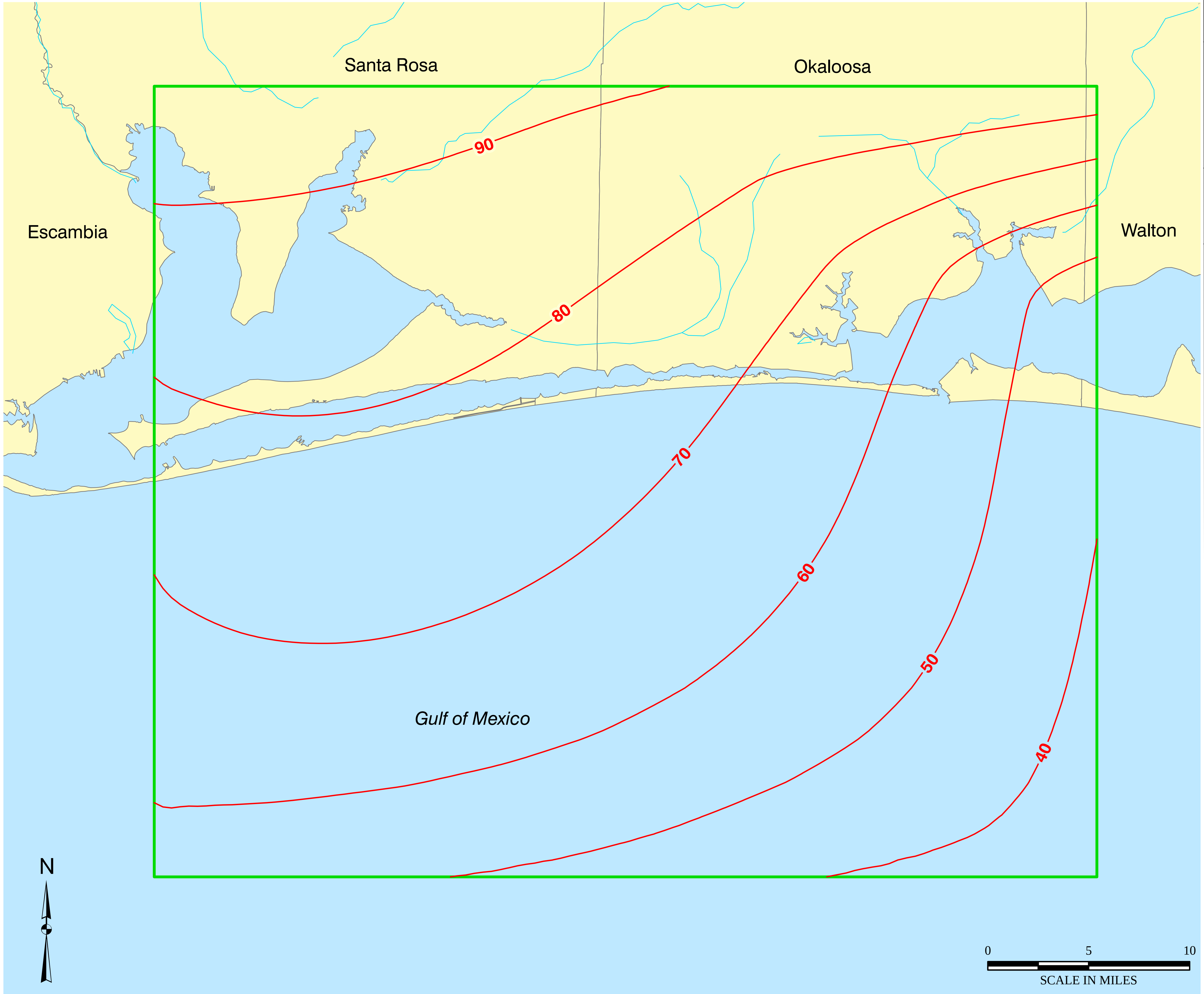


Filename: X:/NWF002/003-07/eh_16.mxd
Project: NWF002-003-06
Revised: 04/18/05 TB
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.2
Pre-Development
Equivalent Freshwater Head for the Lower Floridan Aquifer
(Nodal Layer 7, mid-aquifer)

Northwest Florida Water Management District



Legend

County Boundary

Hydrology

—50— Equivalent Freshwater Head (ft)

Model Boundary

Location Map

Filename: X:/NWF002/003-07/eh_07.mxd
Project: NWF002-003-06
Revised: 04/18/05 TB
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

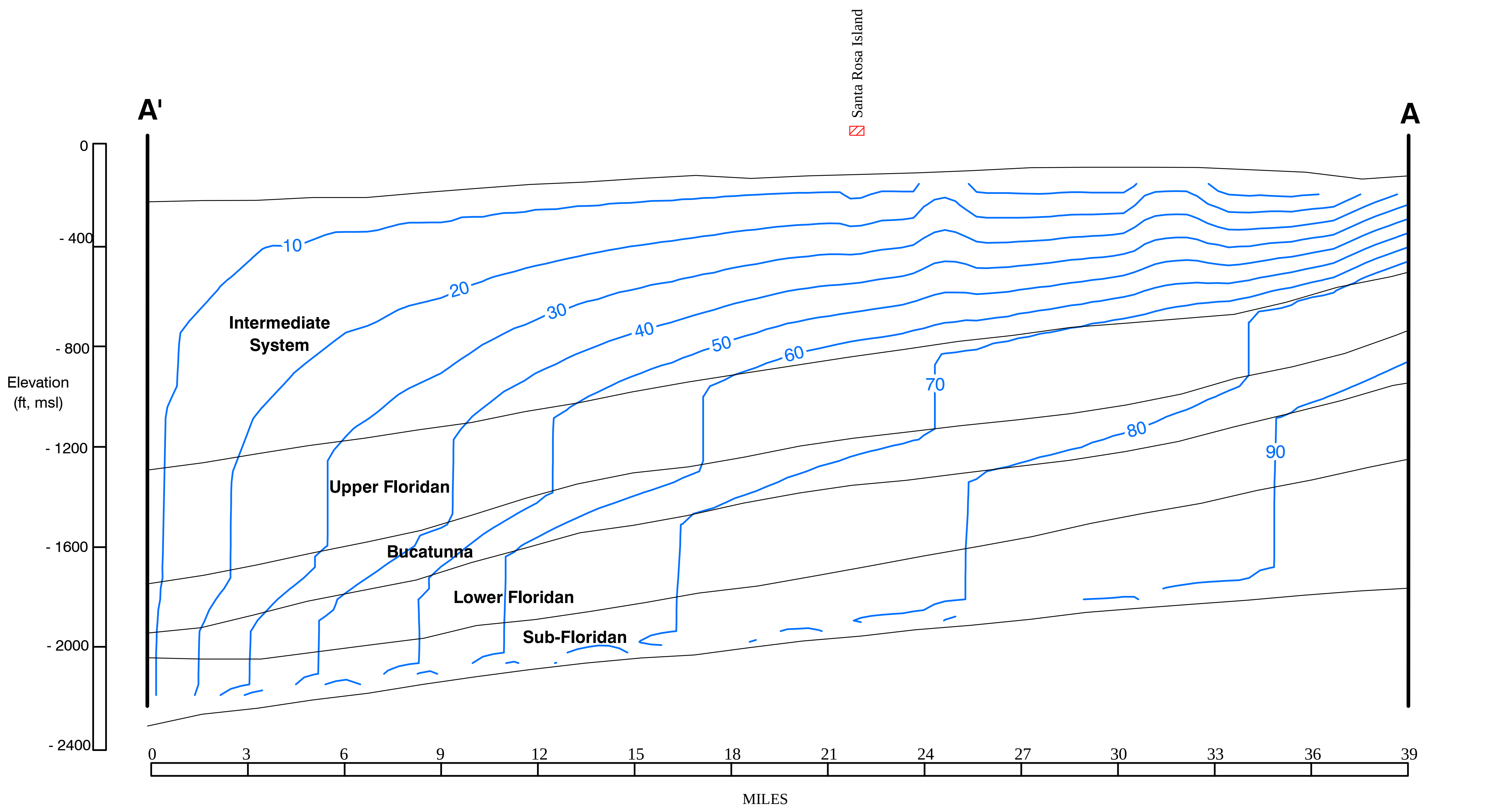
Figure 4.3
Pre-Development Environmental Head for Cross-Section A-A'

Northwest Florida Water Management District

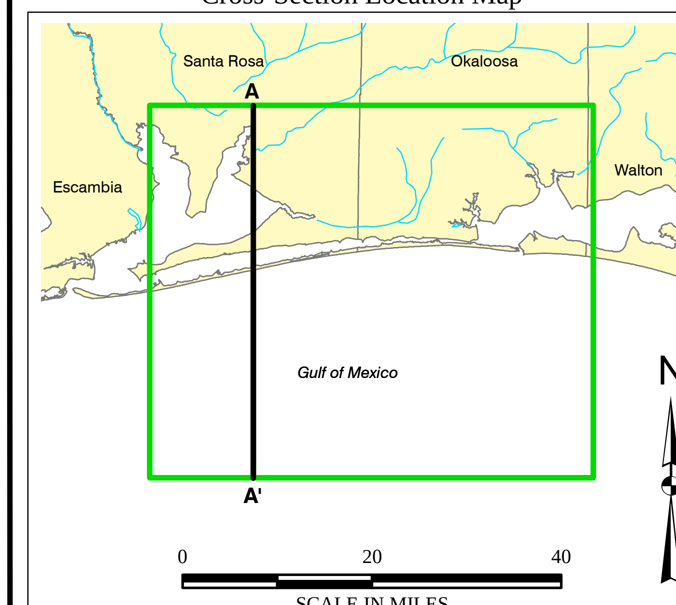
Legend

Environmental Head (ft)

Vertical Exaggeration 41:1



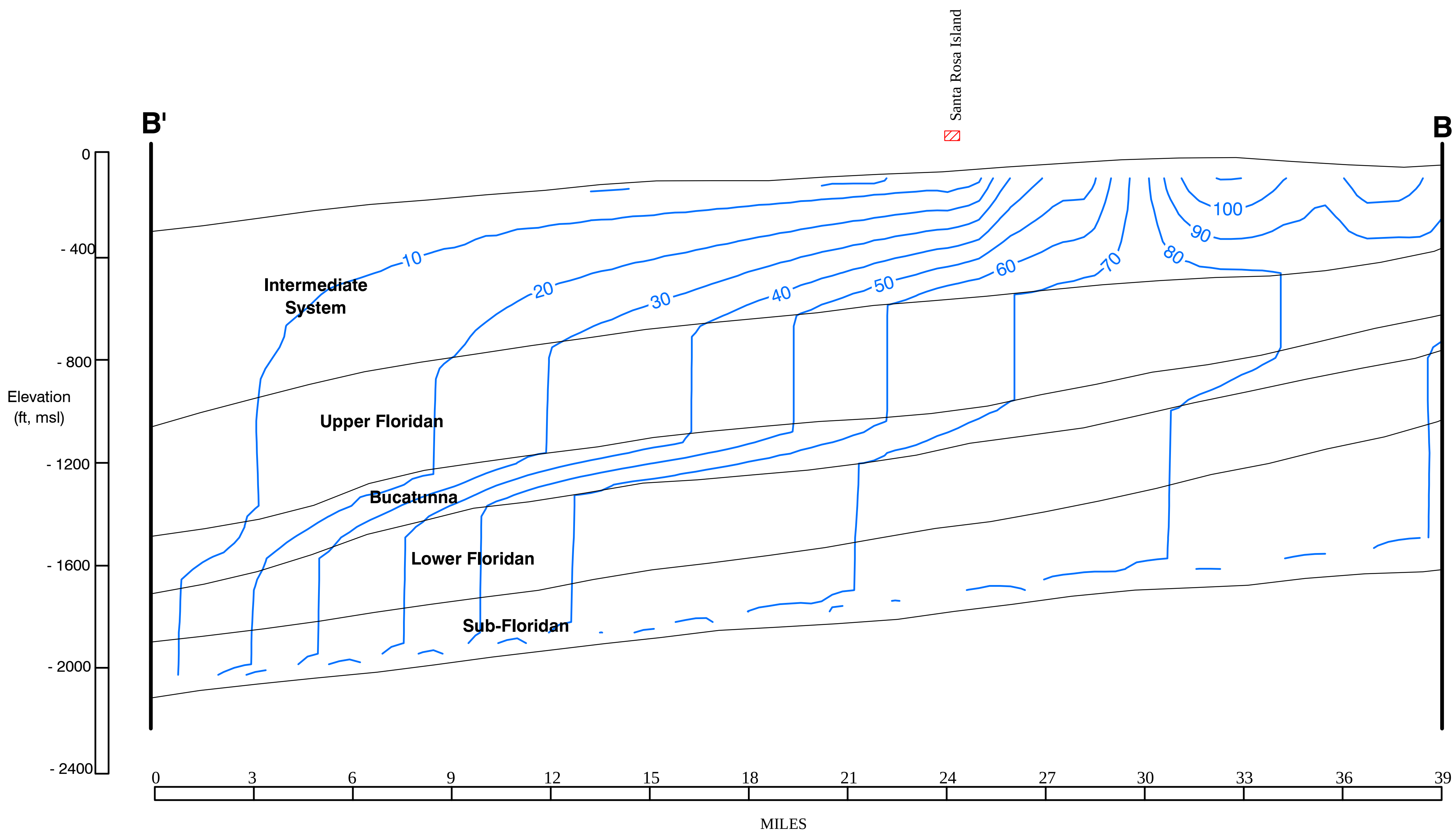
Cross-Section Location Map



Filename: X:/NWF002/004-06/Maps/aa'eh_x-sec.mxd
Project: NWF002-004-06
Revised: 04/29/05 ASC
Map Source: HydroGeoLogic GIS Database 2005

Figure 4.4
Pre-Development Environmental Head for Cross-Section B-B'

Northwest Florida Water Management District

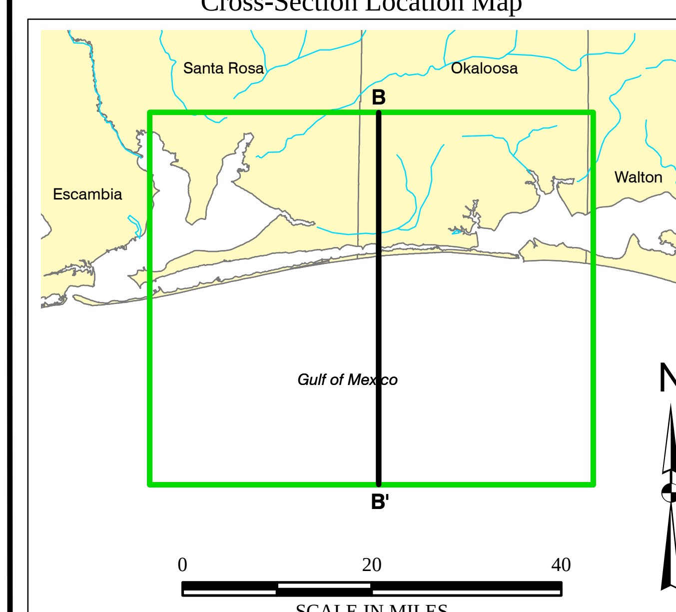


Legend

Environmental Head (ft)

Vertical Exaggeration 41:1

Cross-Section Location Map

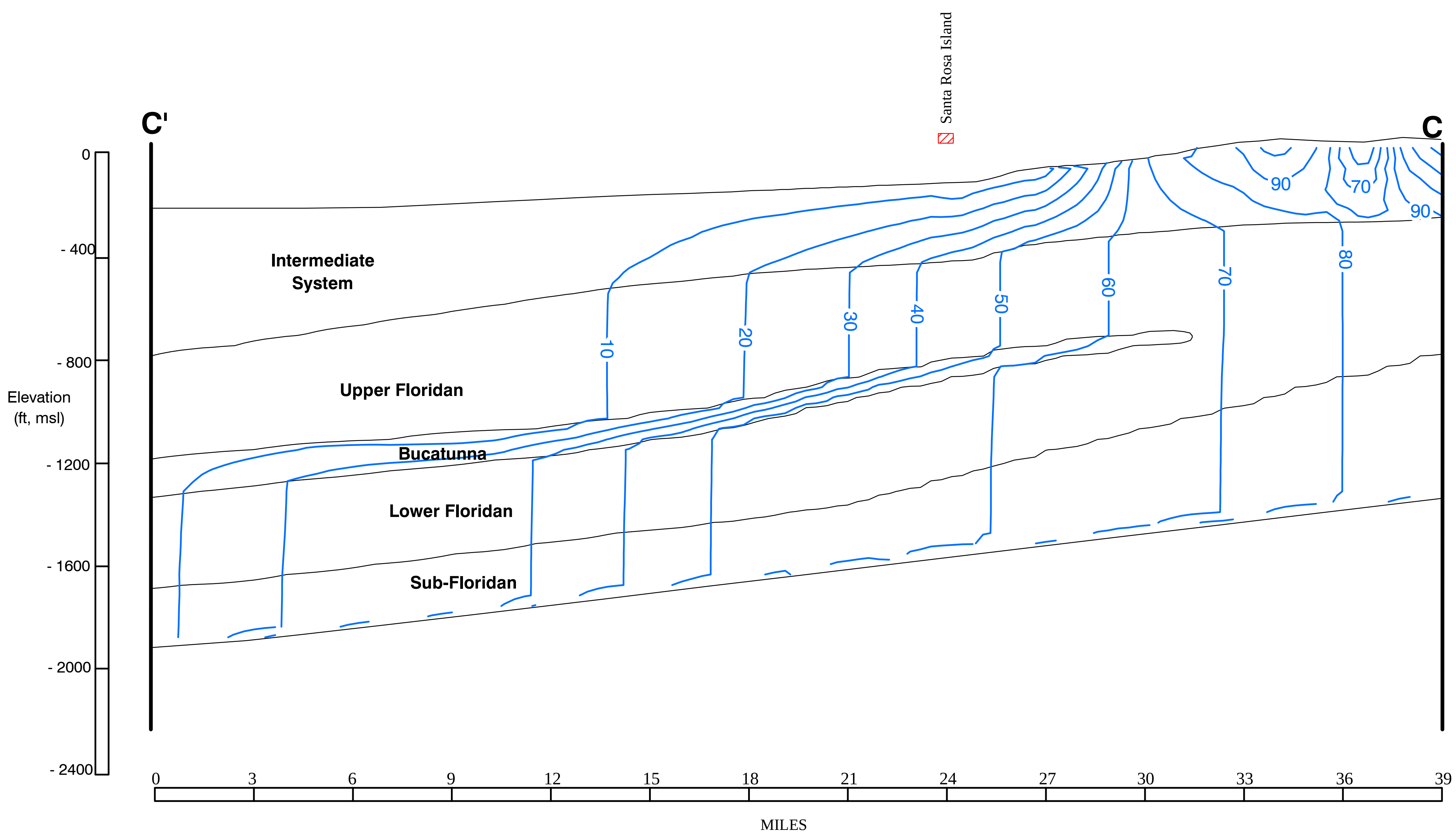


Filename: X:/NWF002/004-06/Maps/bb'eh_x-sec.mxd
Project: NWF002-004-06
Revised: 04/29/05 ASC
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.5
Pre-Development Environmental Head for Cross-Section C-C'

Northwest Florida Water Management District

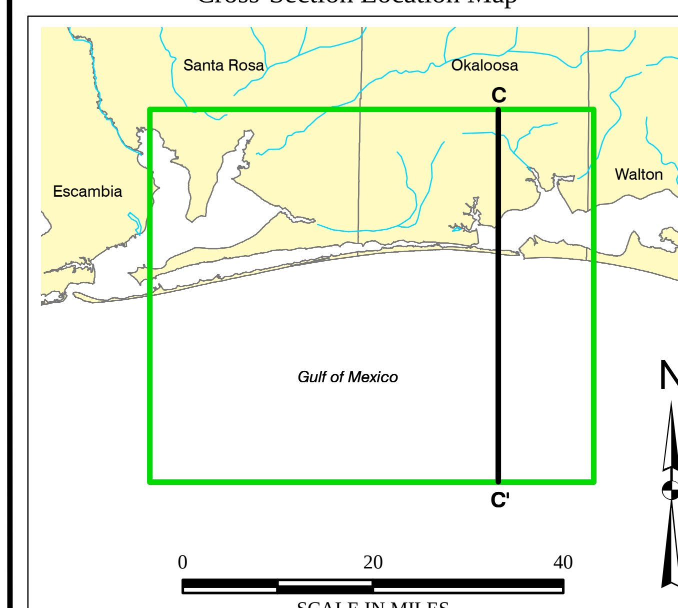


Legend

Environmental Head (ft)

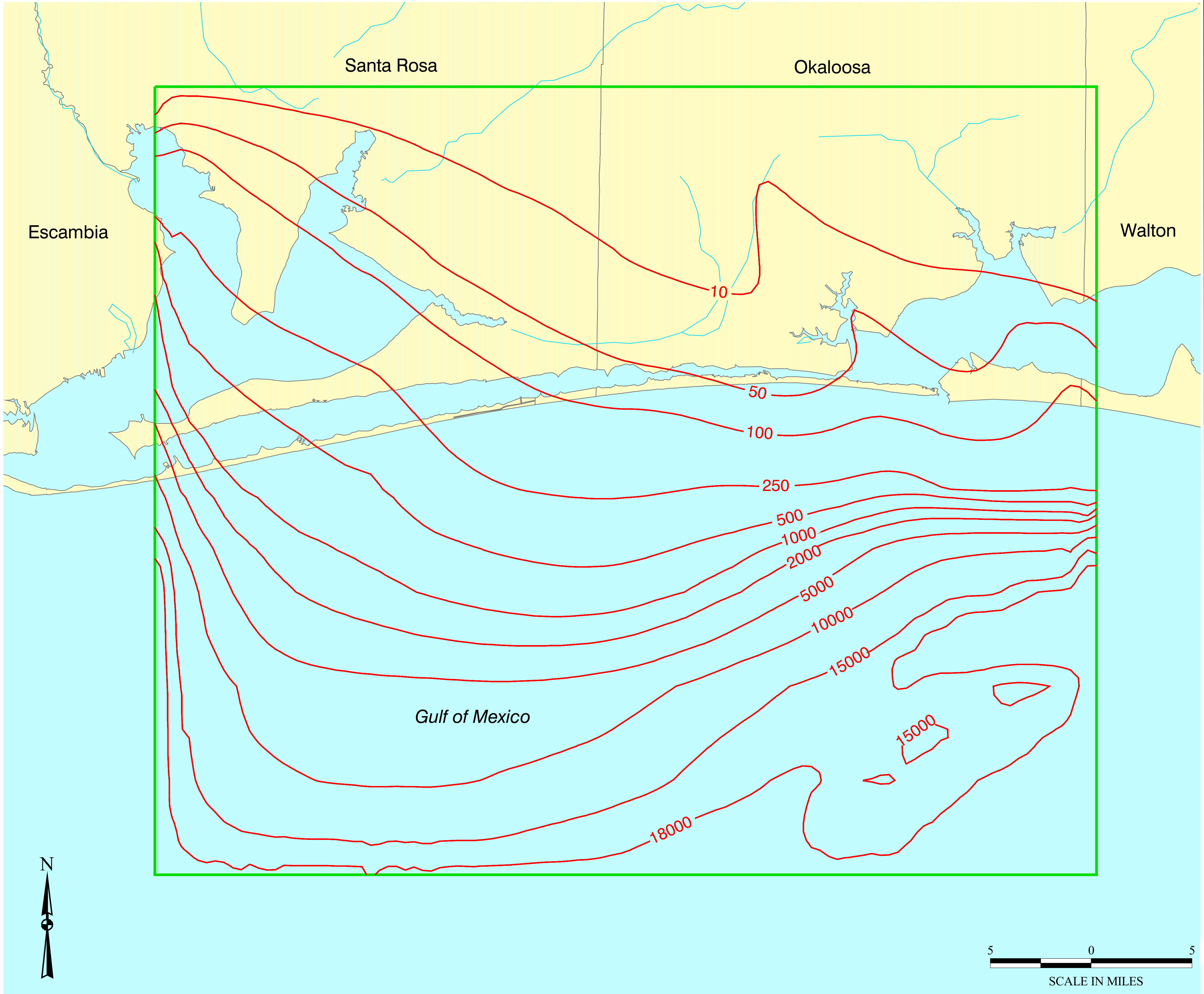
Vertical Exaggeration 41:1

Cross-Section Location Map



Filename: X:/NWF002/003-07/Maps/cc'eh_x-sec.mxd
Project: NWF002-003-07
Revised: 08/05/05 ASC
Map Source: HydroGeoLogic GIS Database 2005

HYDRO GeoLogic INC.



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.6
Pre-Development
Chloride Concentration for the Upper Floridan Aquifer
(Nodal Layer 16, mid-aquifer)

Northwest Florida Water Management District

Legend

County Boundary

Hydrology

250 Chloride Concentration (mg/l)
(nx, ny, nz) = (146,72,21)

Model Boundary

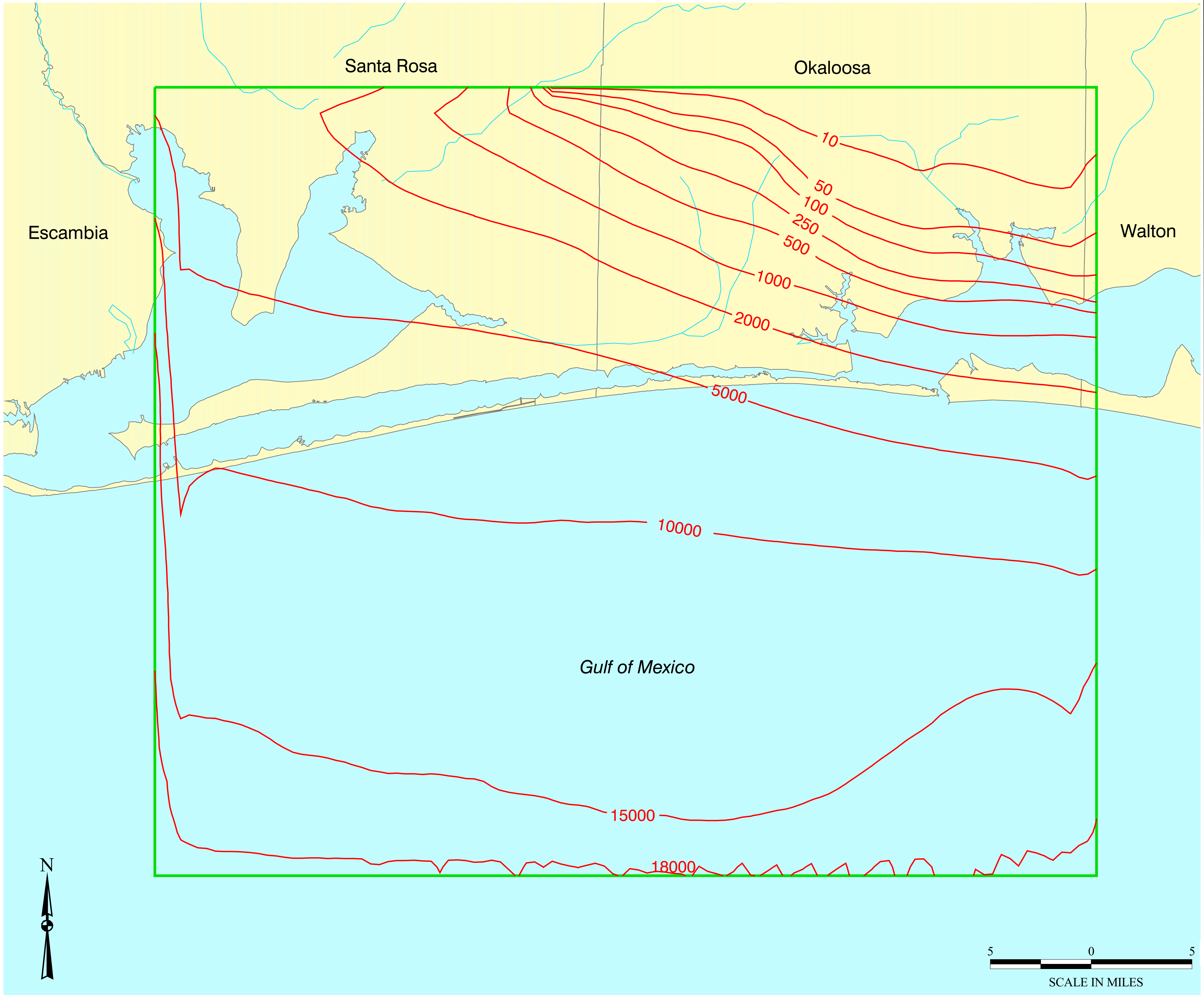
Location Map

Filename: X:\NWF002\003-07\Old_figures\chlorides_16.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 07/25/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.7
Pre-Development
Chloride Concentration for the Lower Floridan Aquifer
(Nodal Layer 7, mid-aquifer)

Northwest Florida Water Management District



Legend

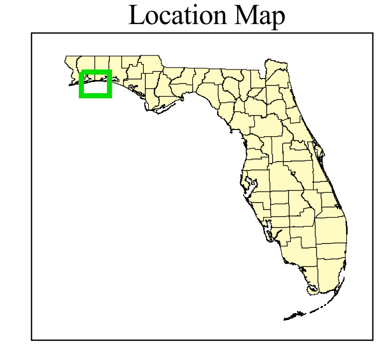
County Boundary

Hydrology

Chloride Concentration (mg/l)
(nx, ny, nz) = (146,72,21)

Model Boundary

Location Map

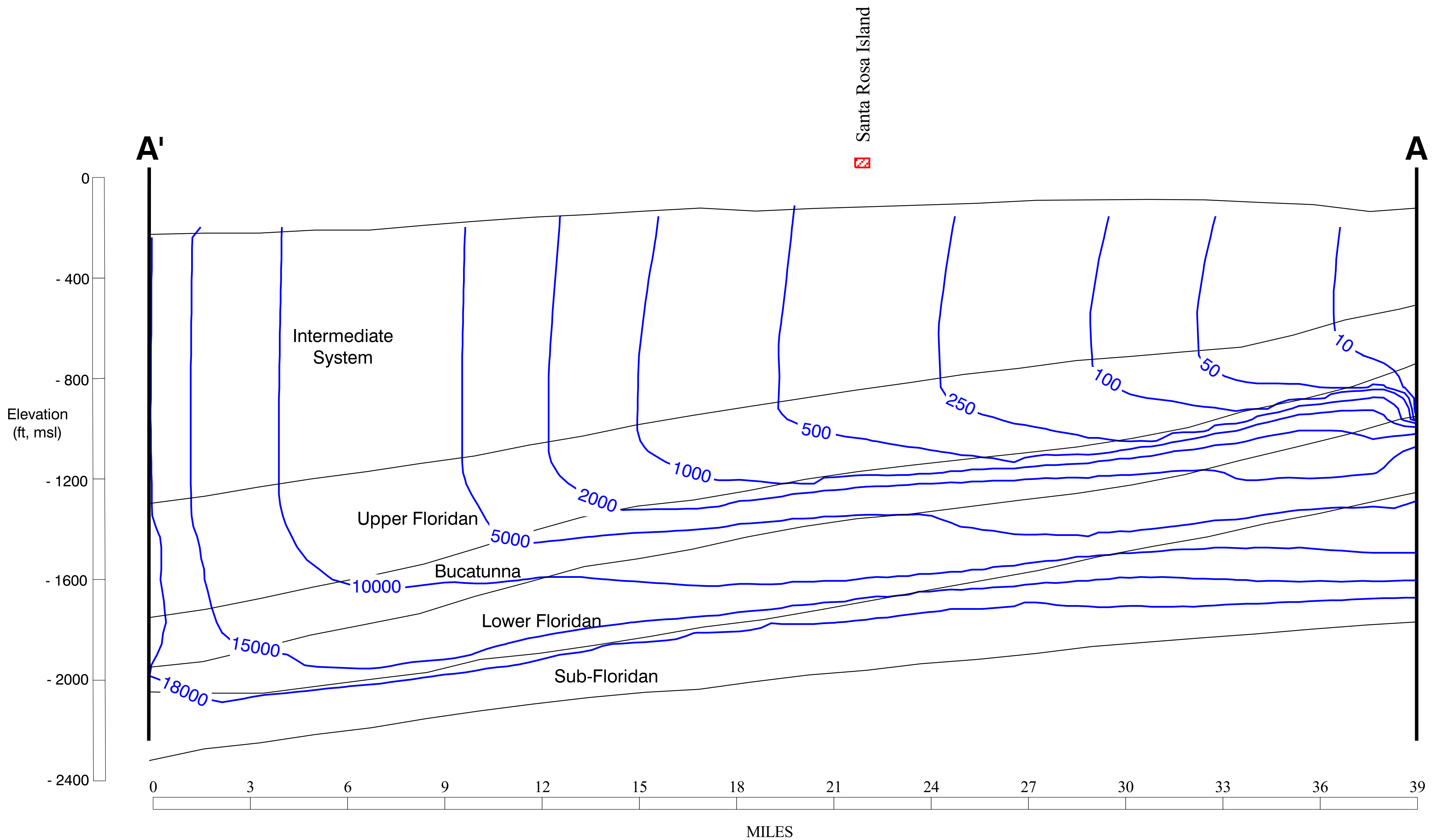


Filename: X:\NWF002\003-07\Old_figures\chloride_7.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 07/22/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.8
Pre-Development
Chloride Concentration for
Cross-Section A-A'

Northwest Florida
Water Management District

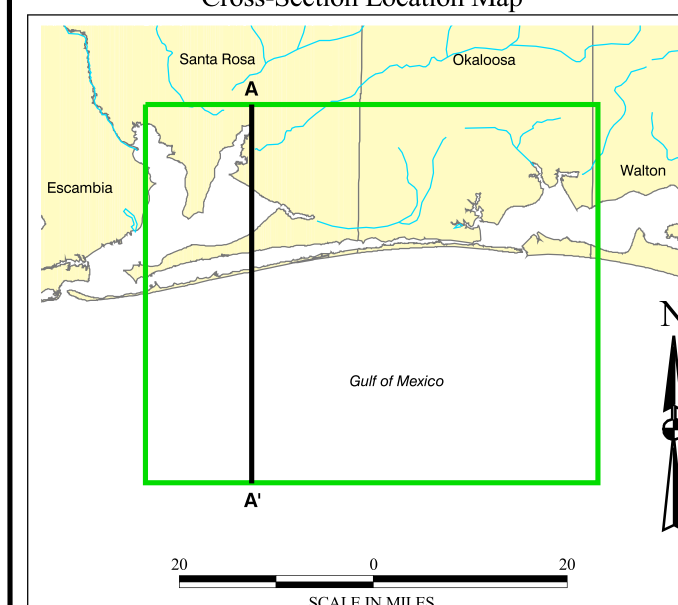


Legend

Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map



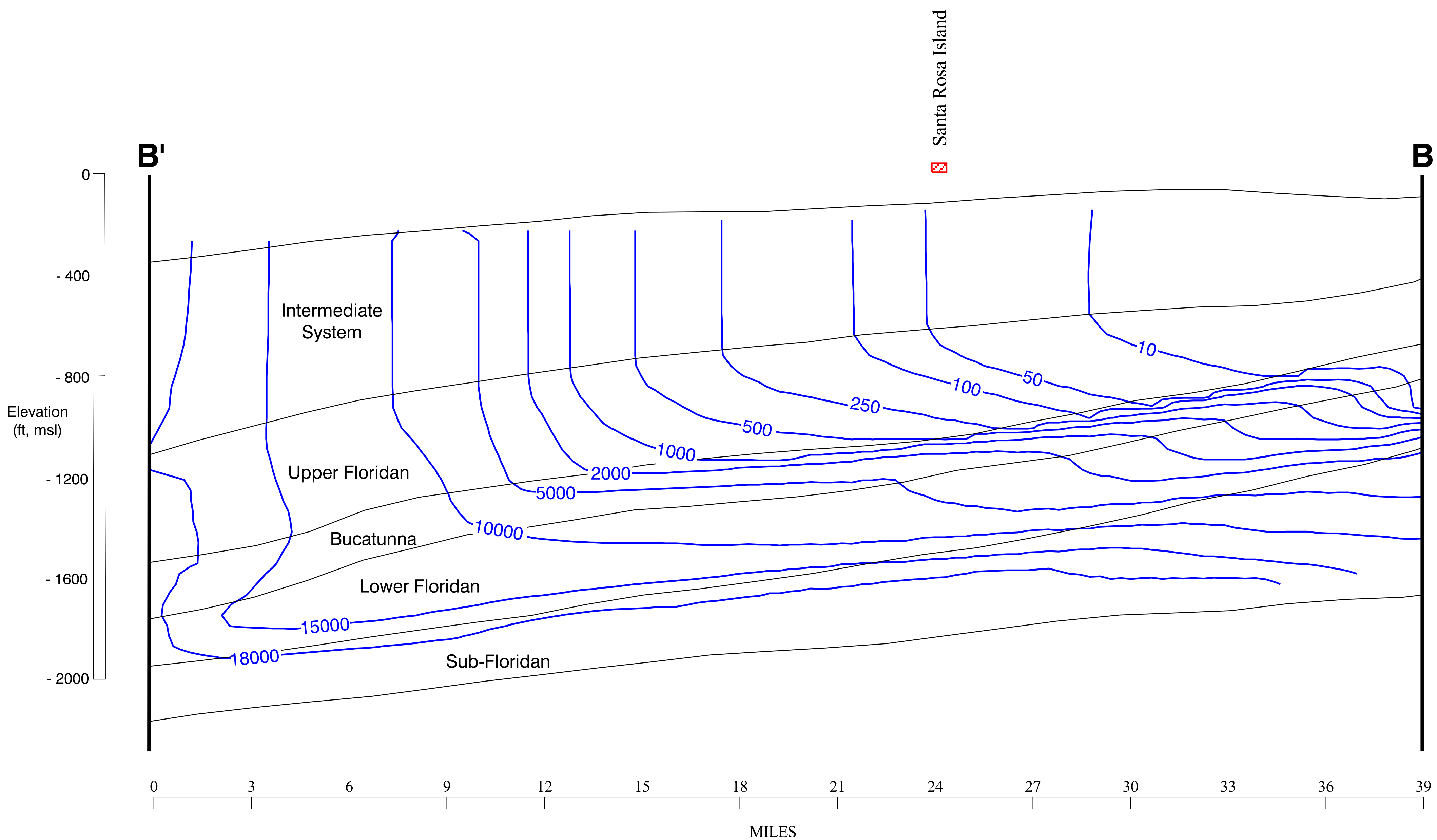
Filename: X:\NWF002\003-07\Old_figures\aa'Chlor.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 04/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic Inc.

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.9
Pre-Development
Chloride Concentration for
Cross-Section B-B'

Northwest Florida Water Management District

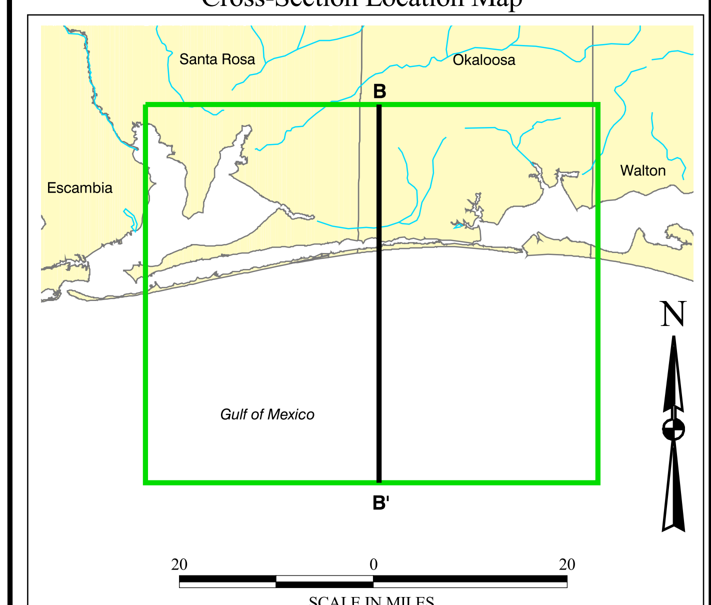


Legend

Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map



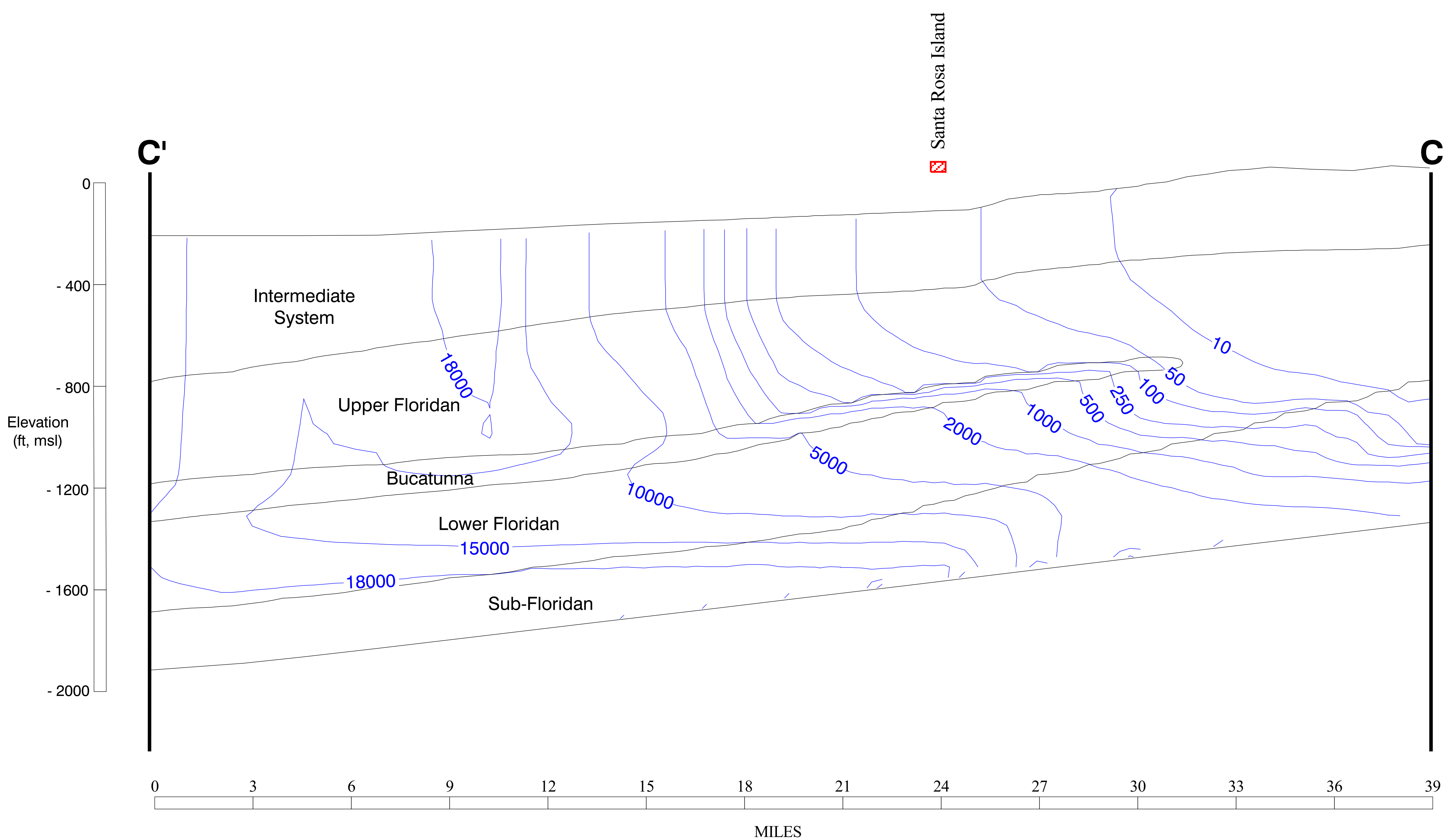
Filename: X:\NWF002\003-07\Old_figures\bb'Chlor.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 04/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HYDRO GeoLogic INC.

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.10
Pre-Development Chloride Concentration for Cross-Section C-C'

Northwest Florida Water Management District

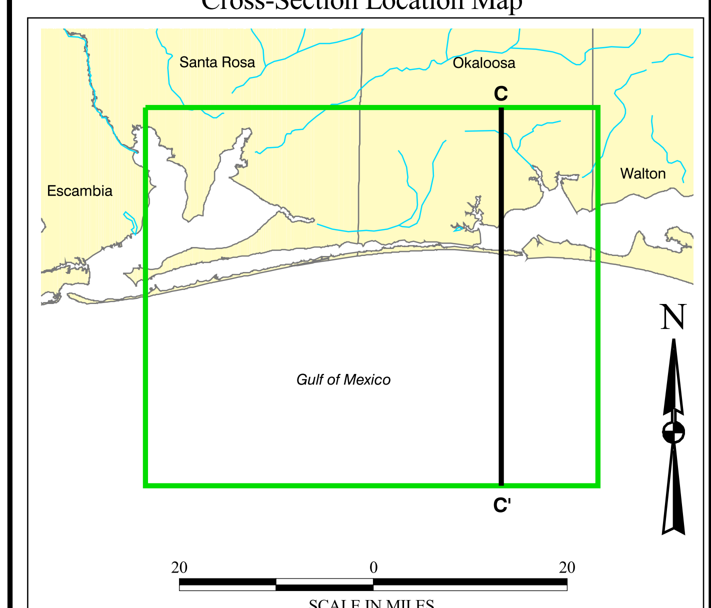


Legend

Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map

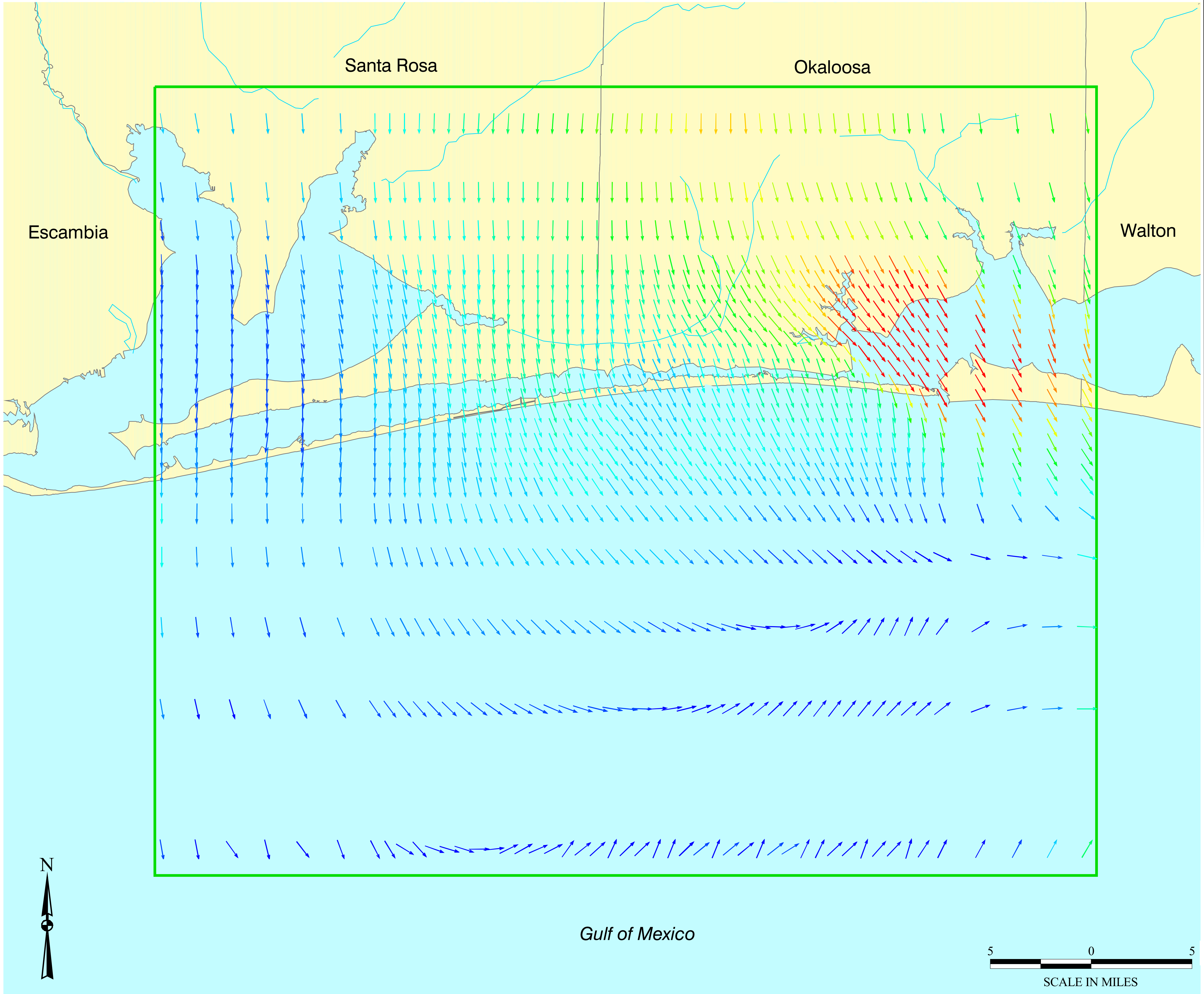


Filename: X:\NWF002\003-07\cc'Chlor.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 08/08/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.11
Pre-Development Darcy Velocities for the Upper Floridan Aquifer (Elemental Layer 15)

Northwest Florida Water Management District



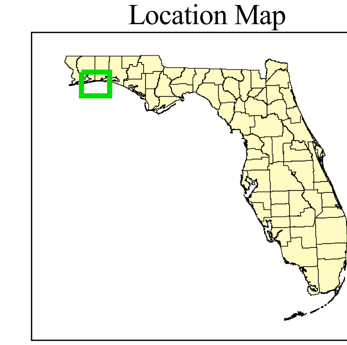
Legend

- County Boundary
- Hydrology
- Model Boundary

Velocities (ft/d)

0.013
0.0121
0.0112
0.0104
0.0095
0.0087
0.0078
0.0070
0.0061
0.0053
0.0044
0.0036
0.0027
0.0019
0.0010

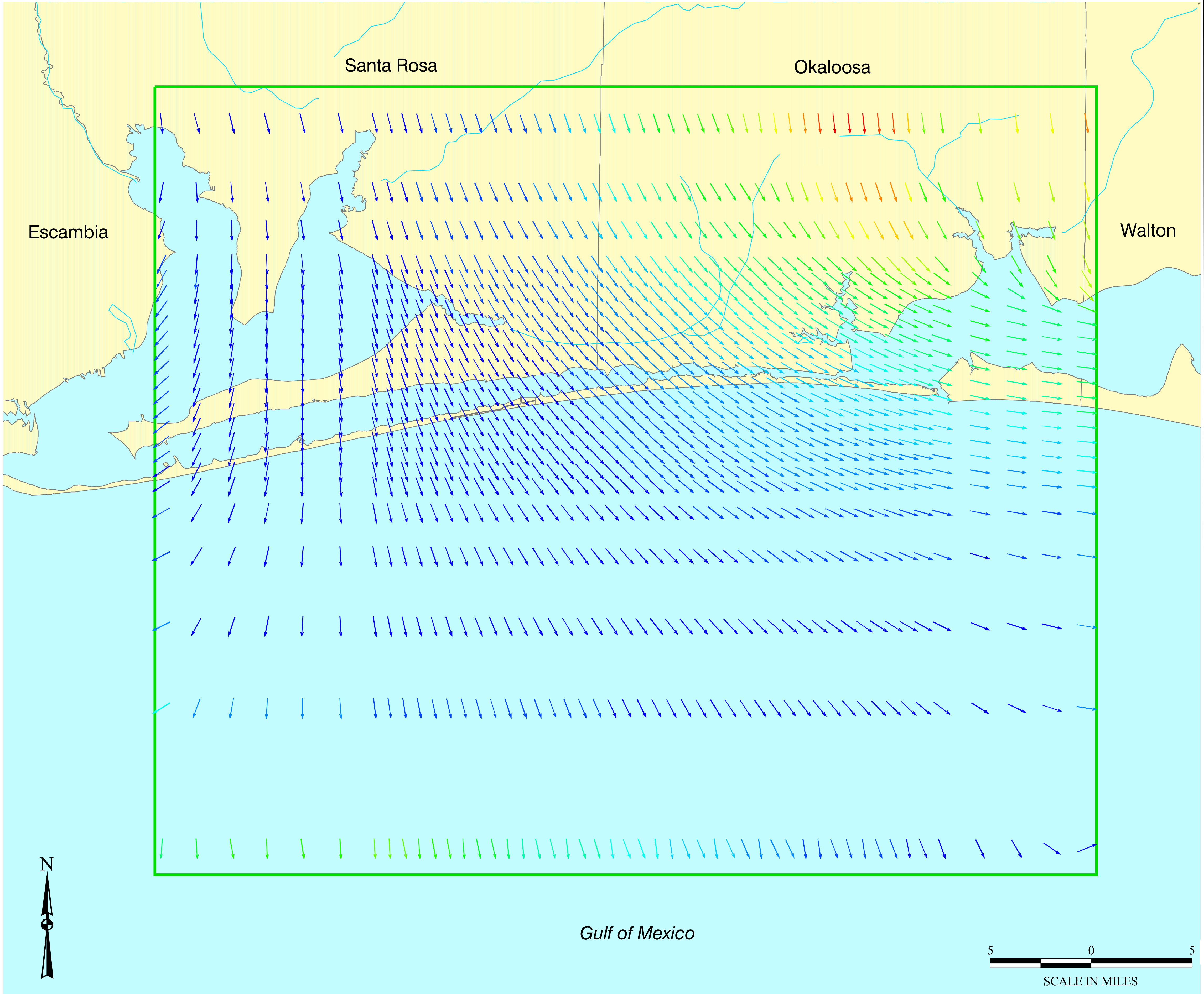
Location Map



Filename: X:\NWF002\003-07\Old_figures\uf_velocity.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 11/08/04 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.12
Pre-Development
Darcy Velocities for the
Lower Floridan Aquifer
(Elemental Layer 6)



Northwest Florida Water Management District

Legend

County Boundary

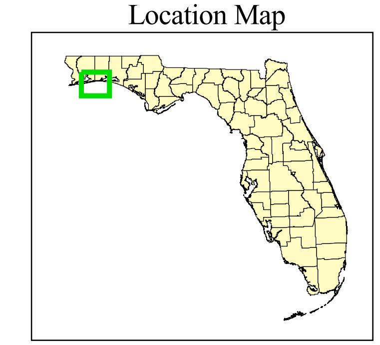
Hydrology

Model Boundary

Velocities (ft/d)

0.007
0.0065
0.0061
0.0057
0.0053
0.0048
0.0044
0.0040
0.0036
0.0031
0.0027
0.0023
0.0019
0.0015
0.0010

Location Map



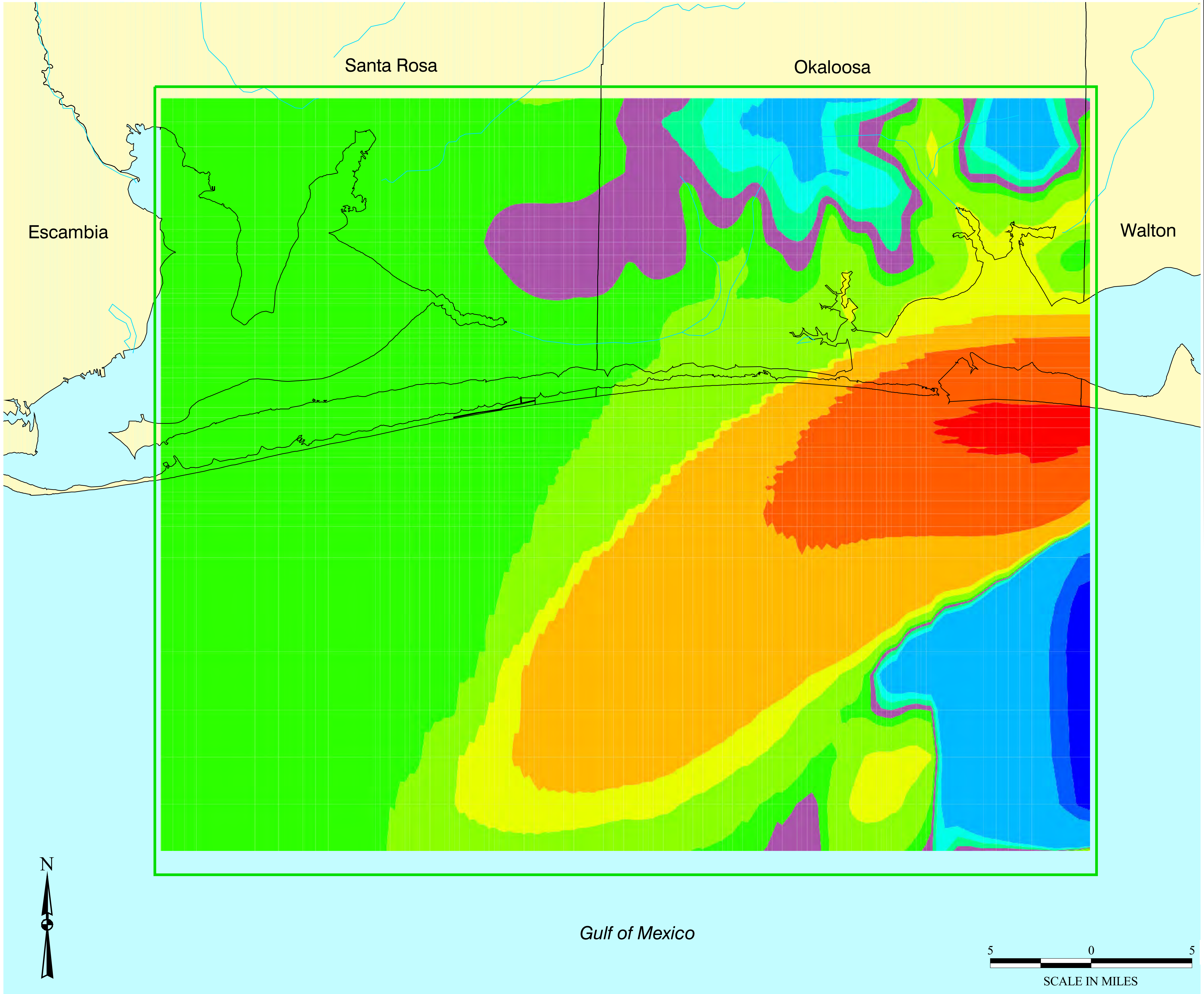
Filename: X:\NWF002\003-07\Old_figures\lf_velocity.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 11/08/04 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HYDRO GeoLogic INC.

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.13
Pre-Development Vertical Darcy Velocities for the Intermediate System (Elemental Layer 19)

Northwest Florida Water Management District



Legend

County Boundary

Hydrology

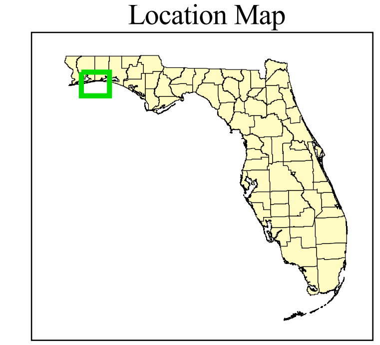
Model Boundary

Velocities (ft/d)

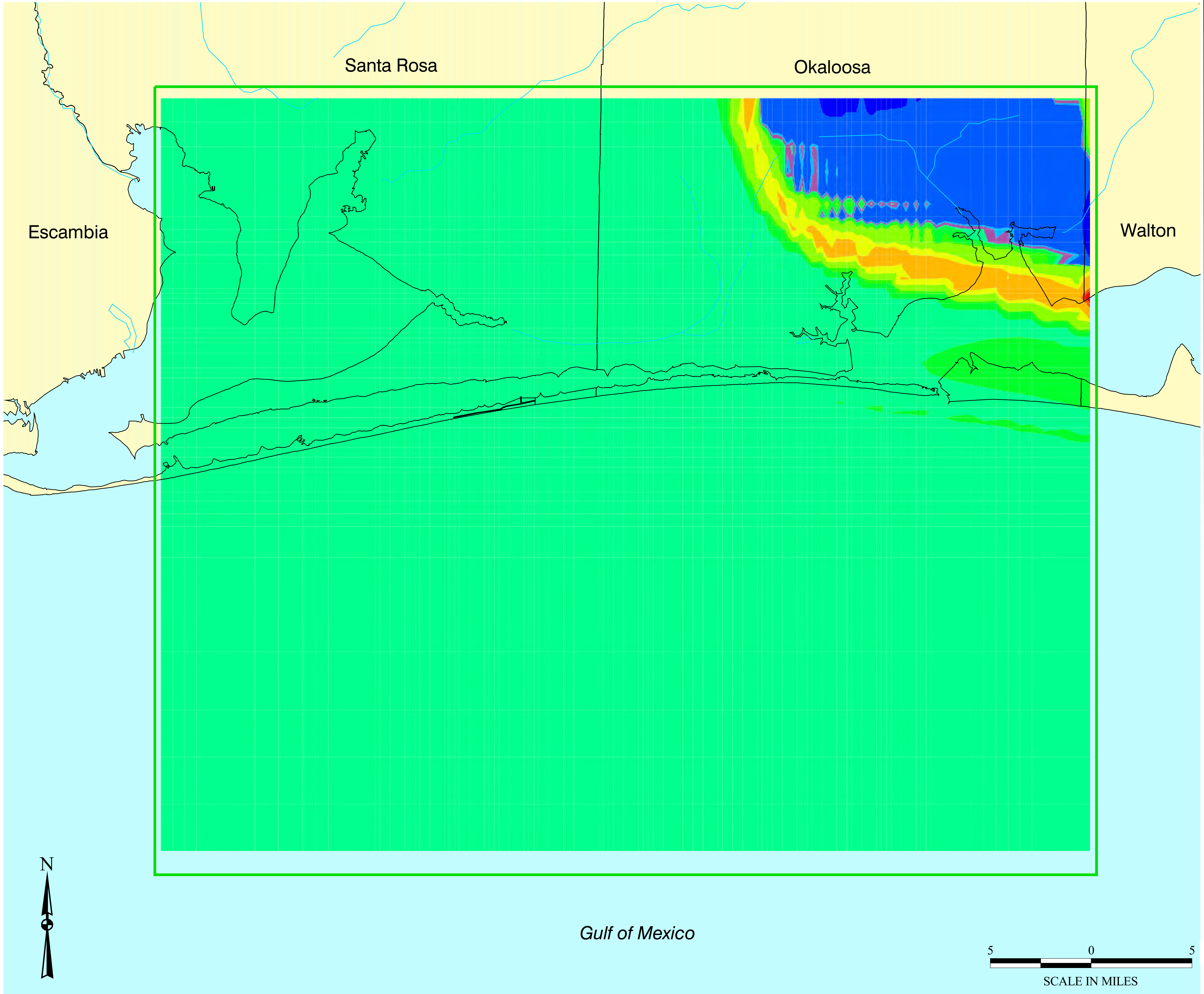
1.0E-04
5.0E-05
1.1E-05
6.6E-06
1.7E-06
0.0E+00
-1.6E-06
-3.2E-06
-5.0E-06
-7.0E-05
-1.0E-04

Note: Negative velocity indicates downward flow

Location Map



Filename: X:\NWF002\003-07\Old_figures\velz19.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 04/28/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.14
Pre-Development Vertical Darcy Velocities for the Bucatunna Clay Confining Unit and Middle Portion of the Undifferentiated Floridan Aquifer System (Elemental Layer 11)

Northwest Florida Water Management District

Legend

- County Boundary
- Hydrology
- Model Boundary

Velocities (ft/d)

- 8.0E-04
- 5.0E-04
- 1.0E-04
- 5.0E-05
- 1.1E-05
- 6.6E-06
- 1.7E-06
- 0.0E+00
- -3.2E-06
- -5.0E-06
- -7.0E-05

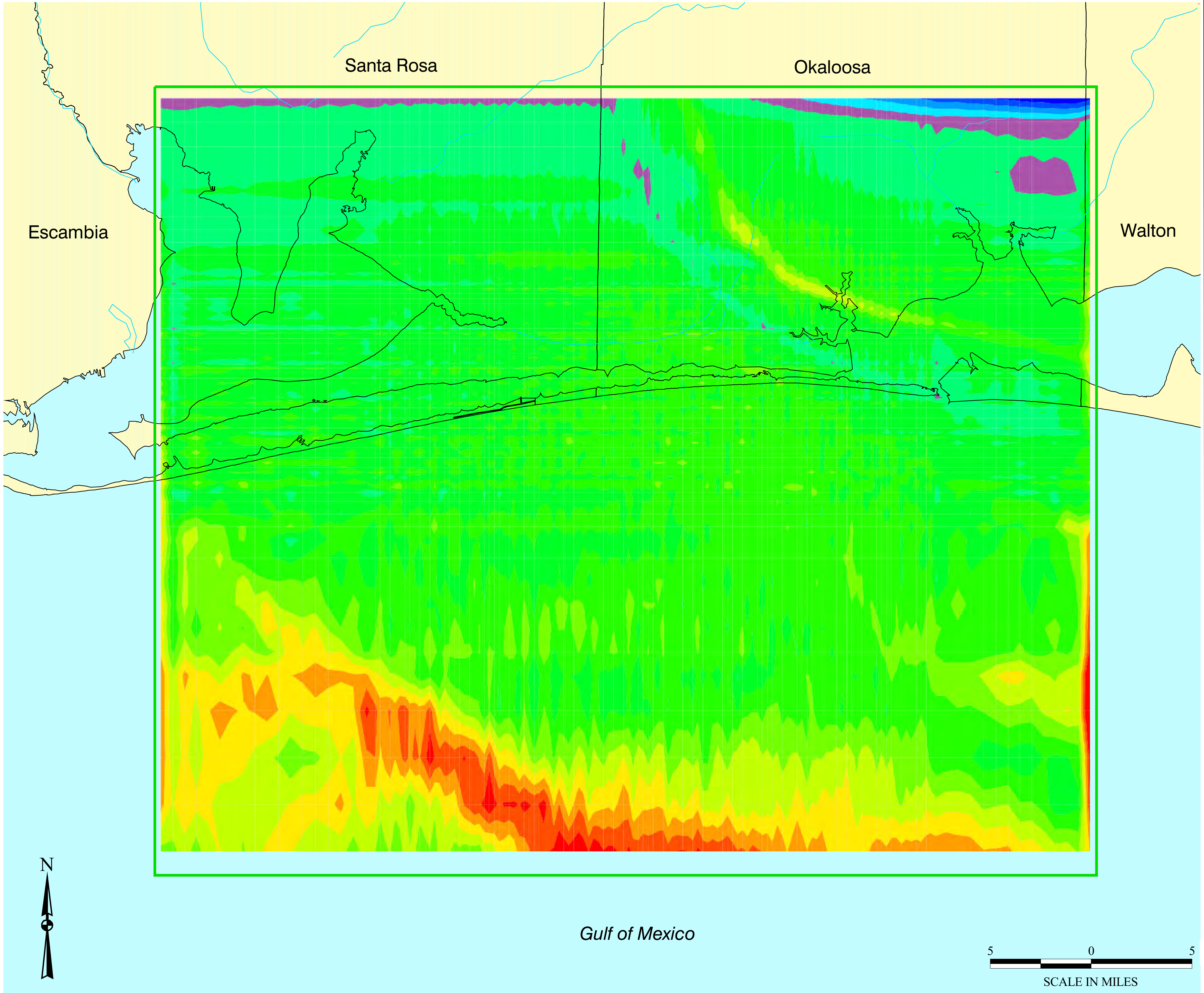
Note: Negative velocity indicates downward flow

Location Map

Filename: X:\NWF002\003-07\Old_figures\velz11.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 11/08/04 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.15
Pre-Development Vertical Darcy Velocities for the Sub-Floridan (Elemental Layer 2)



Northwest Florida Water Management District

Legend

County Boundary

Hydrology

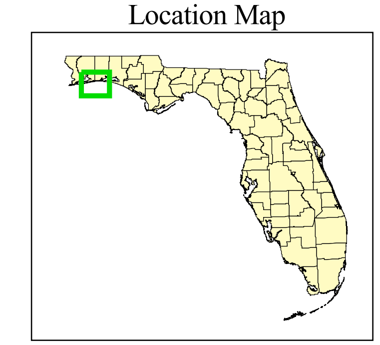
Model Boundary

Velocities (ft/d)

1.3E-05
1.1E-05
9.8E-06
8.2E-06
6.6E-06
4.9E-06
3.3E-06
1.7E-06
0.0E+00
-1.6E-06
-3.2E-06
-4.8E-06
-6.4E-06

Note: Negative velocity indicates downward flow

Location Map

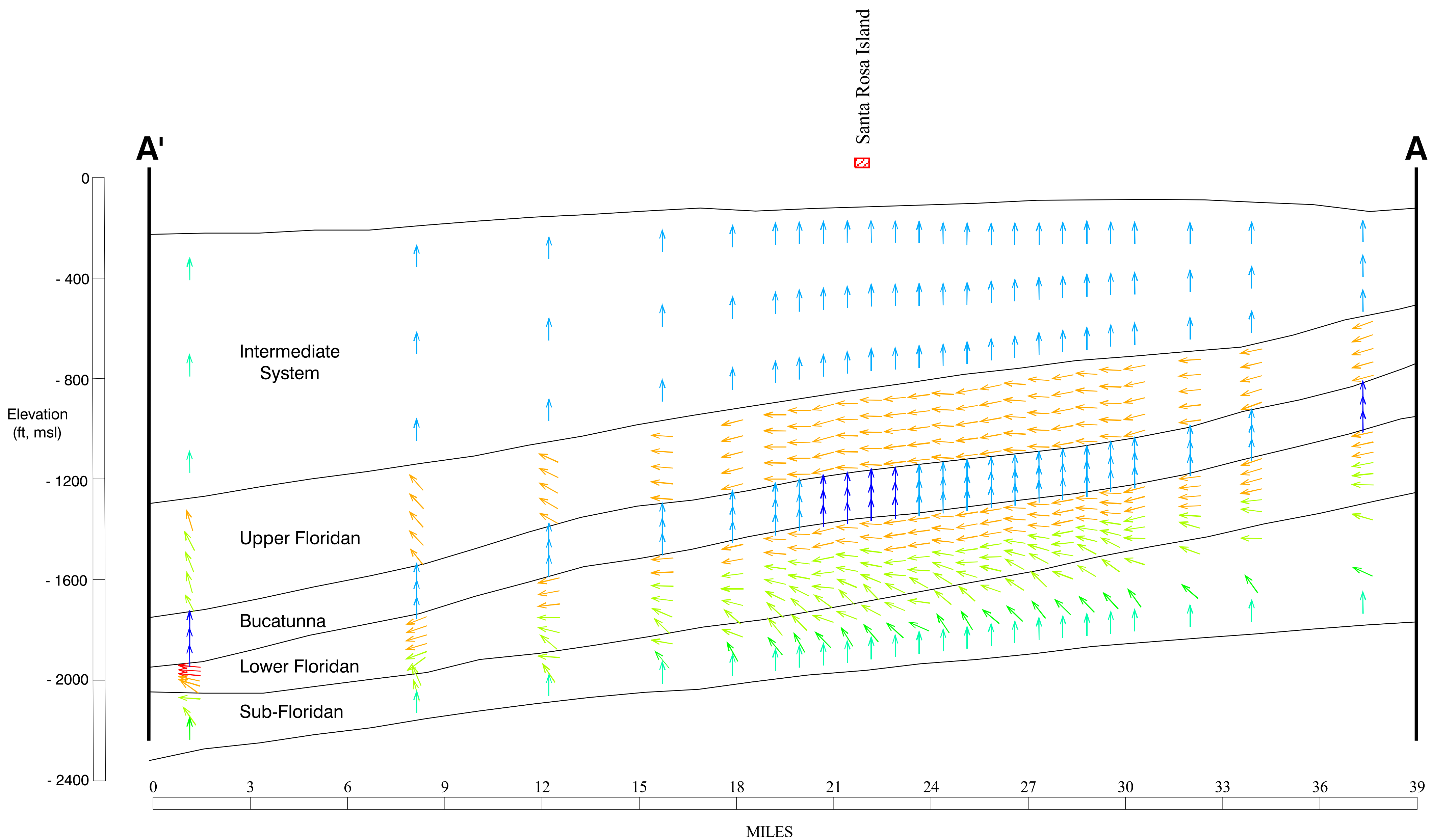


Filename: X:\NWF002\003-07\Old_figures\velz2.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 04/28/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.16
Pre-Development
Darcy Velocities for
Cross-Section A-A'

Northwest Florida Water Management District



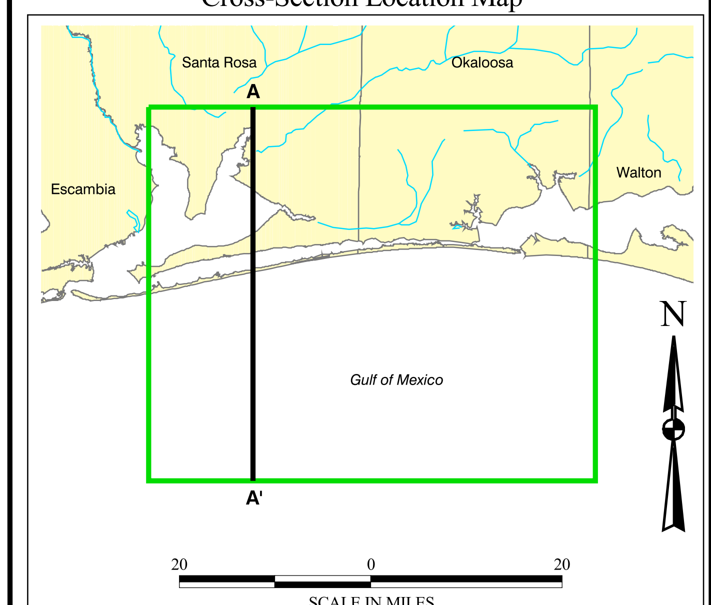
Legend

Velocities (ft/d)

- 0.005
- 0.001
- 0.0001
- 1E-05
- 1E-06
- 1E-07

Vertical Exaggeration 41:1

Cross-Section Location Map

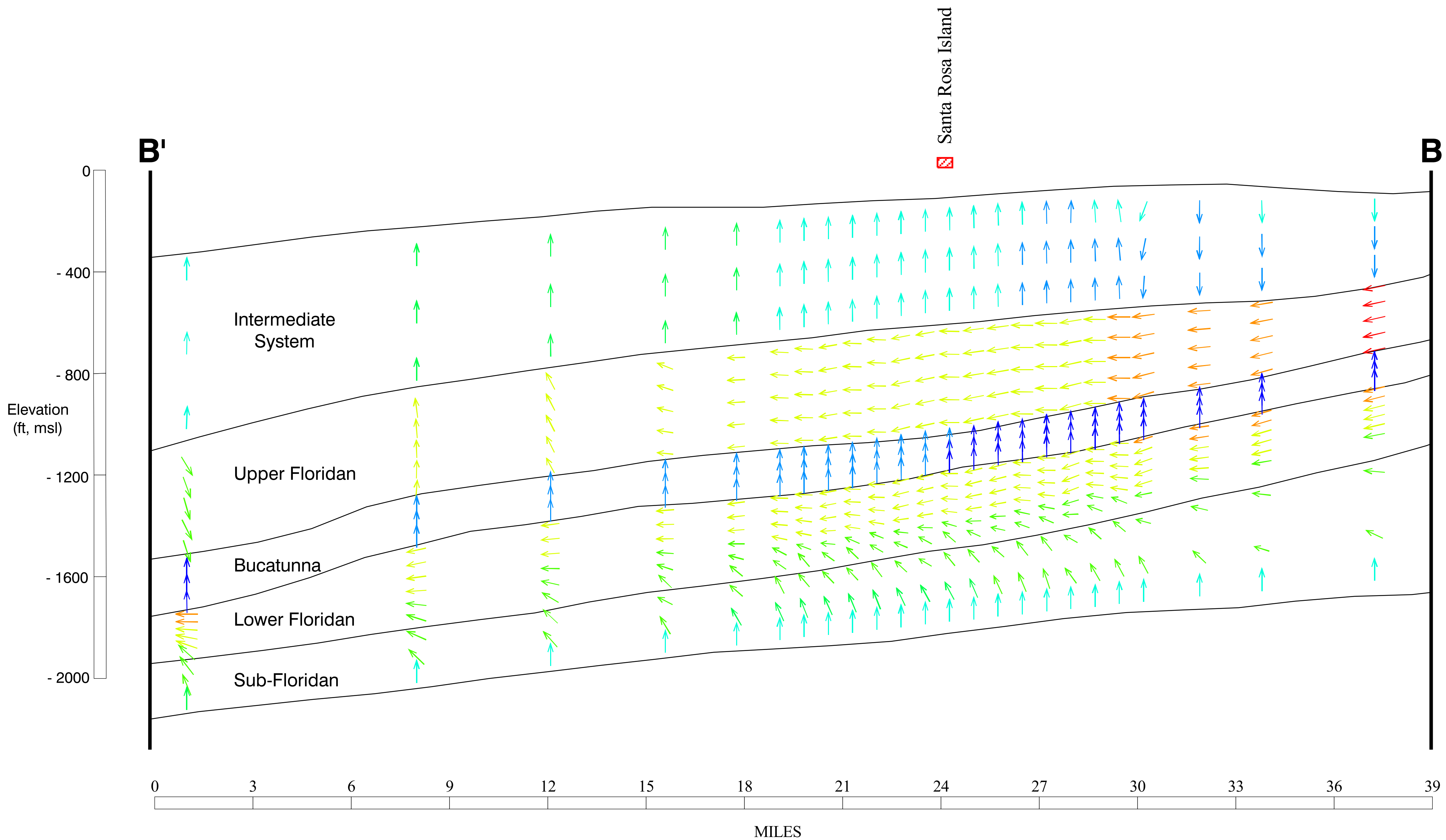


Filename: X:\NWF002\003-07\Old_figures\aa'vel.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 04/28/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.17
Pre-Development Darcy Velocities for Cross-Section B-B'

Northwest Florida Water Management District



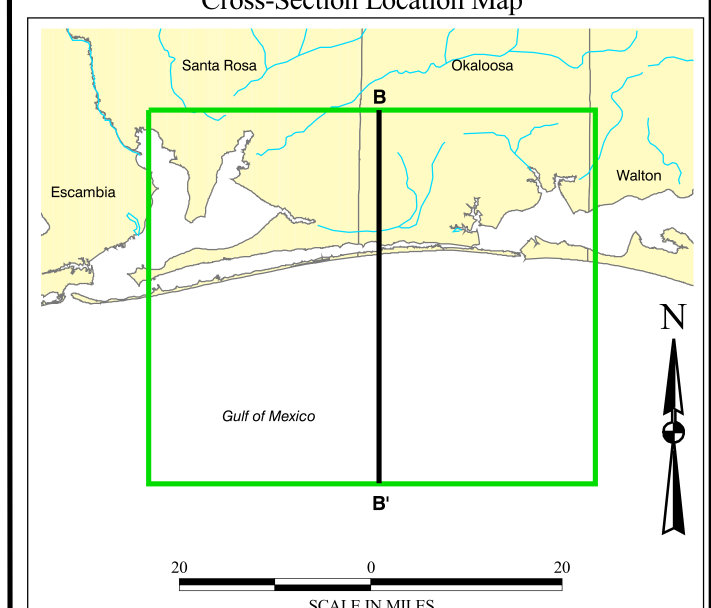
Legend

Velocities (ft/d)

0.009
0.005
0.001
0.0001
1E-05
1E-06
1E-07

Vertical Exaggeration 41:1

Cross-Section Location Map

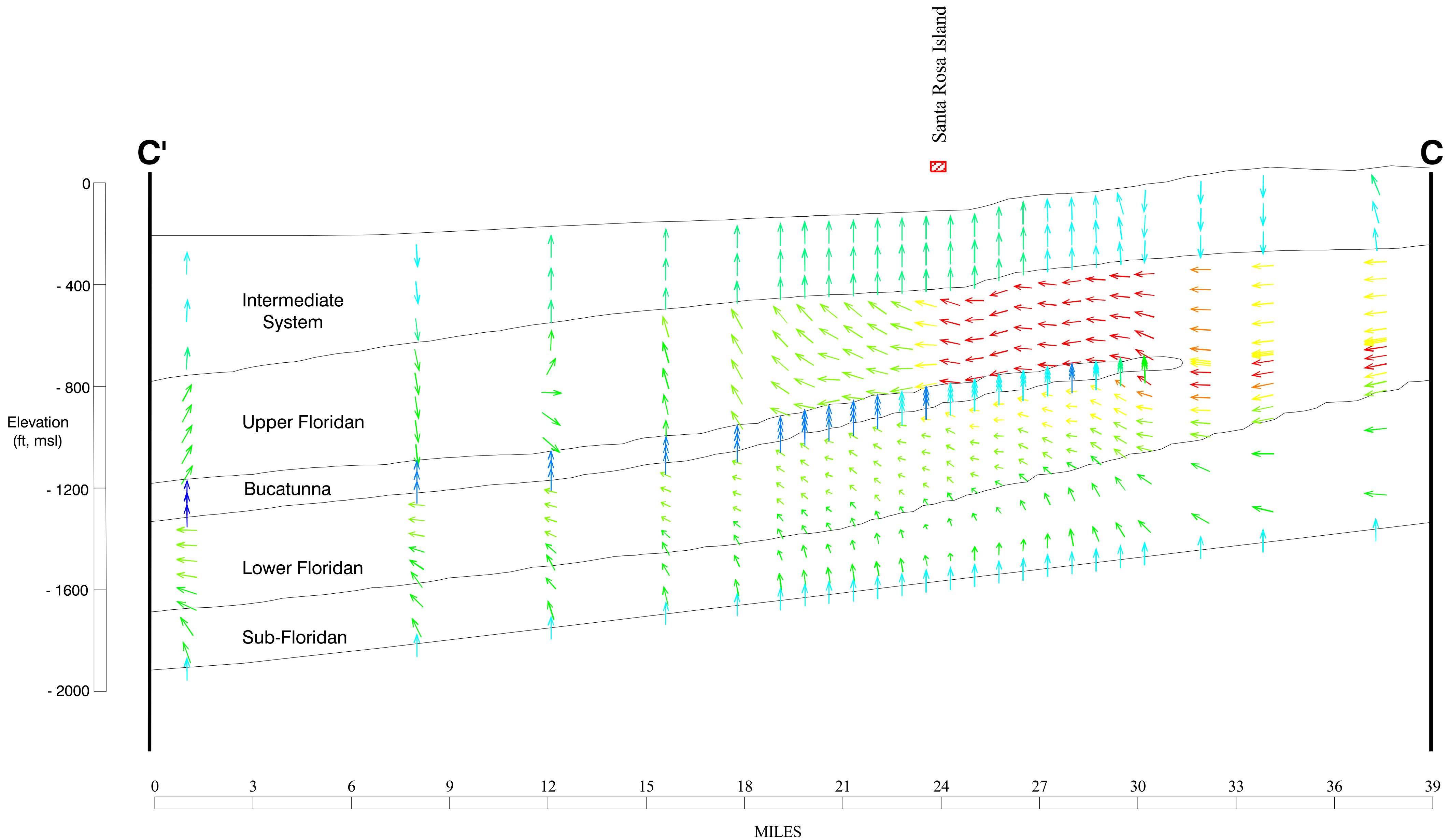


Filename: X:\NWF002\003-07\Old_figures\bb'vel.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 04/28/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.18
Pre-Development
Darcy Velocities for
Cross-Section C-C'

Northwest Florida
Water Management District



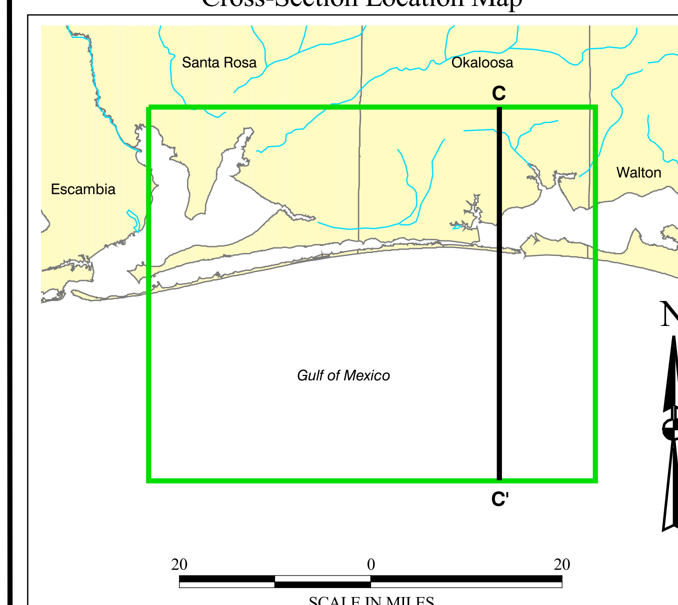
Legend

Velocities (ft/d)

0.01
0.009
0.005
0.001
0.0001
1E-05
1E-06
1E-07

Vertical Exaggeration 41:1

Cross-Section Location Map



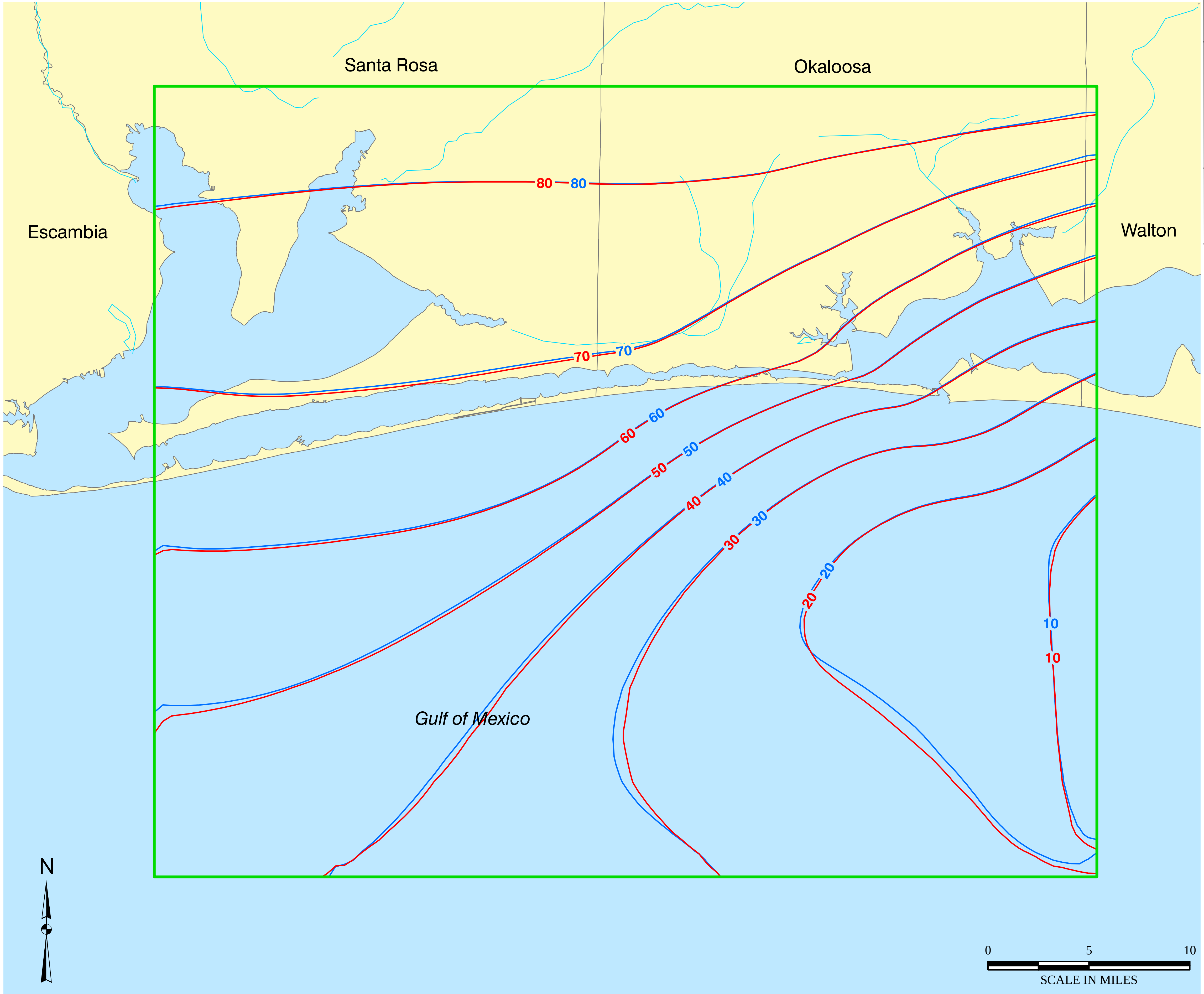
Filename: X:\NWF002\003-07\cc'vel-rev1.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 08/05/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HYDRO GeoLogic INC.

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.19
Pre-Development Equivalent Freshwater Head for the Upper Floridan Aquifer Grid Sensitivity (Nodal Layer 16, mid-aquifer)

Northwest Florida Water Management District



Legend

County Boundary

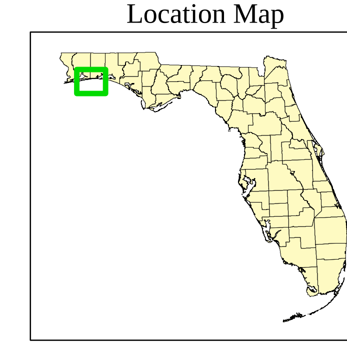
Hydrology

— 20 — Equivalent Freshwater Head (ft) (nx, ny, nz) = (146, 72, 21)

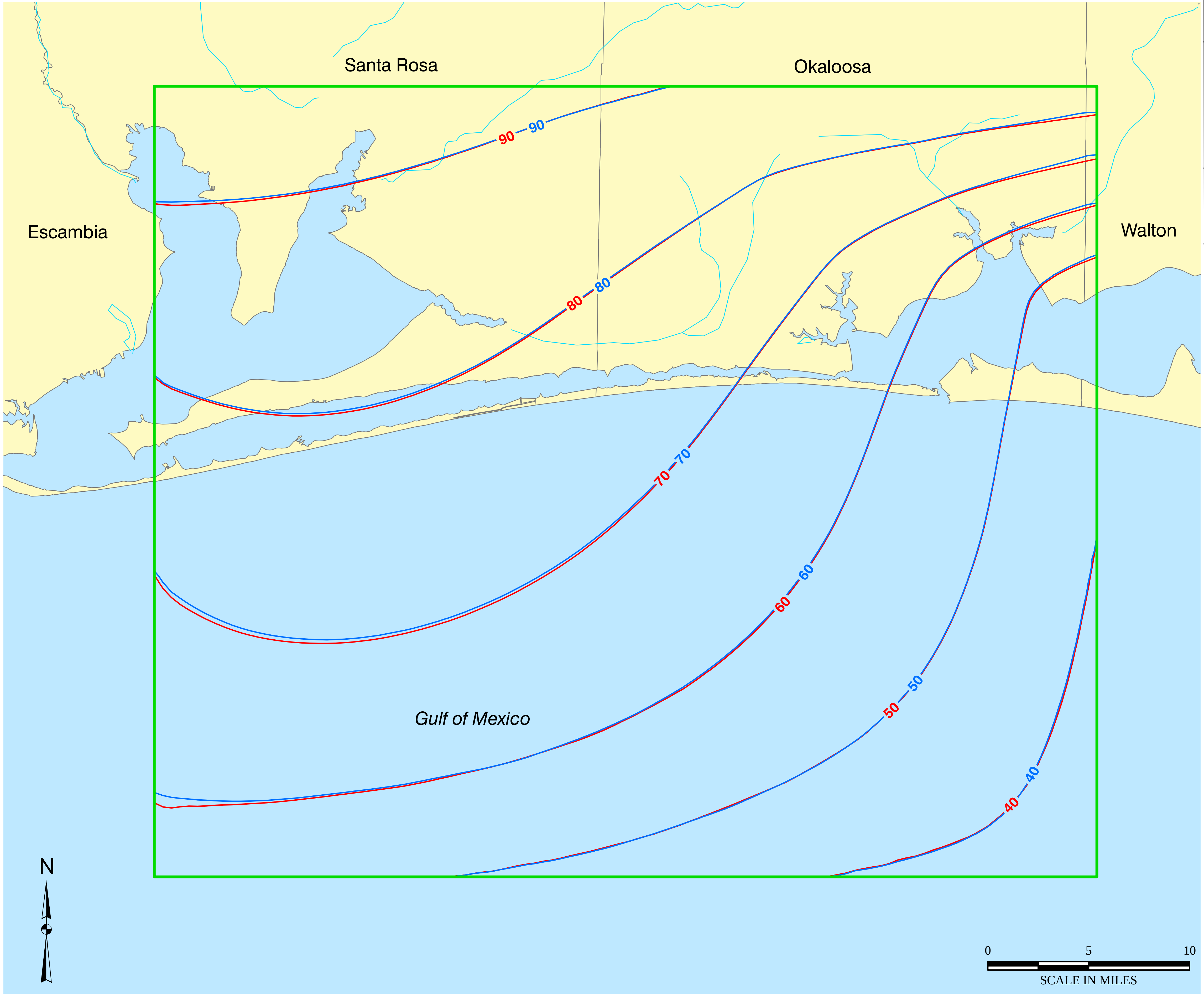
— 20 — Equivalent Freshwater Head (ft) (nx, ny, nz) = (291,143,21)

Model Boundary

Location Map



Filename: X:/NWF002/004-06/Maps/efhd_16_Grid_Sense.mxd
Project: NWF002-004-06
Revised: 04/13/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.20
Pre-Development Equivalent Freshwater Head for the Lower Floridan Aquifer Grid Sensitivity (Nodal Layer 7, mid-aquifer)

Northwest Florida Water Management District

Legend

County Boundary

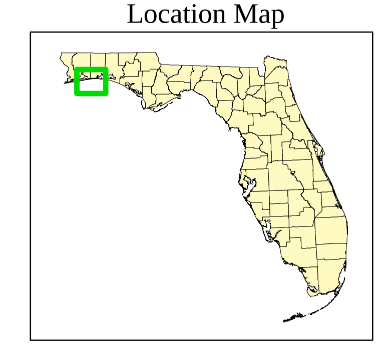
Hydrology

20 Equivalent Freshwater Head (ft) (nx, ny, nz) = (146, 72, 21)

20 Equivalent Freshwater Head (ft) (nx, ny, nz) = (291,143,21)

Model Boundary

Location Map

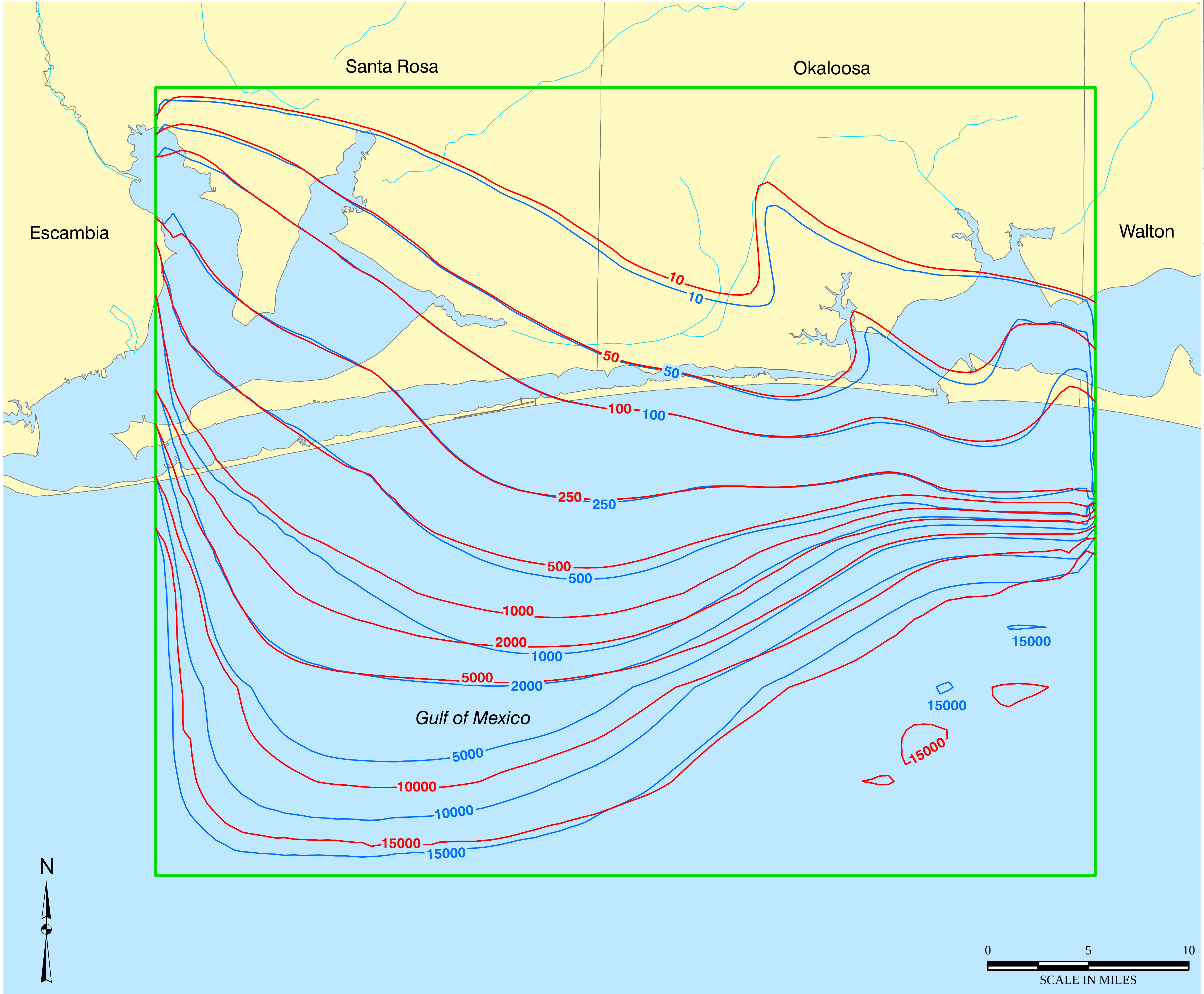


Filename: X:/NWF002/004-06/Maps/efhd_7_Grid_Sense.mxd
Project: NWF002-004-06
Revised: 04/13/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.21
Pre-Development
Chloride Concentration for the
Upper Floridan Aquifer
Grid Sensitivity
(Nodal Layer 16, mid-aquifer)

Northwest Florida Water Management District



Legend

County Boundary

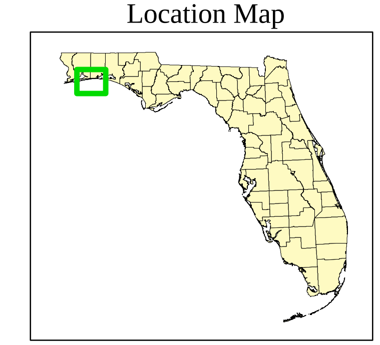
Hydrology

250 Chloride Concentration (mg/l) (nx, ny, nz) = (146, 72, 21)

250 Chloride Concentration (mg/l) (nx, ny, nz) = (291,143,21)

Model Boundary

Location Map



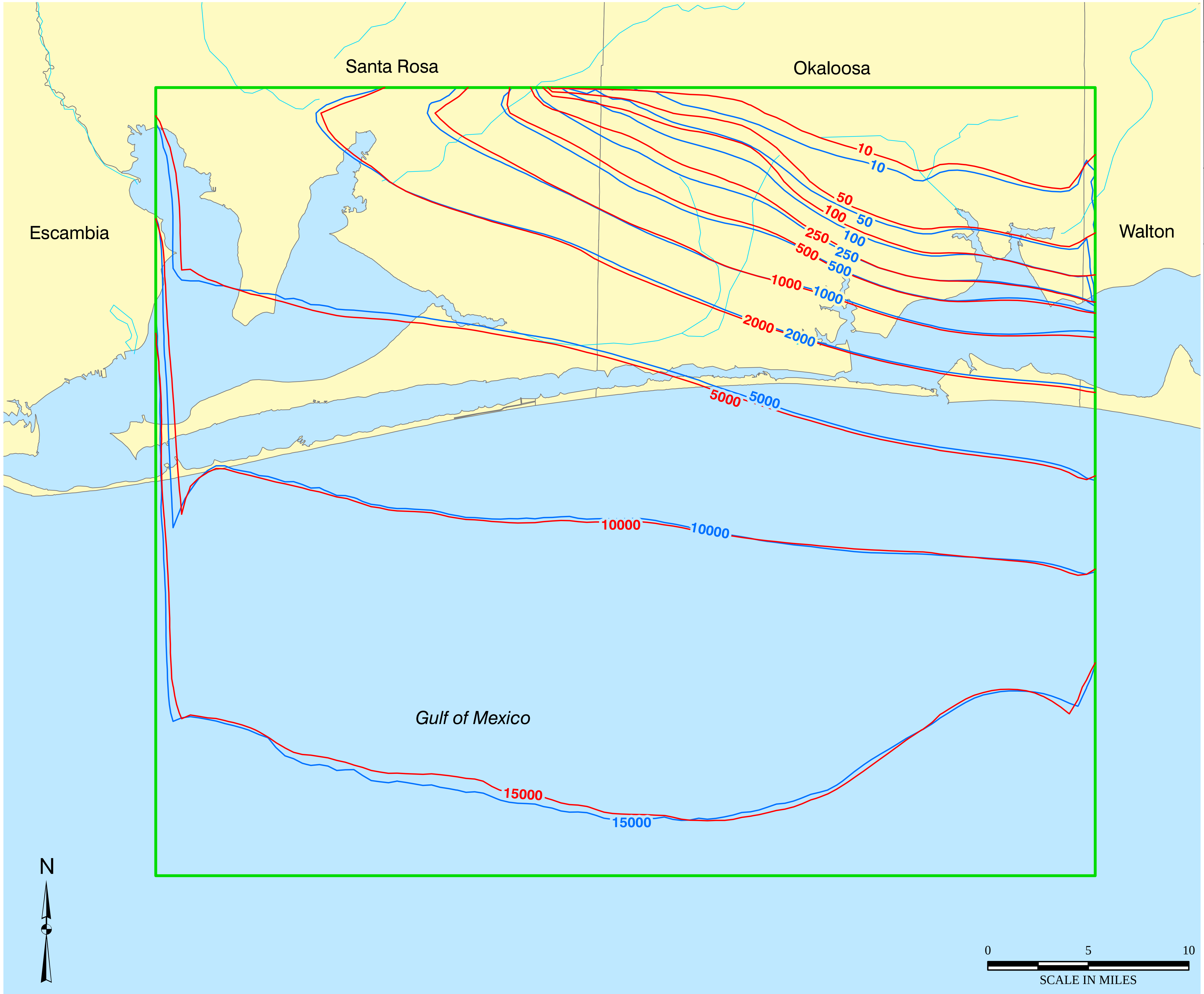
Filename: X:/NWF002/004-06/Maps/chloride_16_grid_sensitivity.mxd
Project: NWF002-004-06
Revised: 07/25/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic INC.

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.22
Pre-Development
Chloride Concentration for the Lower Floridan Aquifer
Grid Sensitivity
(Nodal Layer 7, mid-aquifer)

Northwest Florida Water Management District



Legend

County Boundary

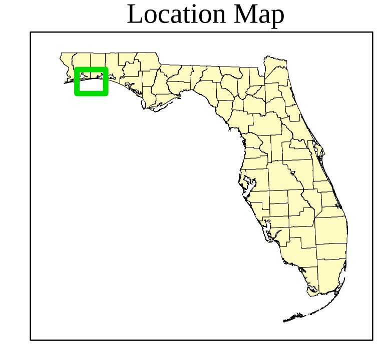
Hydrology

250 Chloride Concentration (mg/l) (nx, ny, nz) = (146, 72, 21)

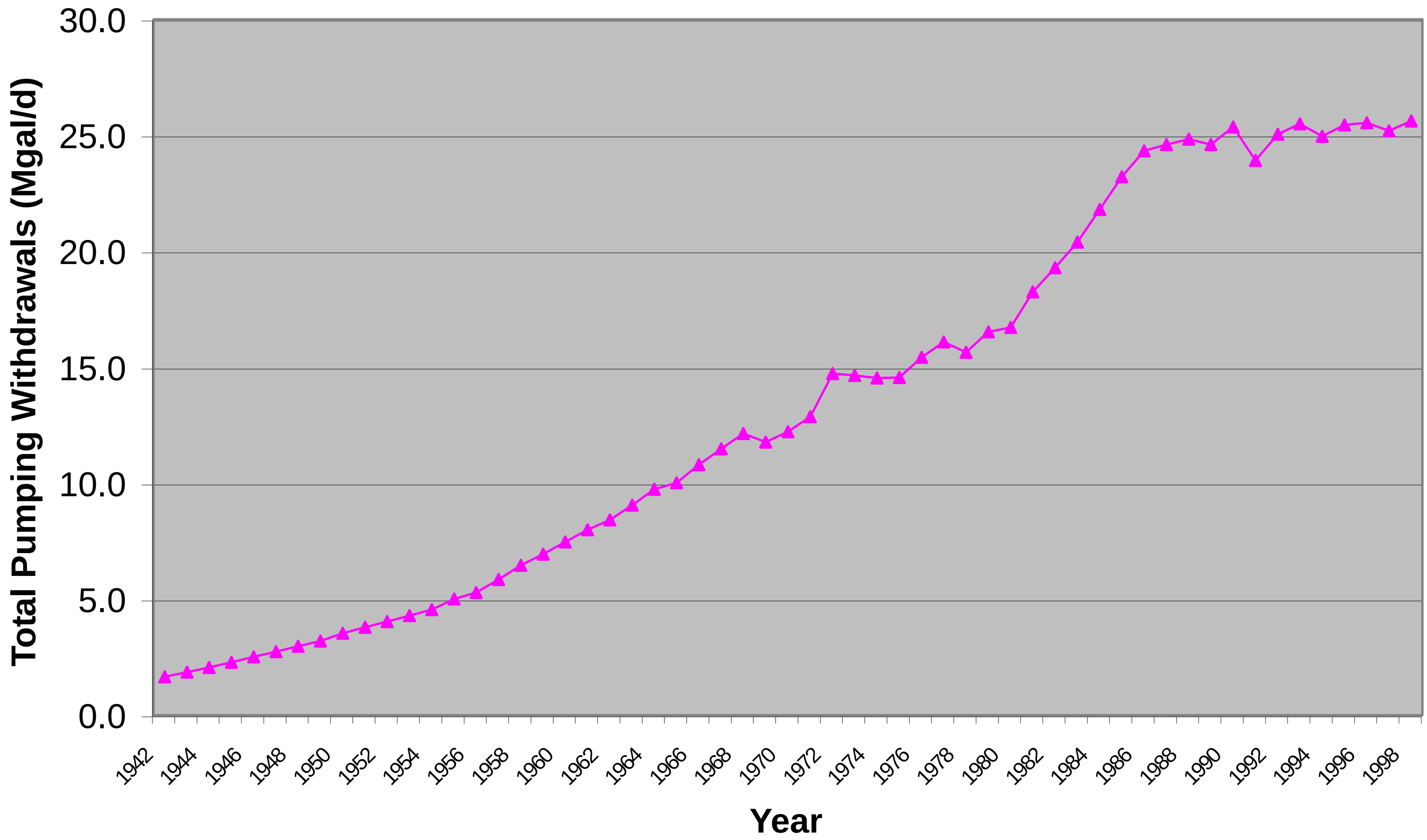
250 Chloride Concentration (mg/l) (nx, ny, nz) = (291,143,21)

Model Boundary

Location Map



Filename: X:/NWF002/004-06/Maps/chloride_7_grid_sensitivity.mxd
Project: NWF002-004-06
Revised: 07/25/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005



HydroGeoLogic, Inc.—Northwest Florida Water Management District

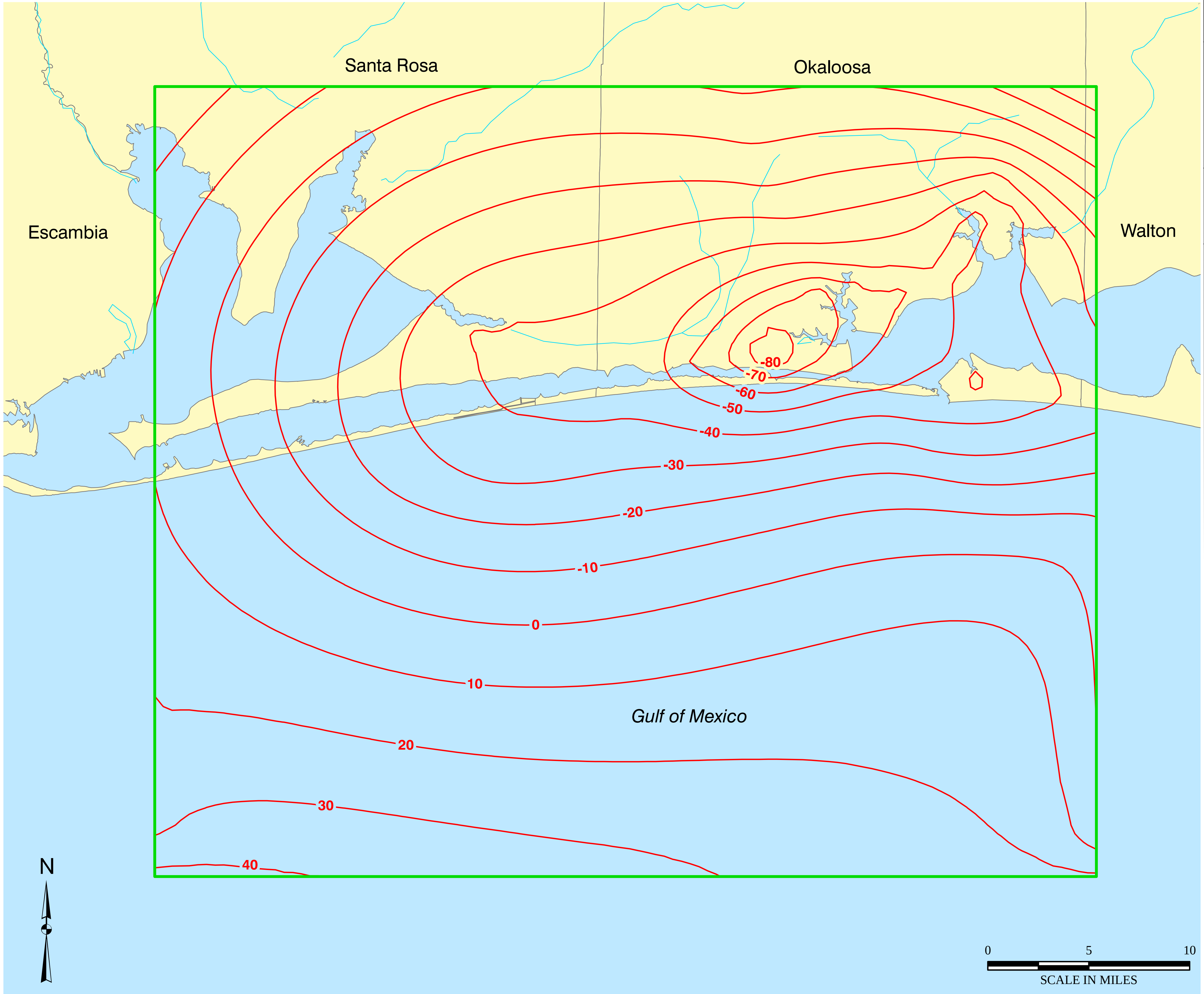
Filename: X:\NWF002\003-07\Total_Pumping_WDrawals.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised: 07/19/05 asc
Source: 04/18/05 CF

Figure 4.23
Total Pumping Withdrawals Applied to the Western Model Domain

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.24
1998 Equivalent Freshwater Head for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)

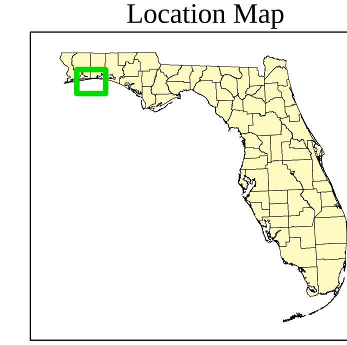
Northwest Florida Water Management District



Legend

- County Boundary
- Hydrology
- 20 Equivalent Freshwater Head (ft)
- Model Boundary

Location Map

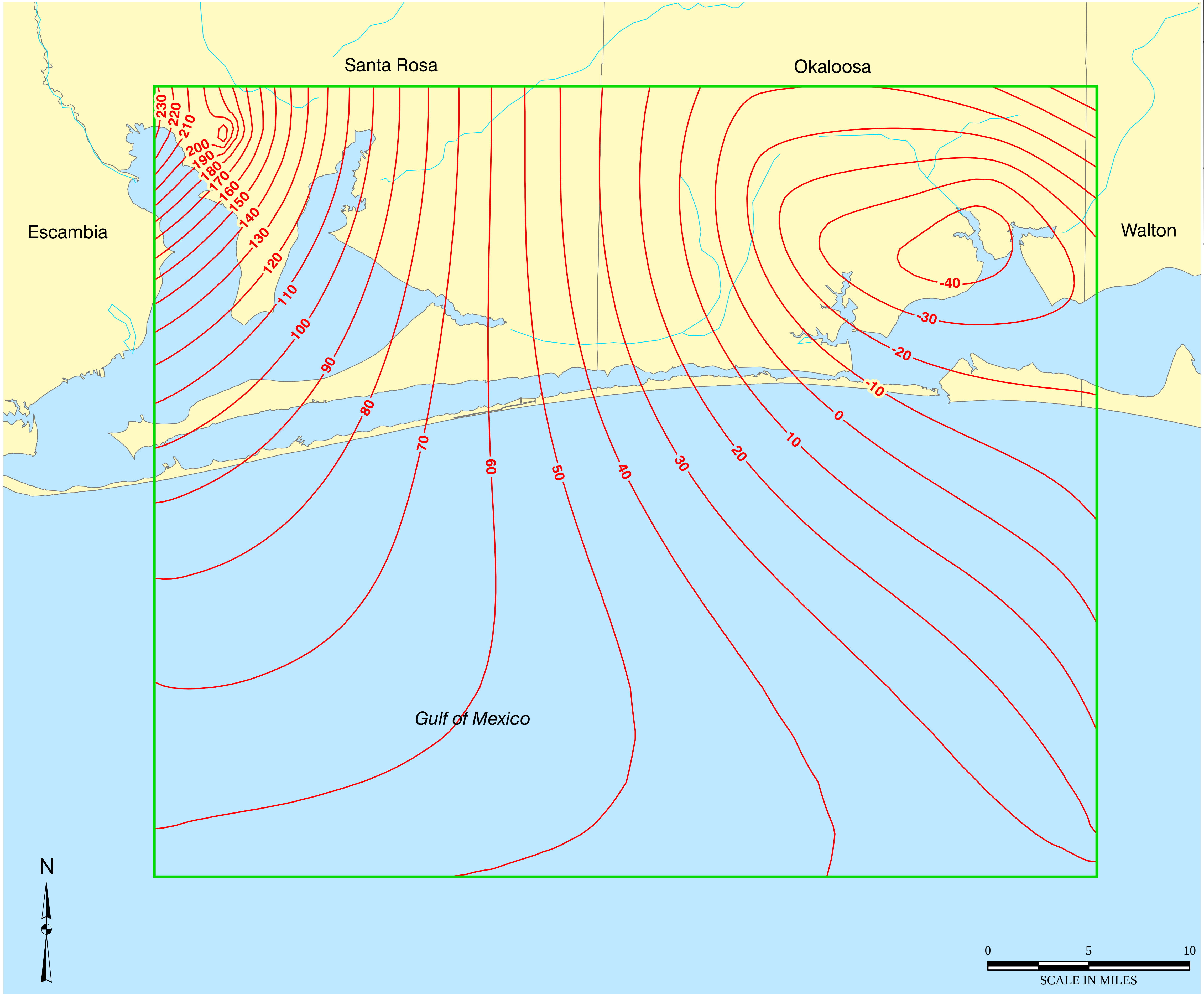


Filename: X:/NWF002/004-06/Maps/l16_efhd_1998.mxd.mxd
Project: NWF002-004-06
Revised: 04/18/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.25
1998 Equivalent Freshwater Head for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)

Northwest Florida Water Management District



Legend

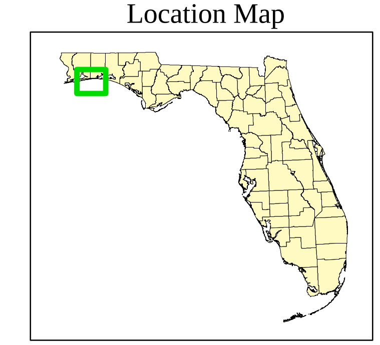
County Boundary

Hydrology

20 Equivalent Freshwater Head (ft)

Model Boundary

Location Map

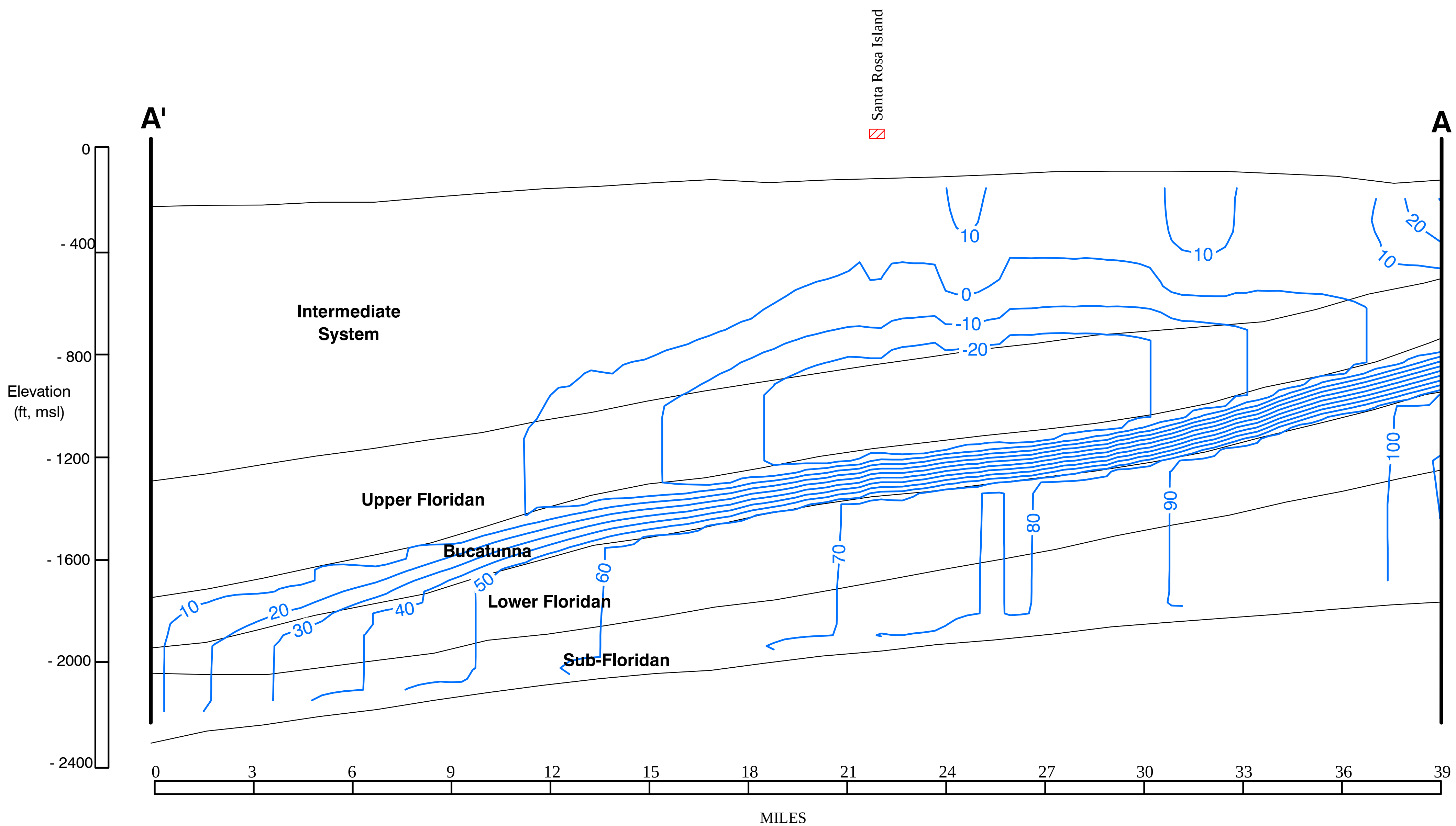


Filename: X:/NWF002/004-06/Maps/l7_efhd_1998.mxd.mxd
Project: NWF002-004-06
Revised: 04/12/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.26
1998
Environmental Head for Cross-Section A-A'

Northwest Florida Water Management District

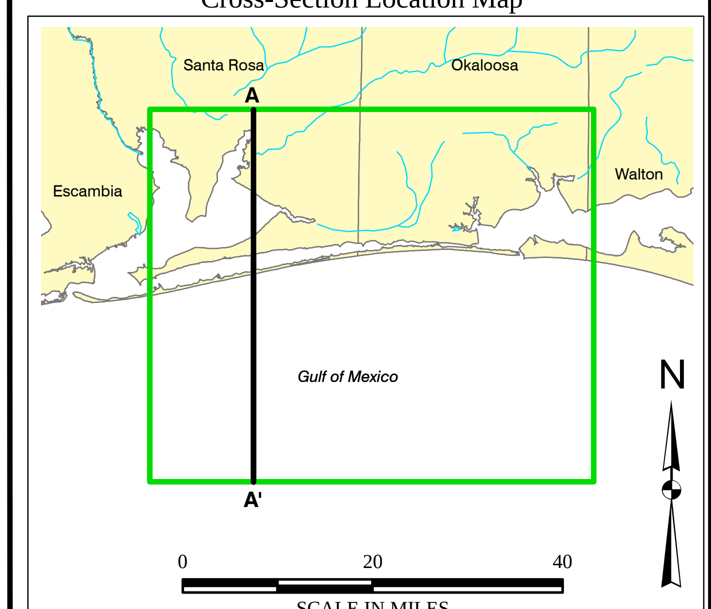


Legend

Environmental Head (ft)

Vertical Exaggeration 41:1

Cross-Section Location Map



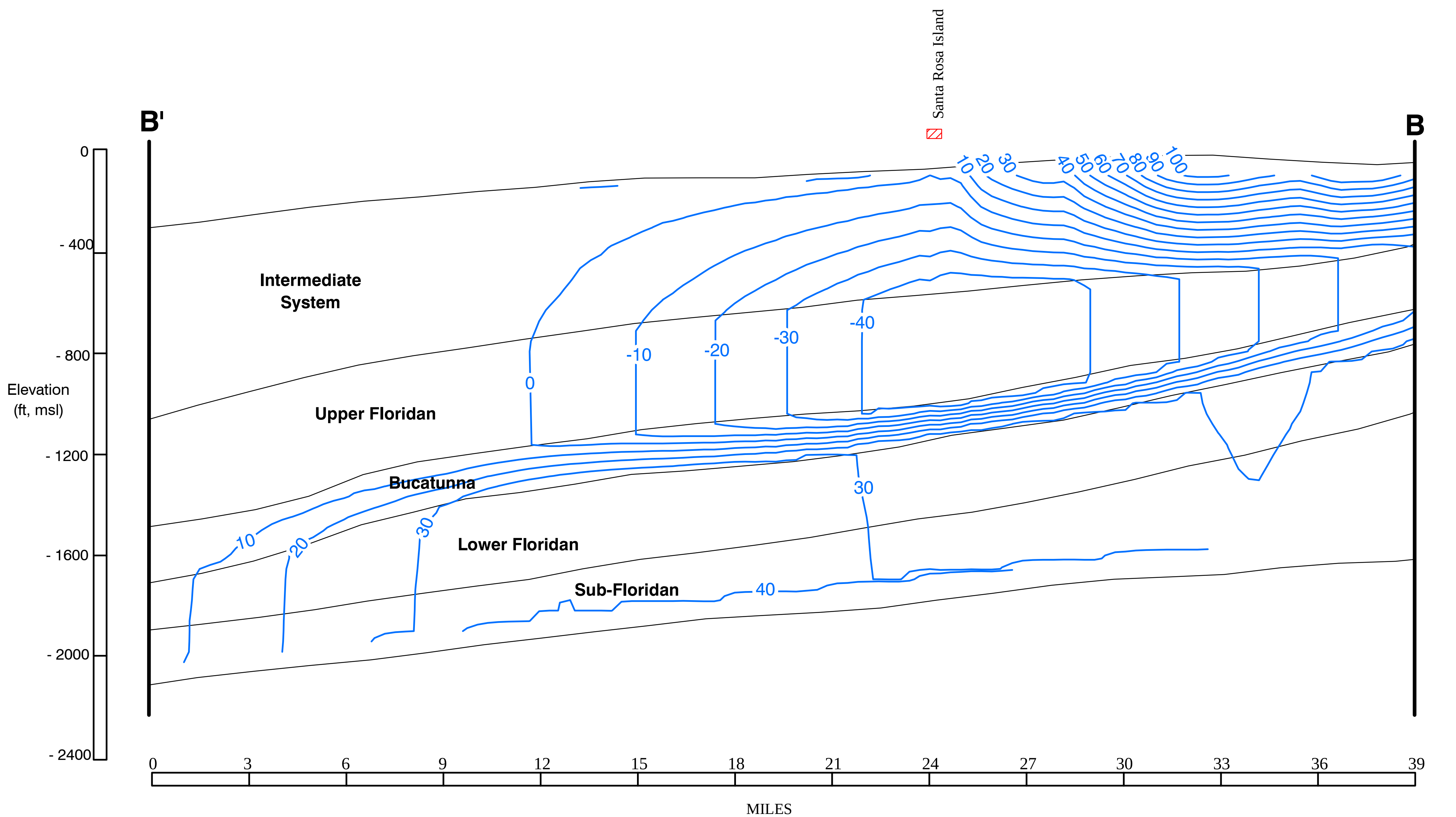
Filename: X:/NWF002/003-07/Maps/aa'eh_98_x-sec.mxd
Project: NWF002-003-07
Revised: 08/05/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HYDROGeoLogic INC.

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.27
1998
Environmental Head for Cross-Section B-B'

Northwest Florida Water Management District

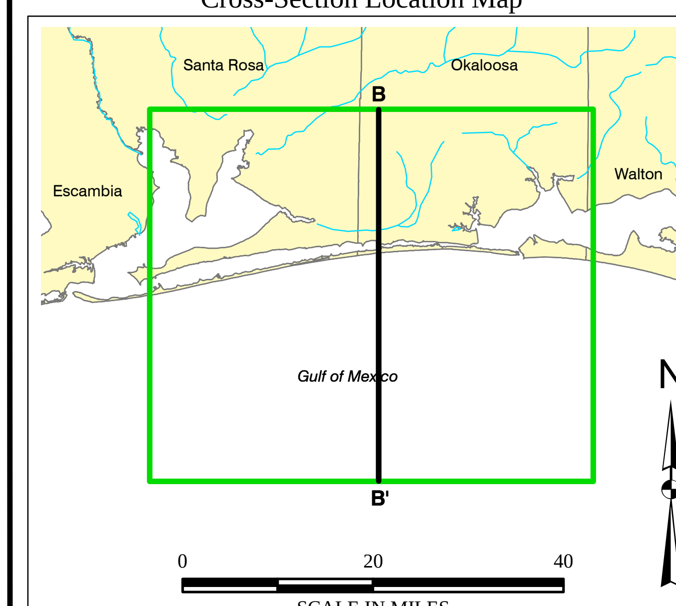


Legend

Environmental Head (ft)

Vertical Exaggeration 41:1

Cross-Section Location Map

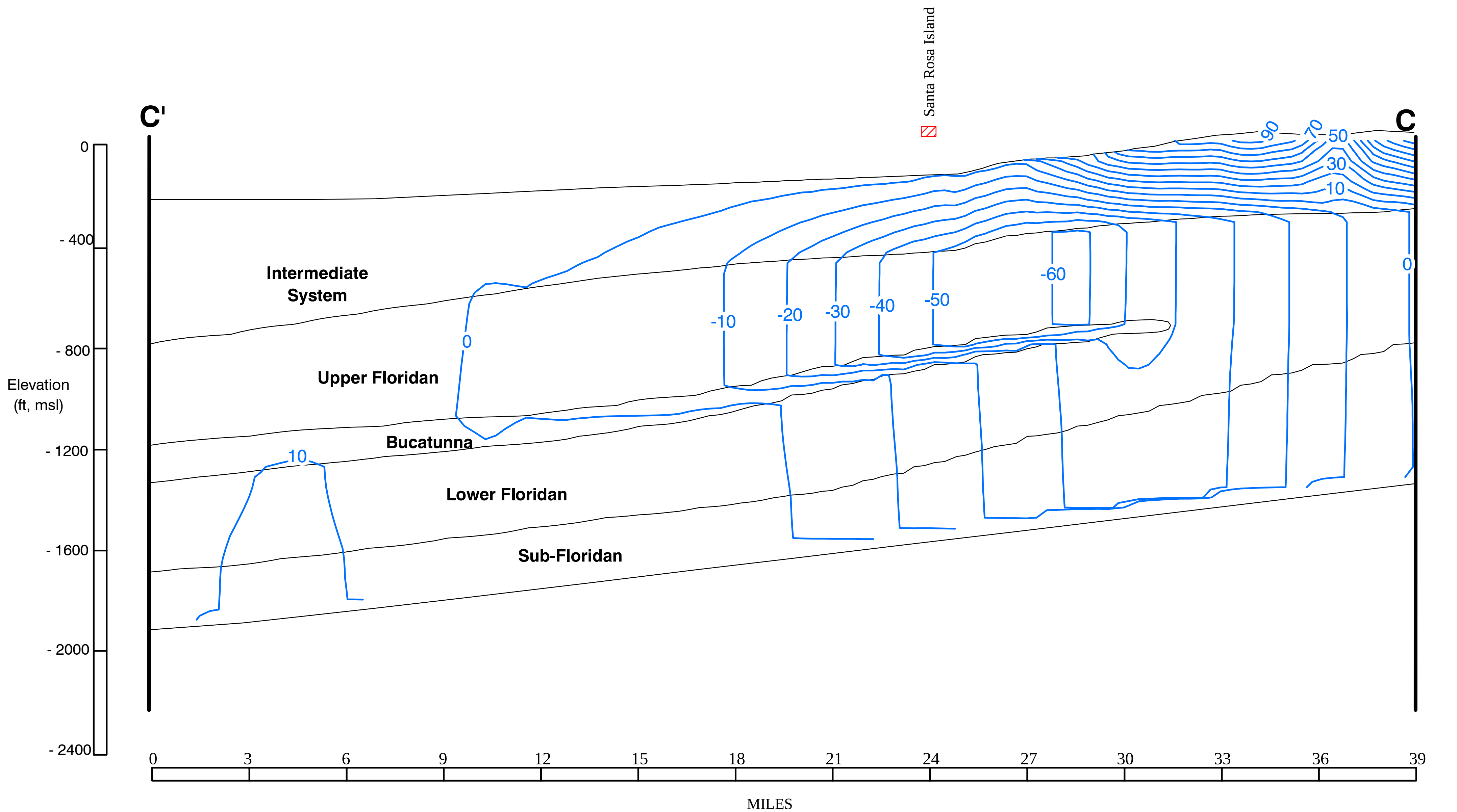


Filename: X:/NWF002/003-07/Maps/bb'eh_98_x-sec.mxd
Project: NWF002-003-07
Revised: 08/05/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.28
1998
Environmental Head for Cross-Section C-C'

Northwest Florida Water Management District

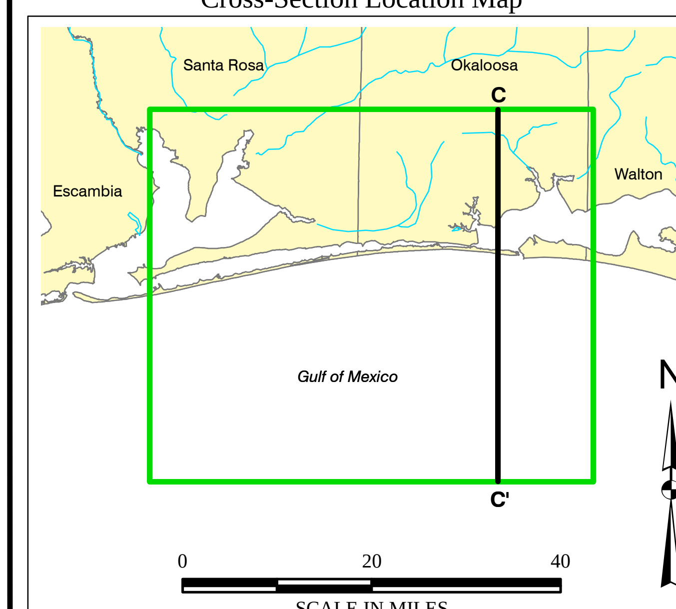


Legend

Environmental Head (ft)

Vertical Exaggeration 41:1

Cross-Section Location Map

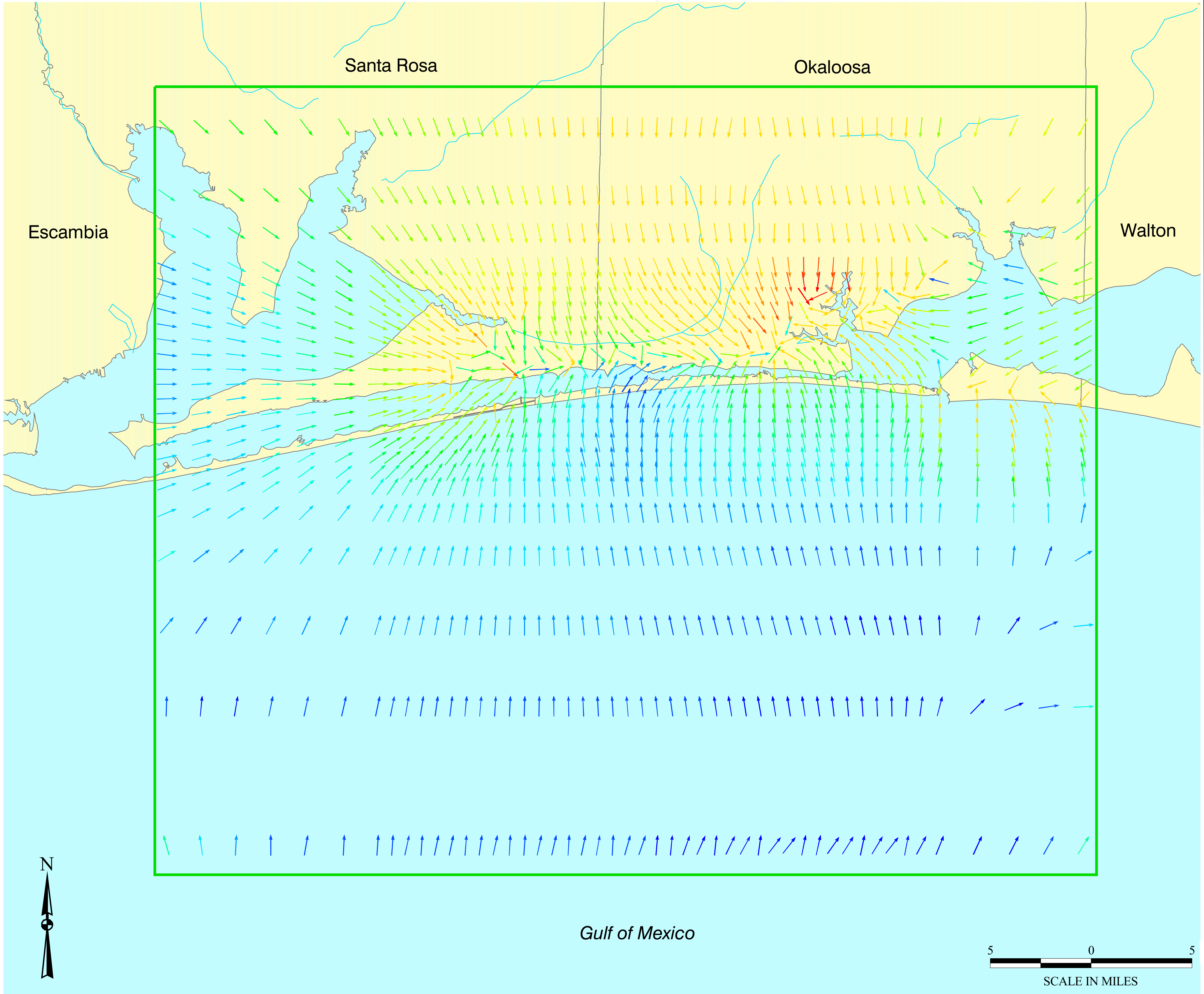


Filename: X:/NWF002/003-07/Maps/cc'eh_98_x-sec.mxd
Project: NWF002-003-07
Revised: 08/05/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.29
1998 Darcy Velocities for the Upper Floridan Aquifer (Elemental Layer 15)

Northwest Florida Water Management District



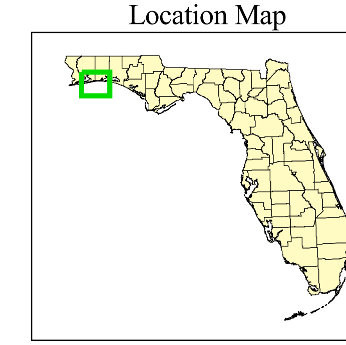
Legend

- County Boundary
- Hydrology
- Model Boundary

Velocities (ft/d)

0.06
0.05
0.04
0.015
0.013
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002

Location Map

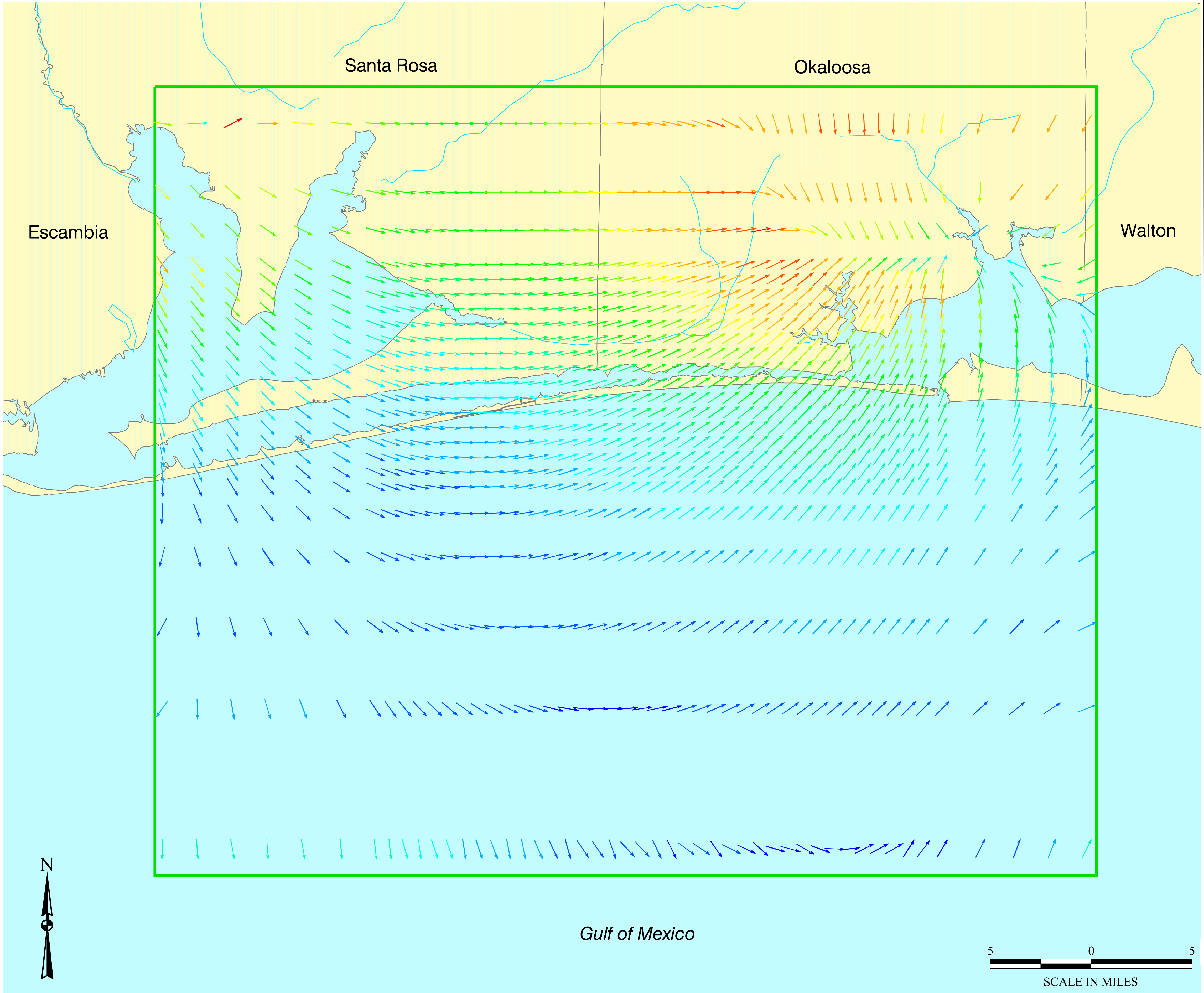


Filename: X:\NWF002\003-07\Old_figures\uf_velocity_1998.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 11/08/04 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.30
1998 Darcy Velocities for the Lower Floridan Aquifer (Elemental Layer 6)

Northwest Florida Water Management District



Legend

County Boundary

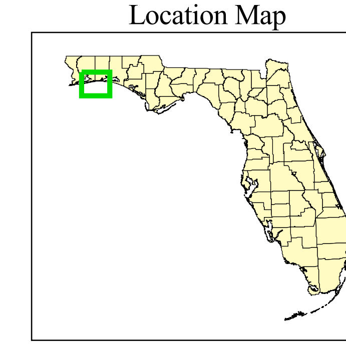
Hydrology

Model Boundary

Velocities (ft/d)

0.015
0.013
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001

Location Map

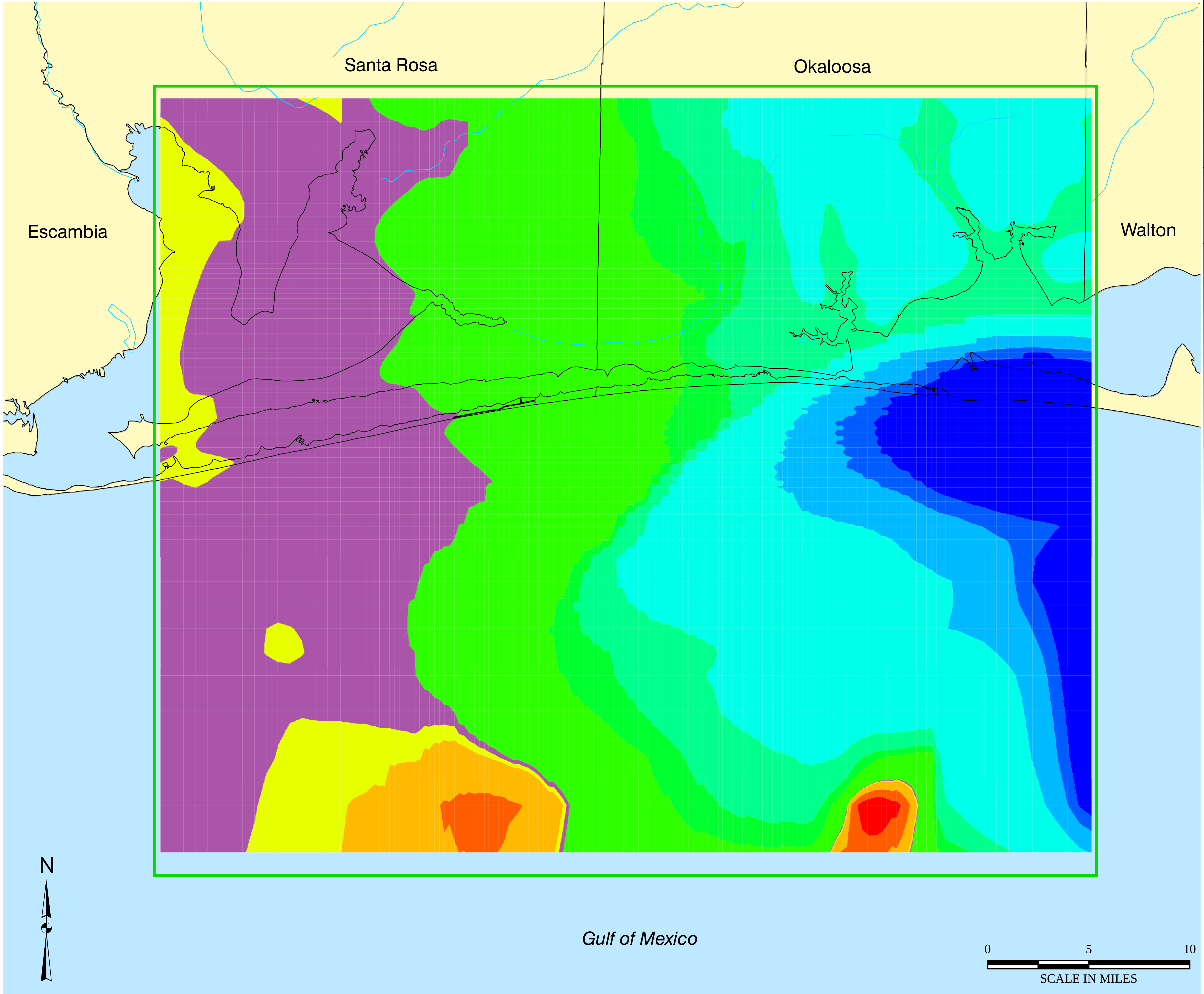


Filename: X:\NWF002\003-07\Old_figures\lf_velocity_1998.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 11/08/04 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.31
1998 Vertical Darcy Velocities for the Intermediate System (Elemental Layer 19)

Northwest Florida Water Management District



Legend

County Boundary

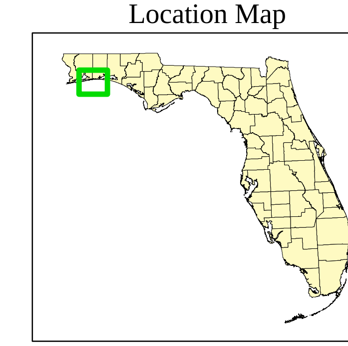
Hydrology

Model Boundary

Velocities (ft/d)

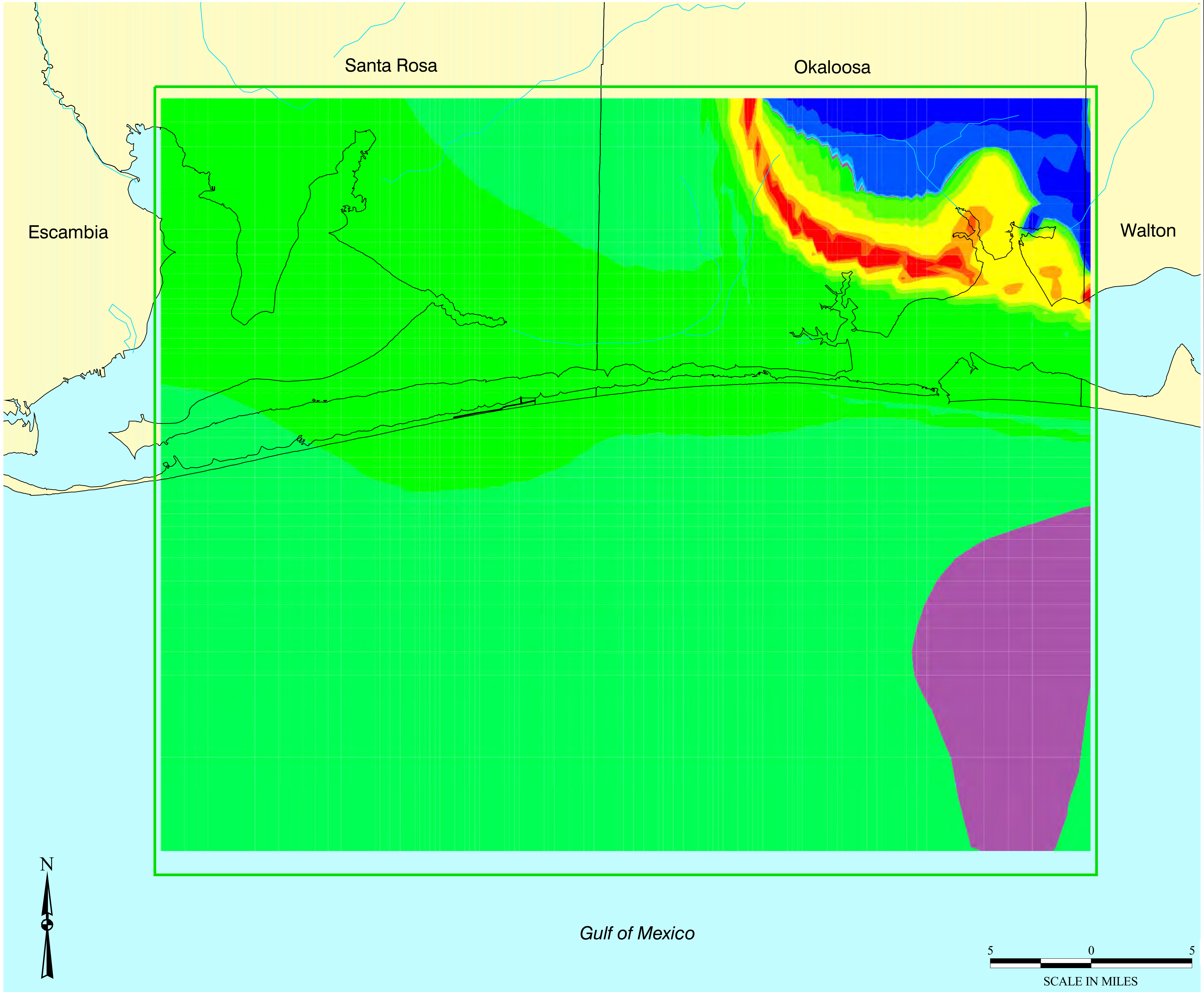
2.00E-06
1.00E-06
1.00E-07
0.00E+00
-1.00E-07
-3.00E-06
-5.00E-06
-1.00E-05
-5.00E-05
-8.00E-05
-1.00E-04

Location Map



Note: Negative velocity indicates downward flow

Filename: X:/NWF002/004-06/Maps/velz19_1998.mxd
Project: NWF002-004-06
Revised: 04/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.32
1998 Vertical Darcy Velocities for the Bucatunna Clay Confining Unit and Middle Portion of the Undifferentiated Floridan Aquifer System (Elemental Layer 11)

Northwest Florida Water Management District

Legend

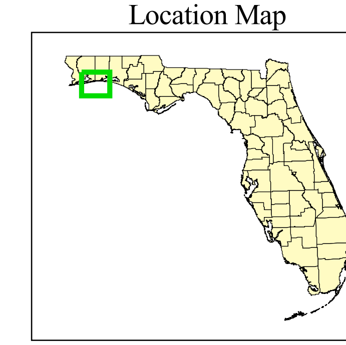
County Boundary

Hydrology

Model Boundary

Velocities (ft/d)

1.00E-03
8.00E-04
5.00E-04
1.00E-04
5.00E-05
1.10E-05
1.00E-06
0.00E+00
-3.00E-06
-5.00E-06
-1.00E-05
-5.00E-05



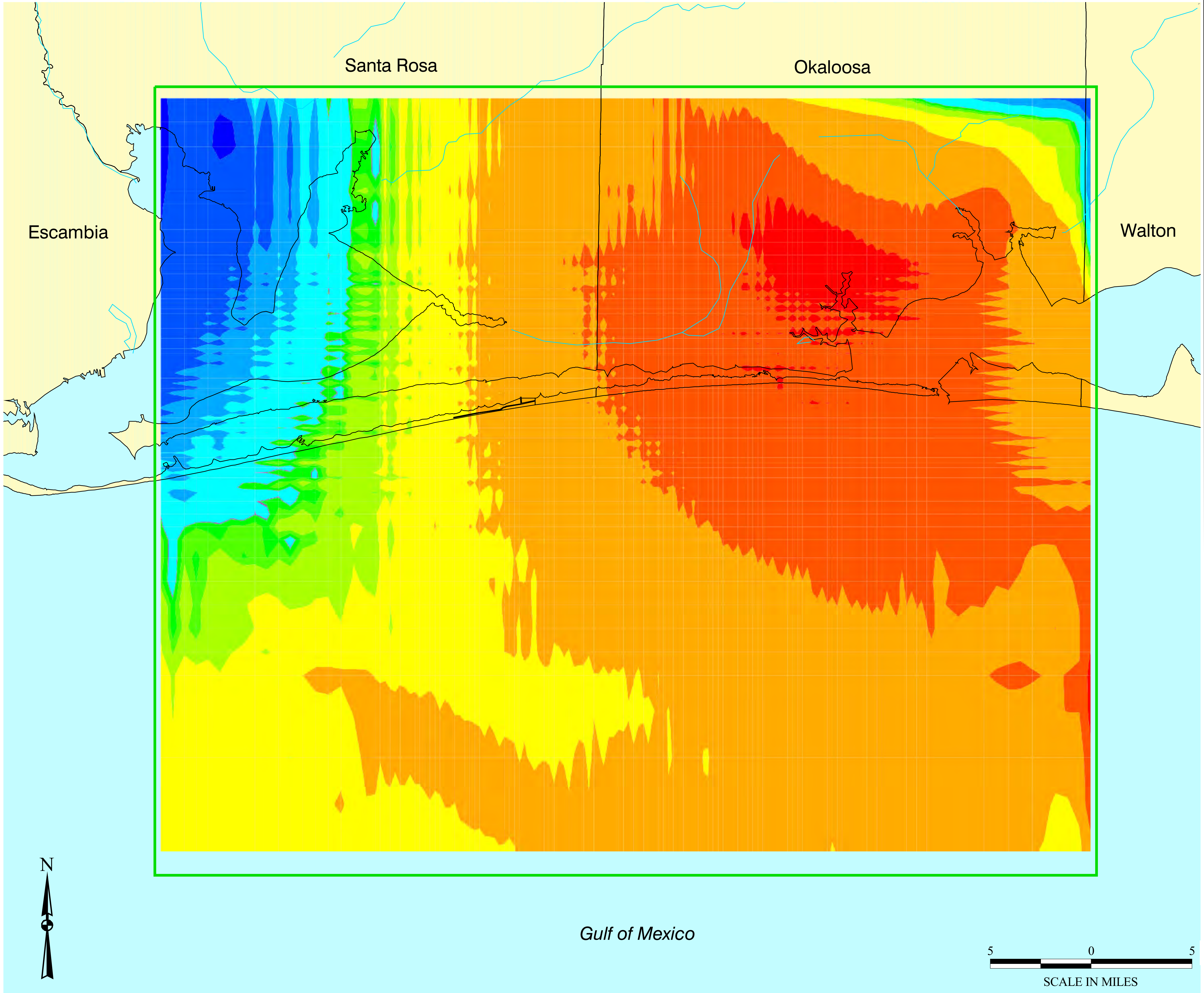
Note: Negative velocity indicates downward flow

Filename: X:\NWF002\003-07\Old_figures\velz11_1998.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 04/28/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.33
1998 Vertical Darcy Velocities for the Sub-Floridan (Elemental Layer 2)

Northwest Florida Water Management District



Legend

County Boundary

Hydrology

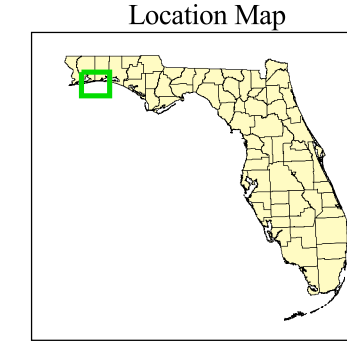
Model Boundary

Velocities (ft/d)

3.00E-05
2.00E-05
1.00E-05
5.00E-06
2.00E-06
1.00E-06
1.00E-07
0.00E+00
-1.00E-07
-5.00E-06
-1.00E-05
-5.00E-05

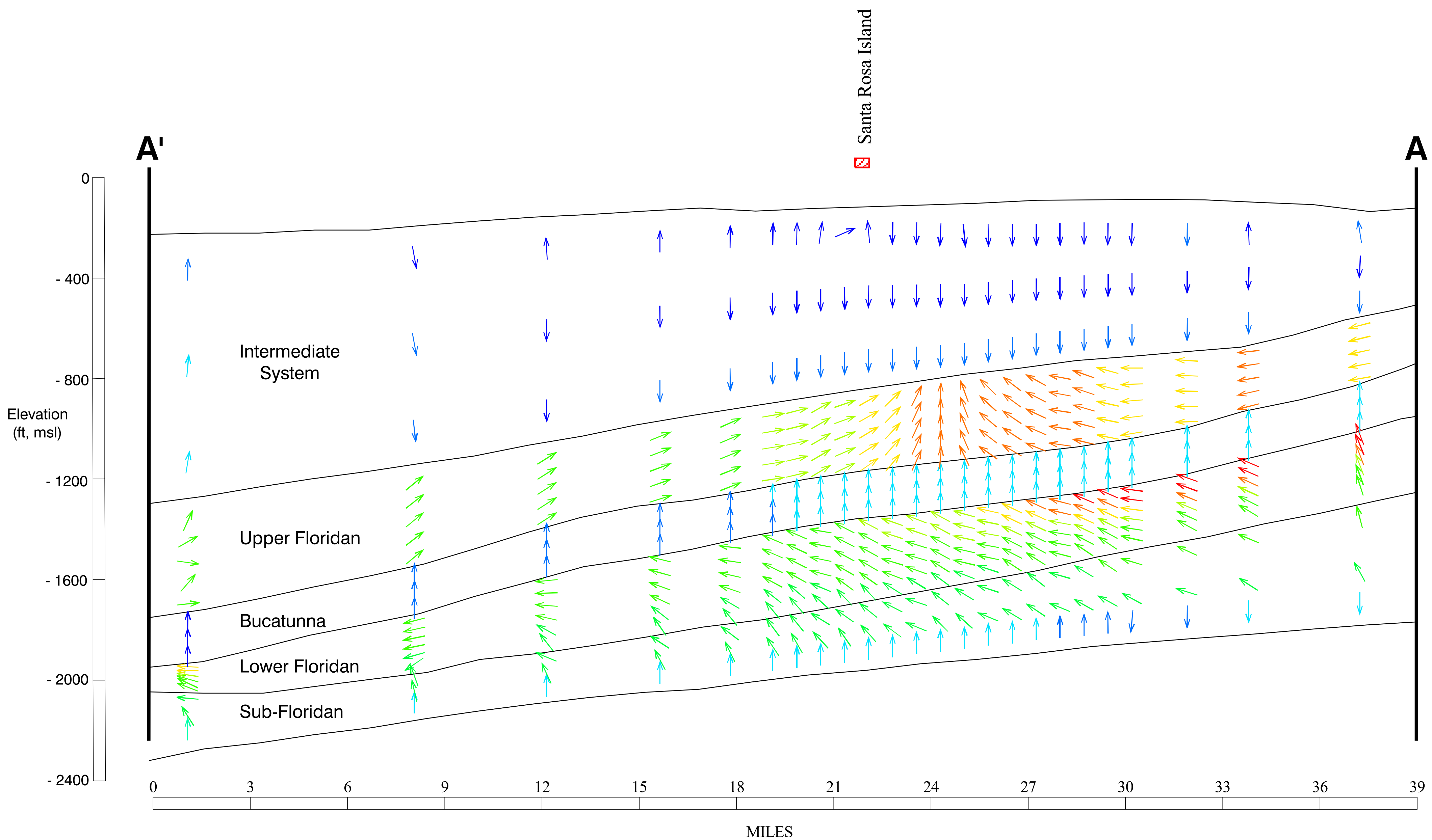
Note: Negative velocity indicates downward flow

Location Map



Filename: X:\NWF002\003-07\Old_figures\velz2_1998.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 04/28/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HYDRO GeoLogic INC.



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.34
1998 Darcy Velocities for Cross-Section A-A'

Northwest Florida Water Management District

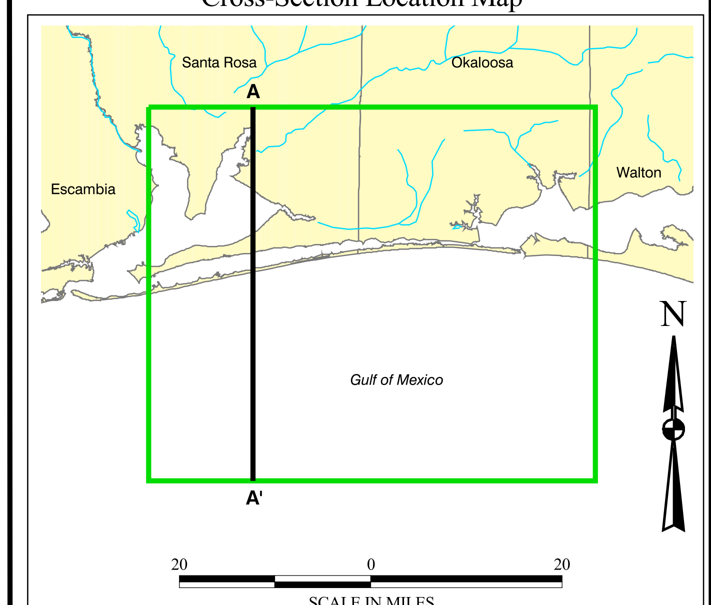
Legend

Velocities (ft/d)

0.012
0.01
0.008
0.005
0.001
0.0001
1E-05
1E-06
1E-07

Vertical Exaggeration 41:1

Cross-Section Location Map

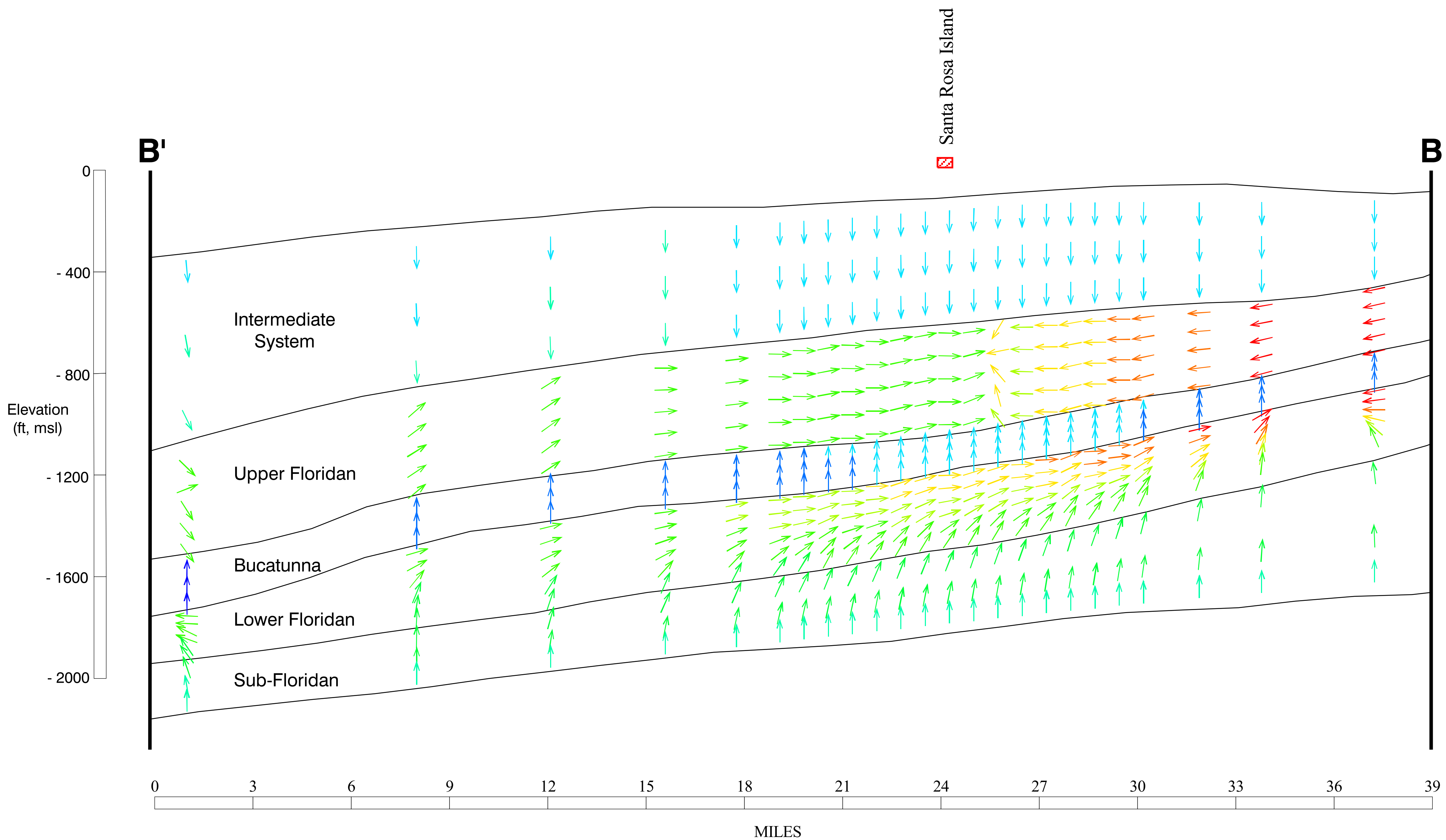


Filename: X:\NWF002\003-07\Old_figures\aa'vel_1998.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 04/29/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.35
1998 Darcy Velocities for Cross-Section B-B'

Northwest Florida Water Management District



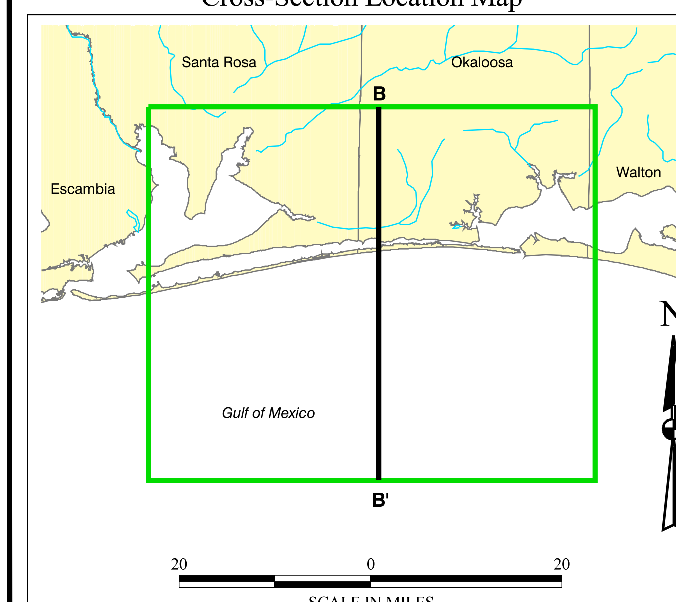
Legend

Velocities (ft/d)

0.02
0.015
0.01
0.005
0.001
0.0001
1E-05
1E-06
1E-07

Vertical Exaggeration 41:1

Cross-Section Location Map

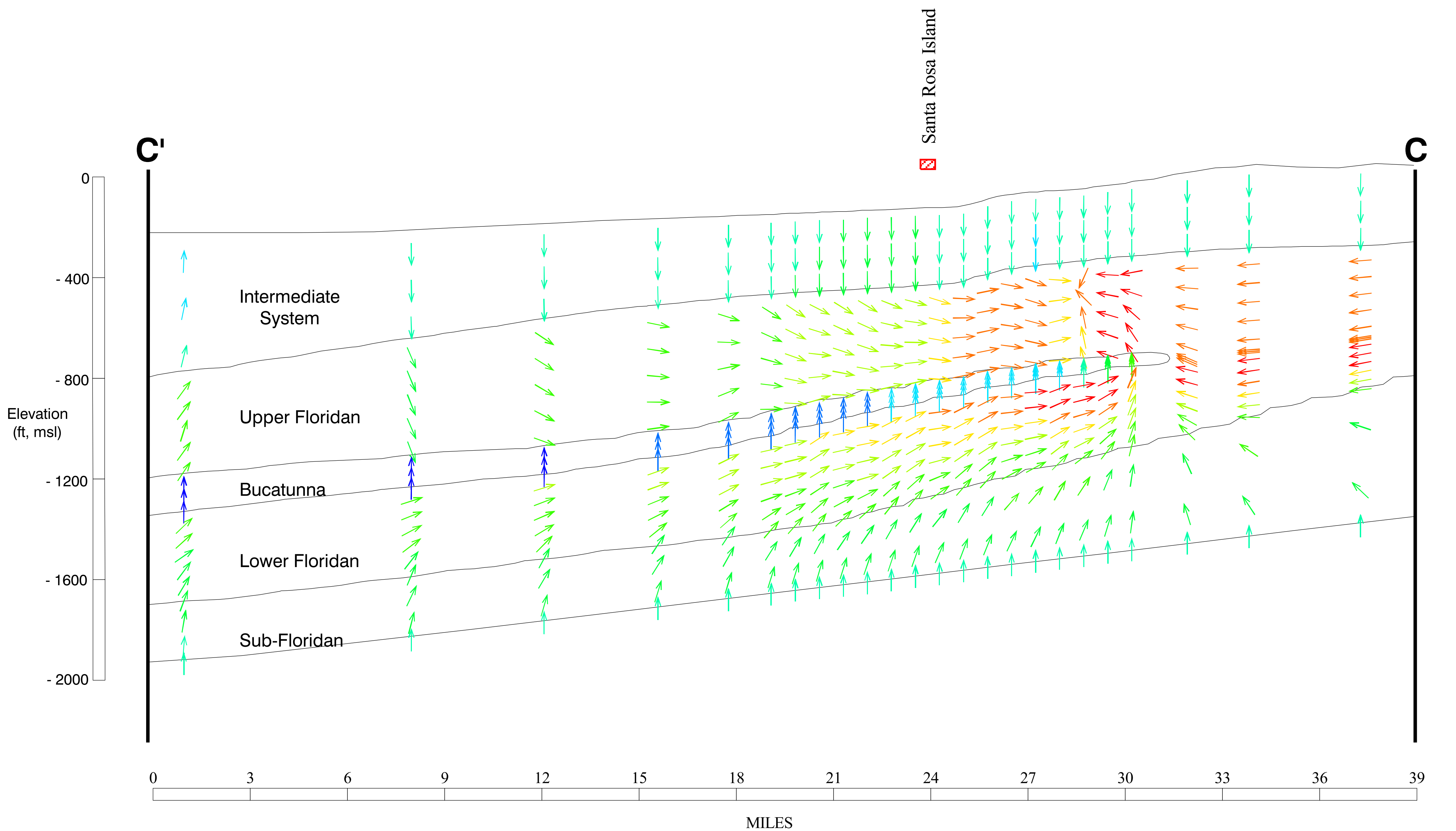


Filename: X:\NWF002\003-07\Old_figures\bb'vel_1998.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 04/29/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.36
1998 Darcy Velocities for Cross-Section C-C'

Northwest Florida Water Management District



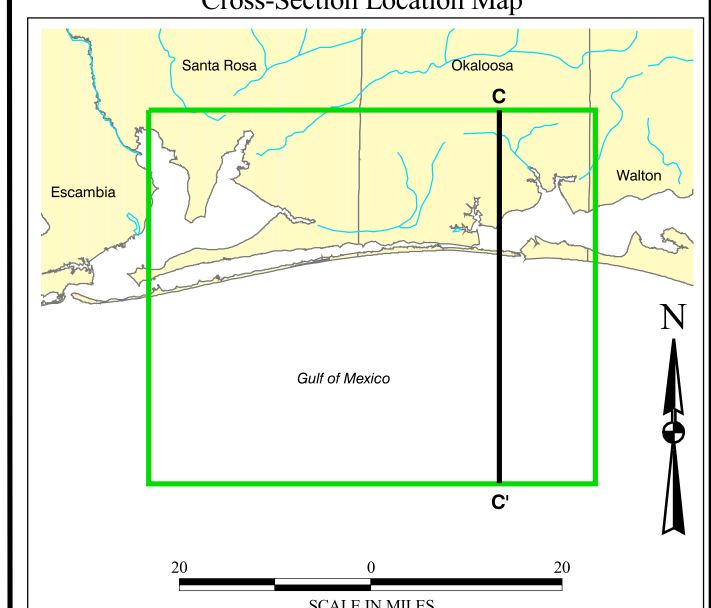
Legend

Velocities (ft/d)

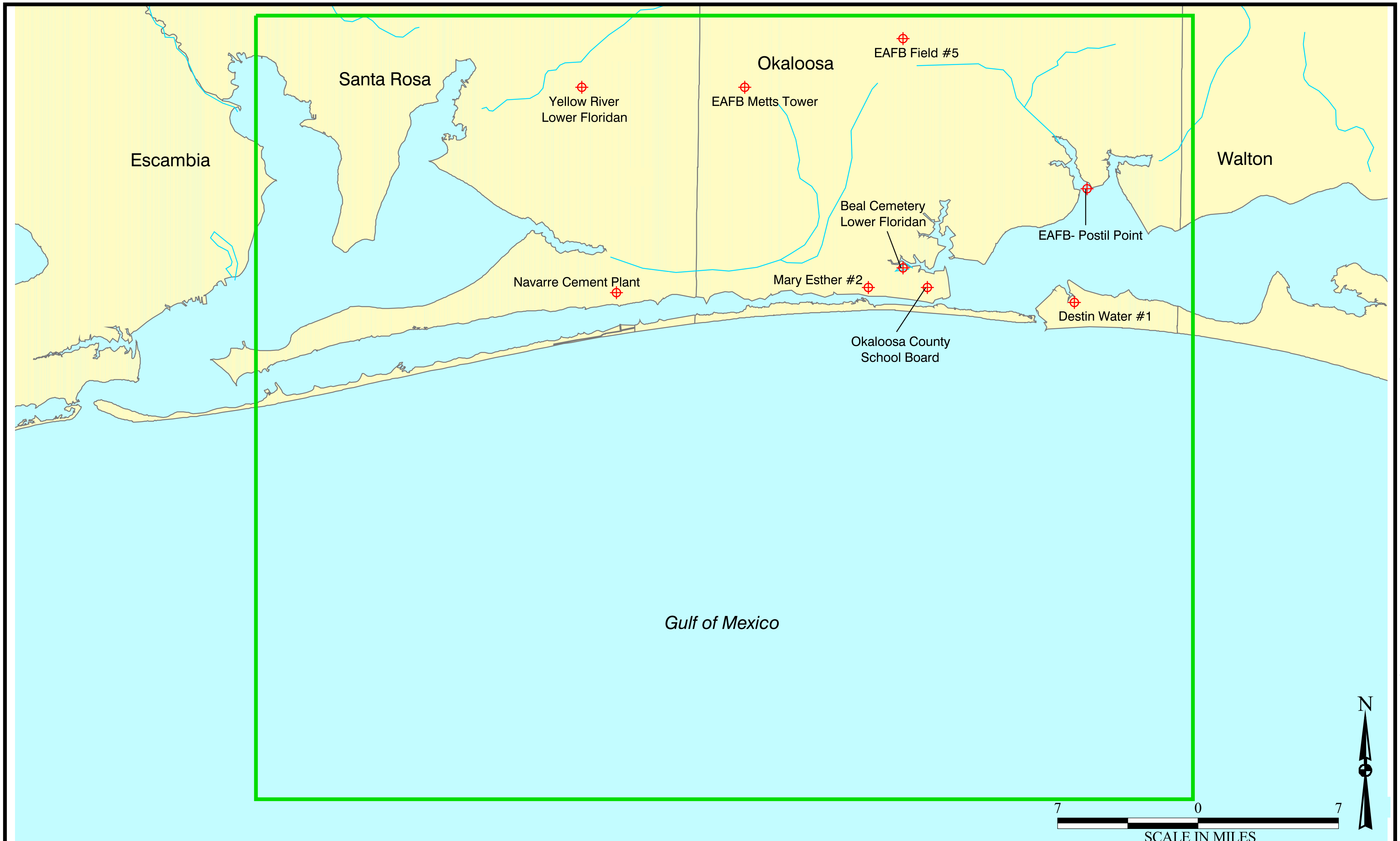
- 0.02
- 0.015
- 0.01
- 0.005
- 0.001
- 0.0001
- 1E-05
- 1E-06
- 1E-07

Vertical Exaggeration 41:1

Cross-Section Location Map



Filename: X:\NWF002\003-07\Old_figures\cc'vel_1998.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 08/05/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002



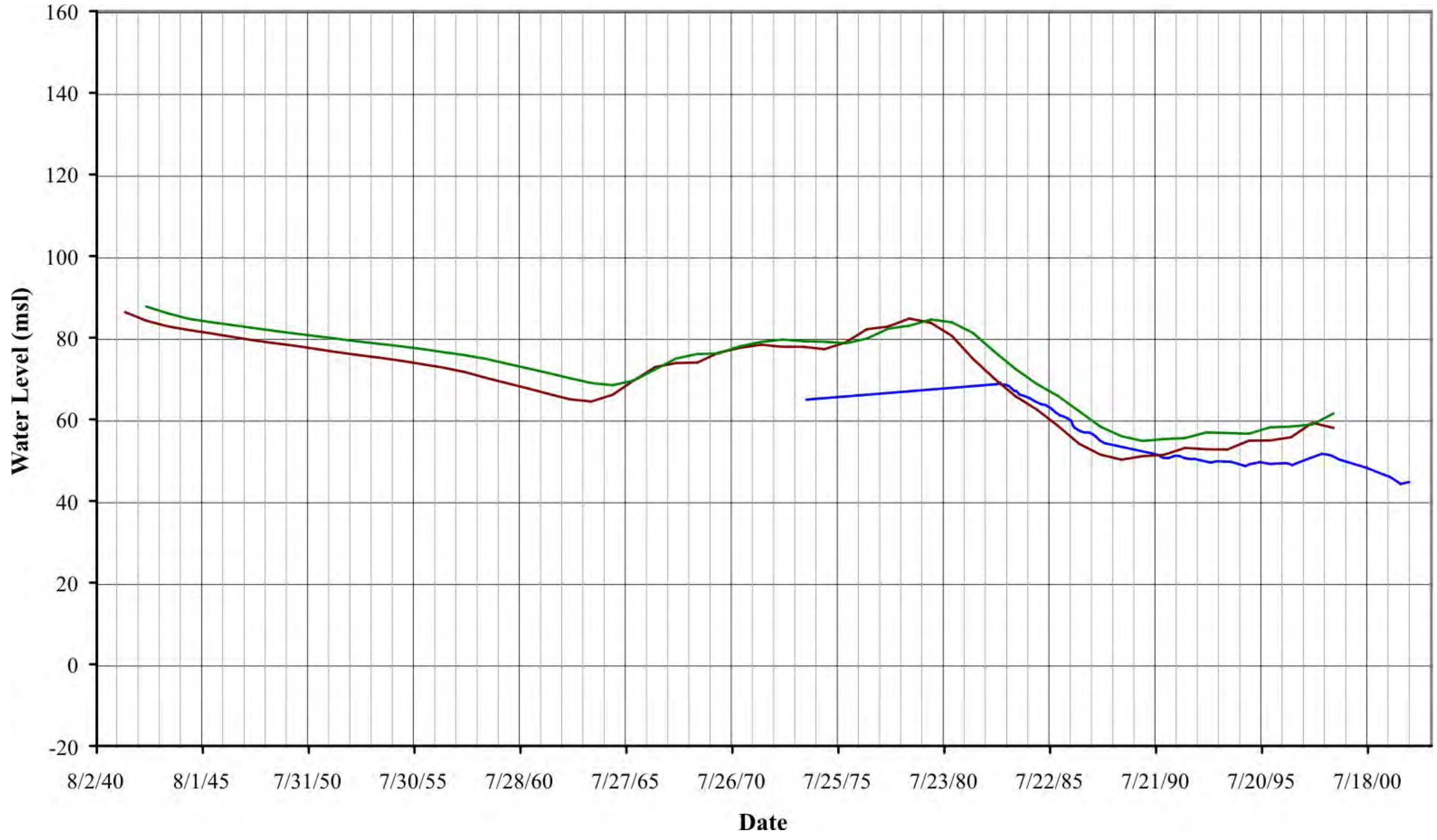
HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Old_figures \water_level_loc.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 09/08/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

Legend

- County Boundary
- Hydrology
- Model Boundary
- Well

Figure 4.37
Water Level Location Map



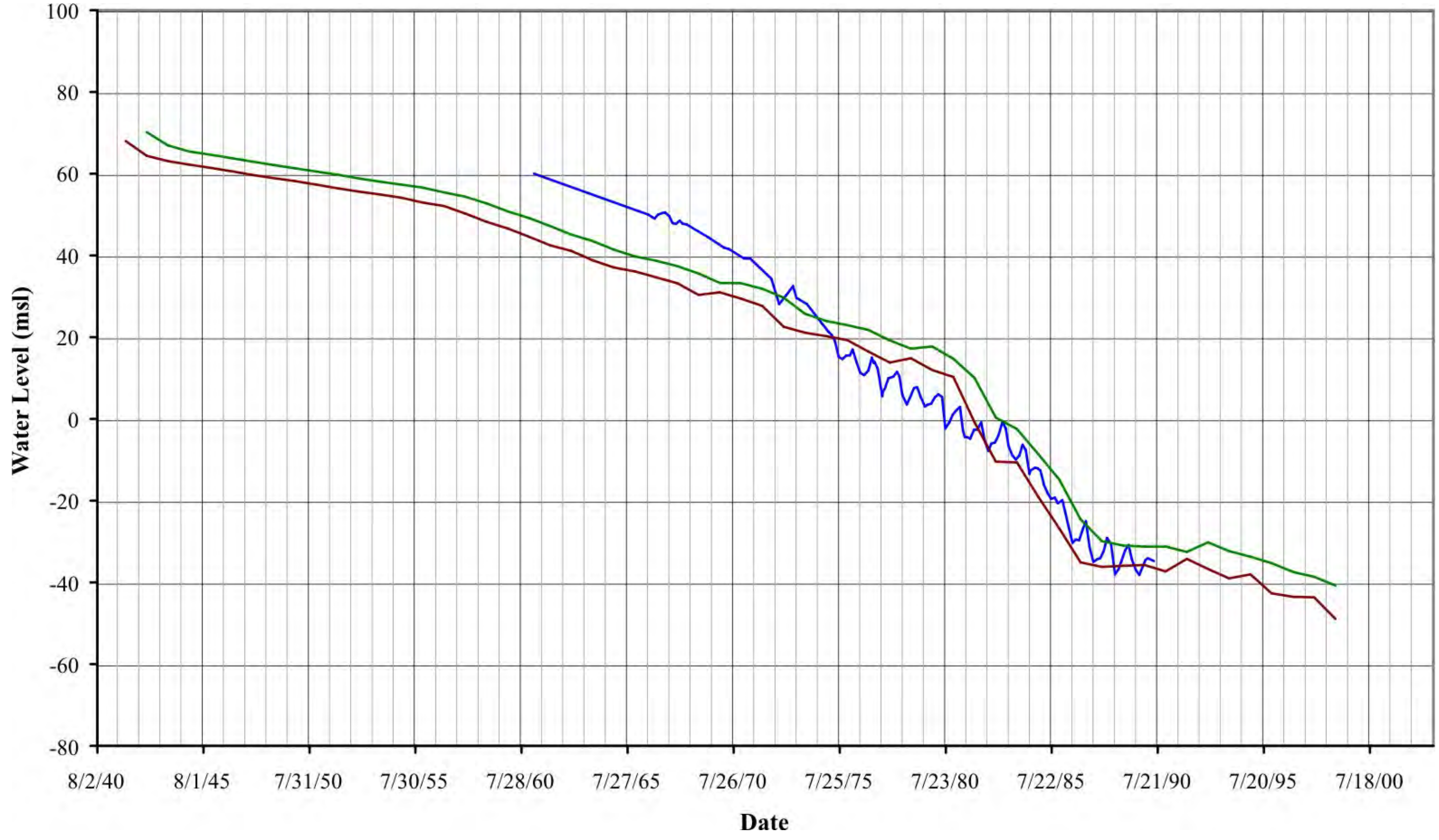
X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Environmental Head

Figure 4.38
Yellow River - Lower Floridan
NWF ID 3555
Water Level

HydroGeoLogic, Inc.—Northwest Florida Water Management District



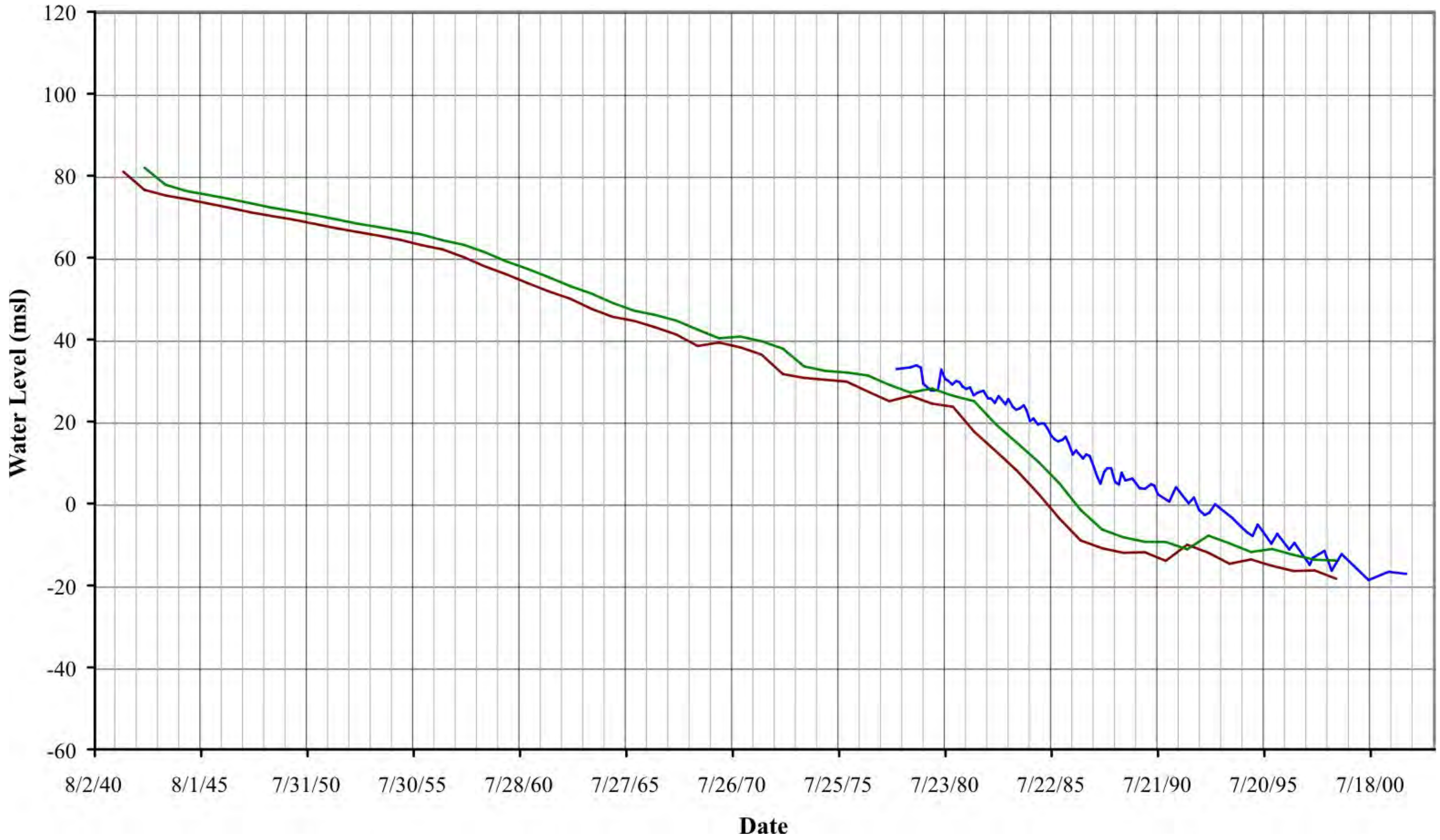
HydroGeoLogic, Inc.—Northwest Florida Water Management District

X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Freshwater Equivalent Head

Figure 4.39
Navarre Cement Plant
NWF ID 1839
Water Level



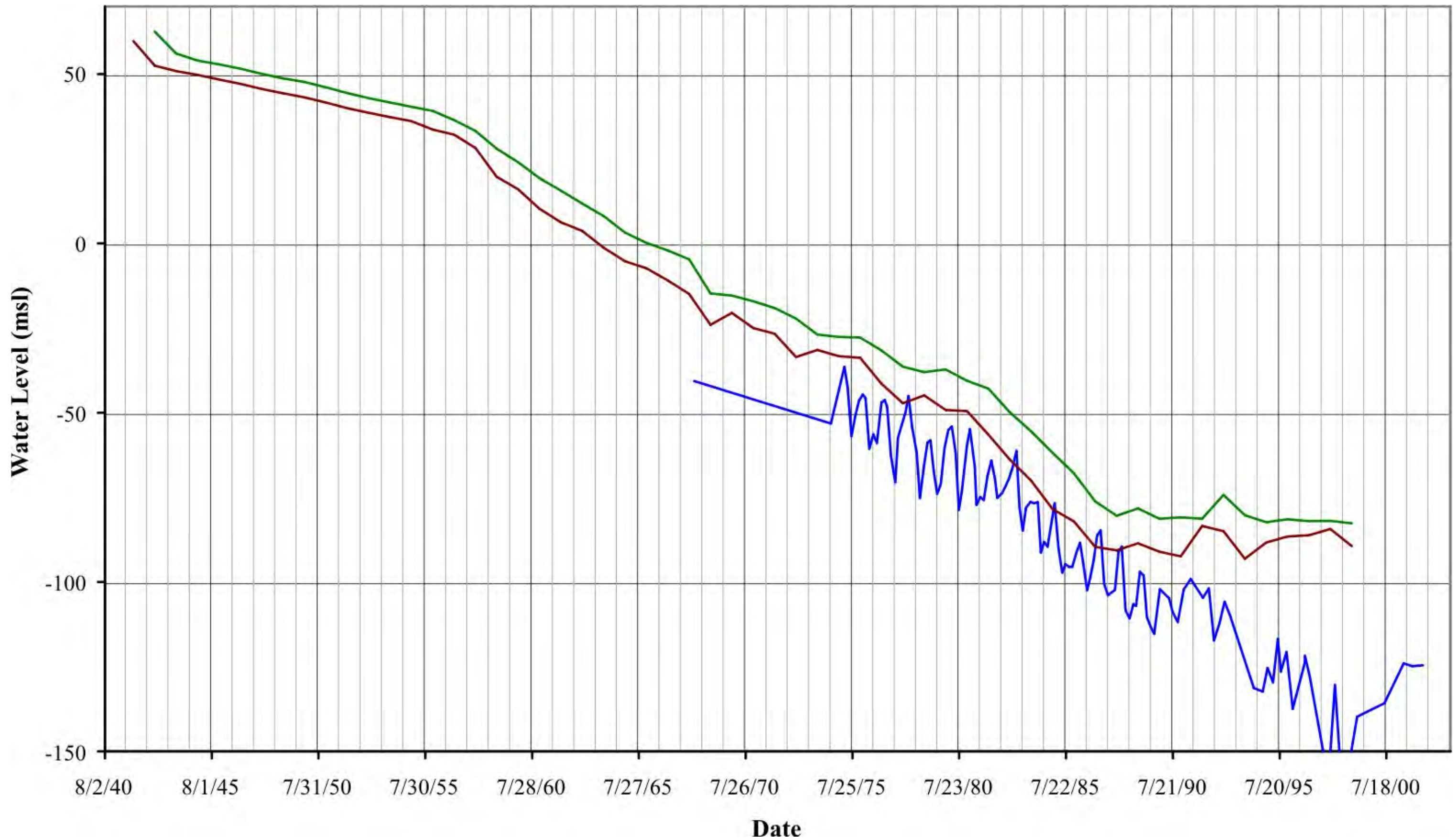
HydroGeoLogic, Inc.—Northwest Florida Water Management District

X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Freshwater Equivalent Head

Figure 4.40
EAFB Metts Tower
NWF ID 3642
Water Level

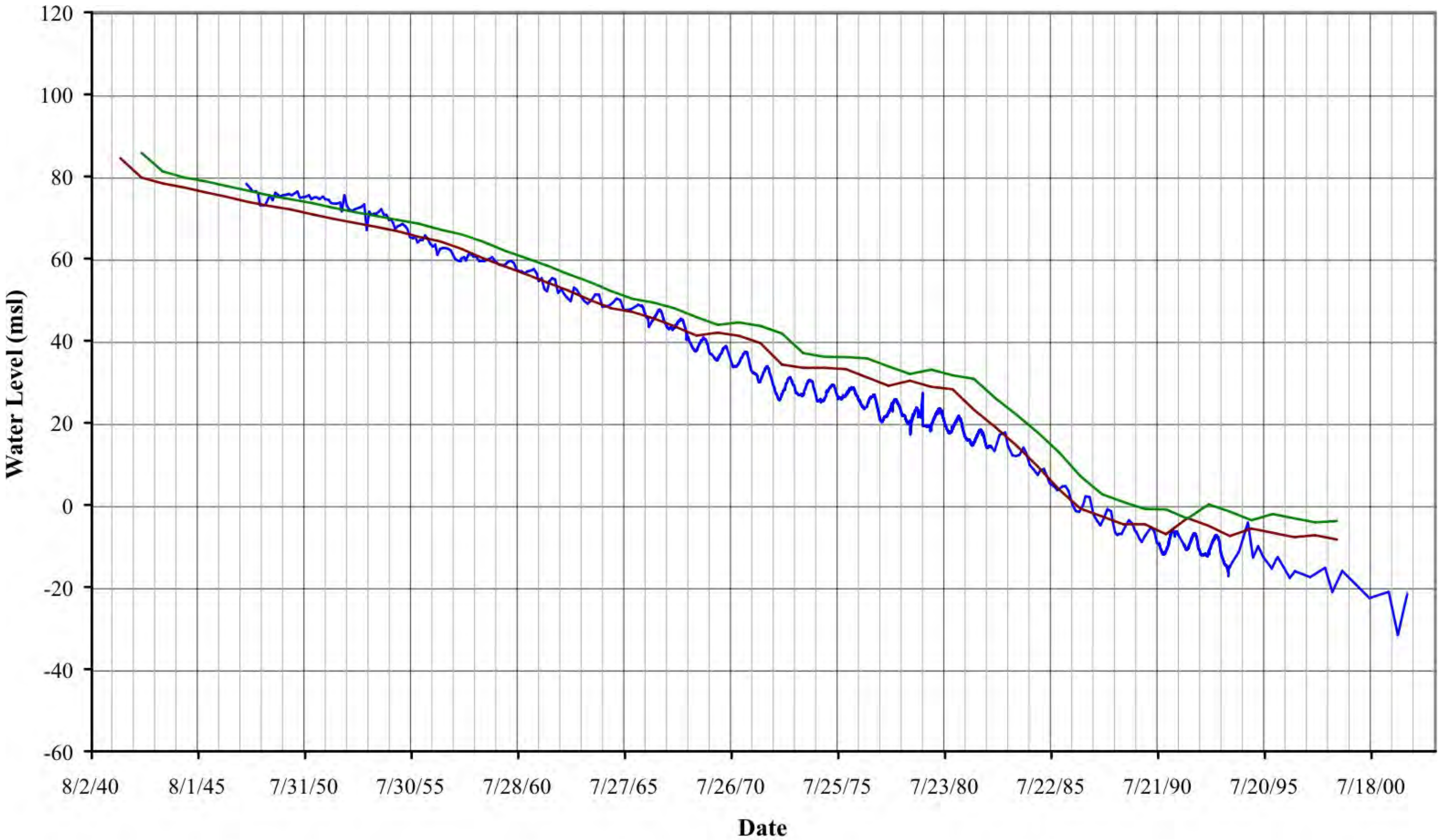


X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Freshwater Equivalent Head

Figure 4.41
Mary Esther #2
NWF ID 2035
Water Level



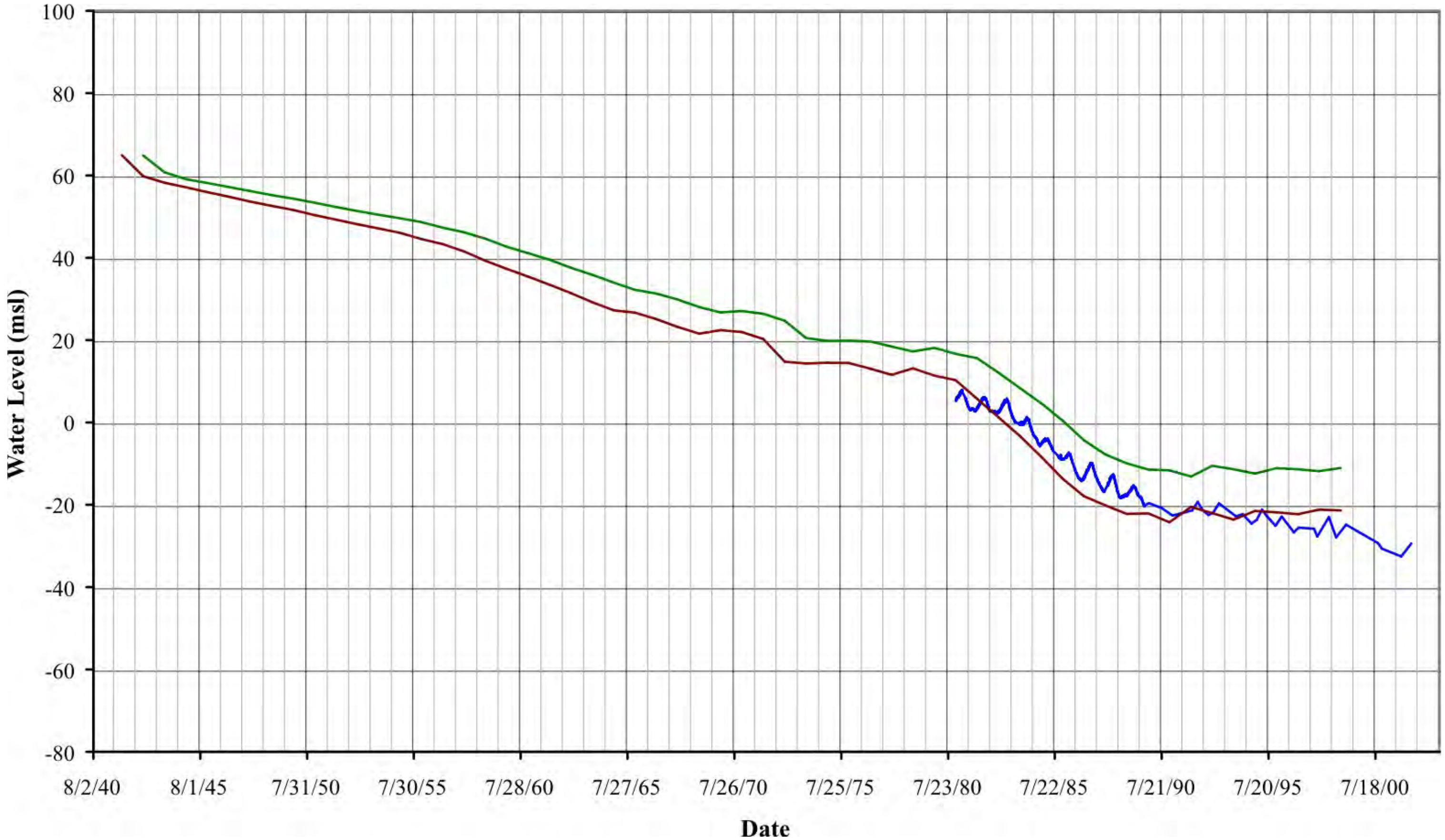
HydroGeoLogic, Inc.—Northwest Florida Water Management District

X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Freshwater Equivalent Head

Figure 4.42
EAFB Field #5
NWF ID 3923
Water Level



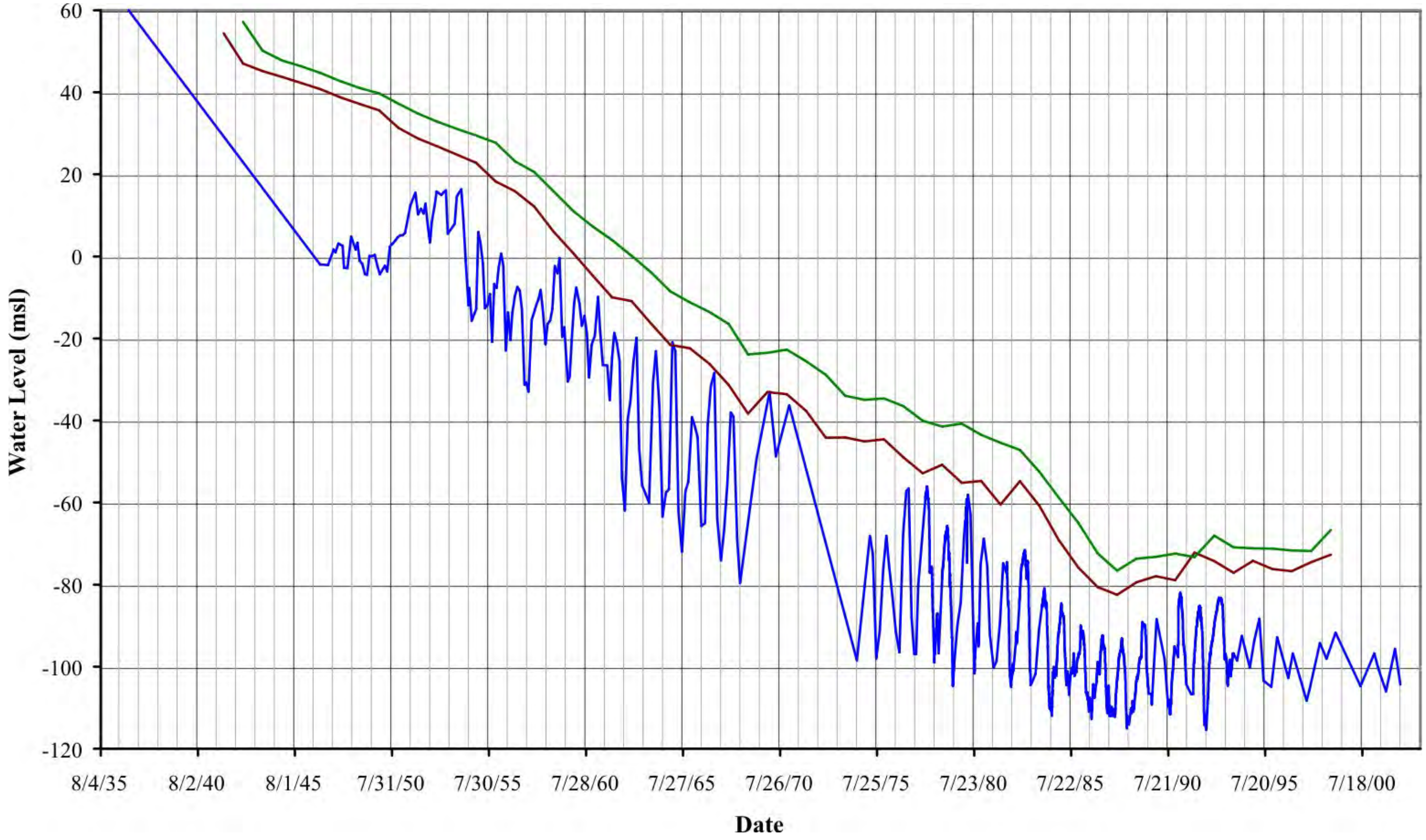
HydroGeoLogic, Inc.—Northwest Florida Water Management District

X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Environmental Head

Figure 4.43
Beal Cemetery - Lower Floridan
NWF ID 2173
Water Level



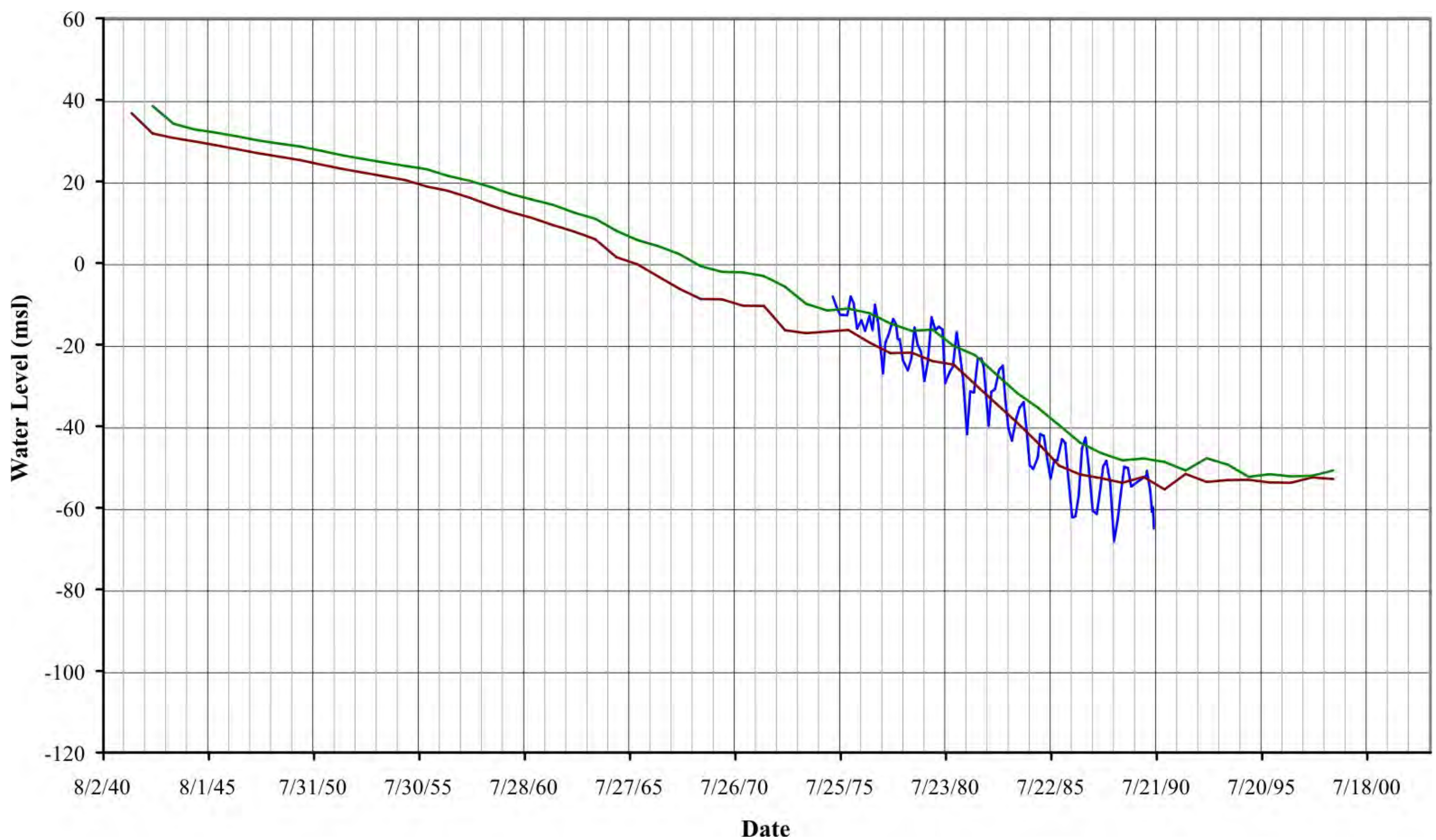
HydroGeoLogic, Inc.—Northwest Florida Water Management District

X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Freshwater Equivalent Head

Figure 4.44
Okaloosa County School Board
NWF ID 1894
Water Level



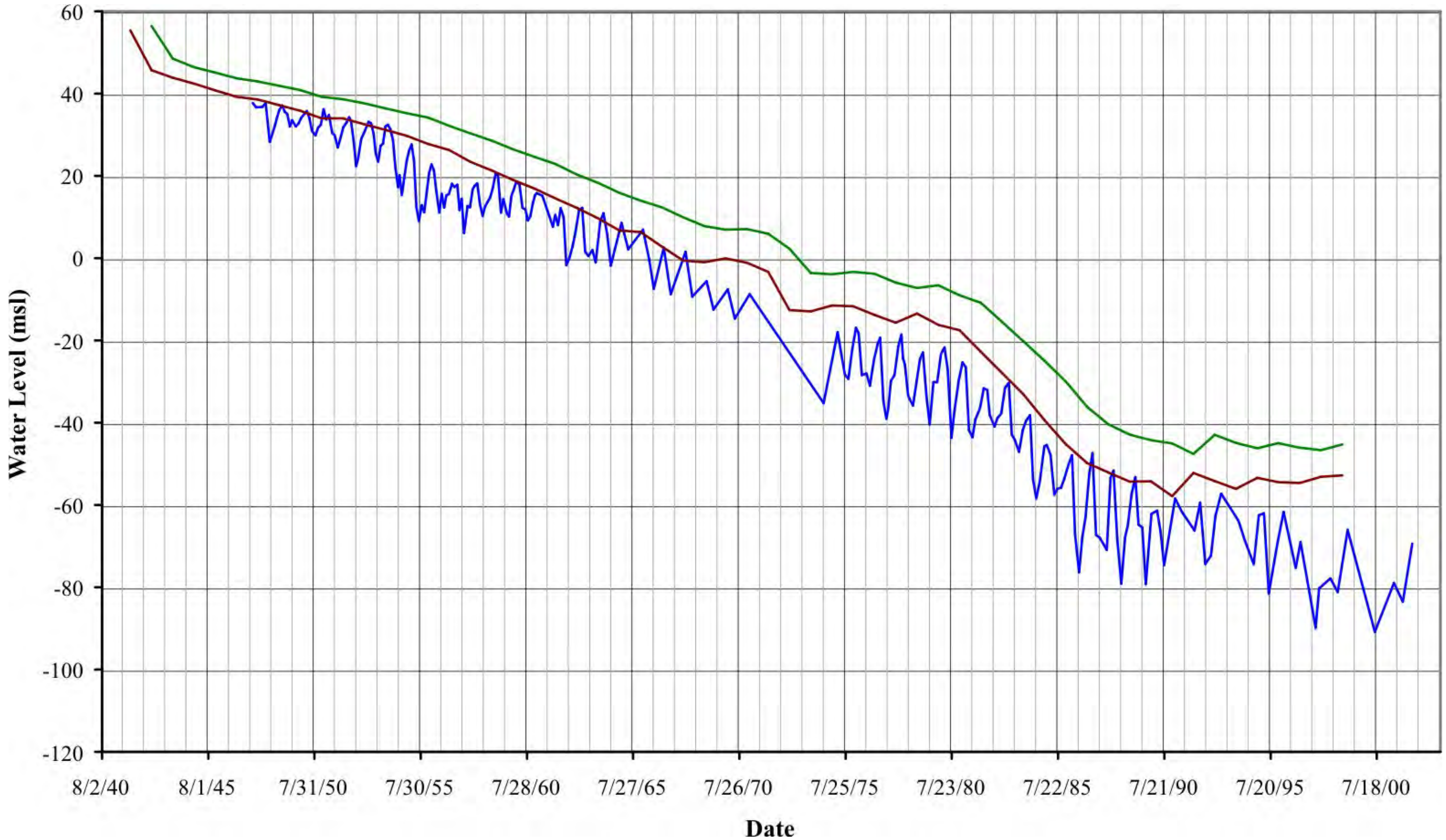
HydroGeoLogic, Inc.—Northwest Florida Water Management District

X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Freshwater Equivalent Head

Figure 4.45
Destin Water #1
NWF ID 1687
Water Level



HydroGeoLogic, Inc.—Northwest Florida Water Management District

X:\NWF002\003-07\Graphs.cdr
Project: NWF002-003-07
Created by: ACarriger 05/05/03
Revised:04/11/05 CF

Legend

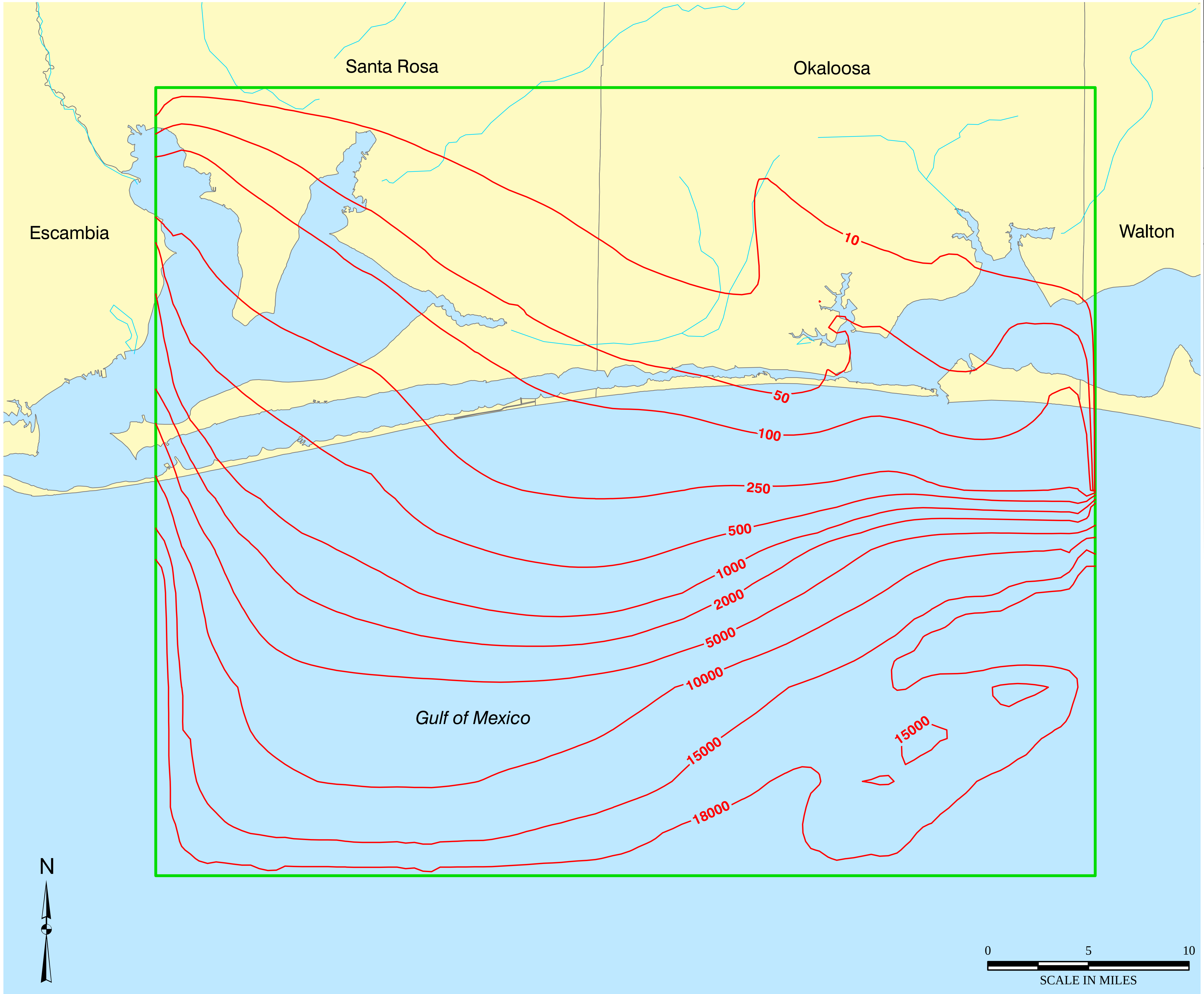
- Observed Water Level
- MODFLOW Simulated Head
- DSTRAM Simulated Freshwater Equivalent Head

Figure 4.46
EAFB - Postil Point
NWF ID 2994
Water Level

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.47
1998 Chloride Concentration for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)

Northwest Florida Water Management District



Legend

County Boundary

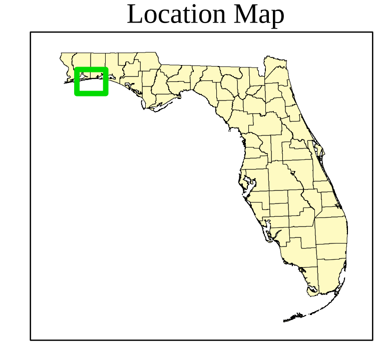
Hydrology

250 Chloride Concentration (mg/l)

Model Boundary

Note: Effective porosity = 0.25

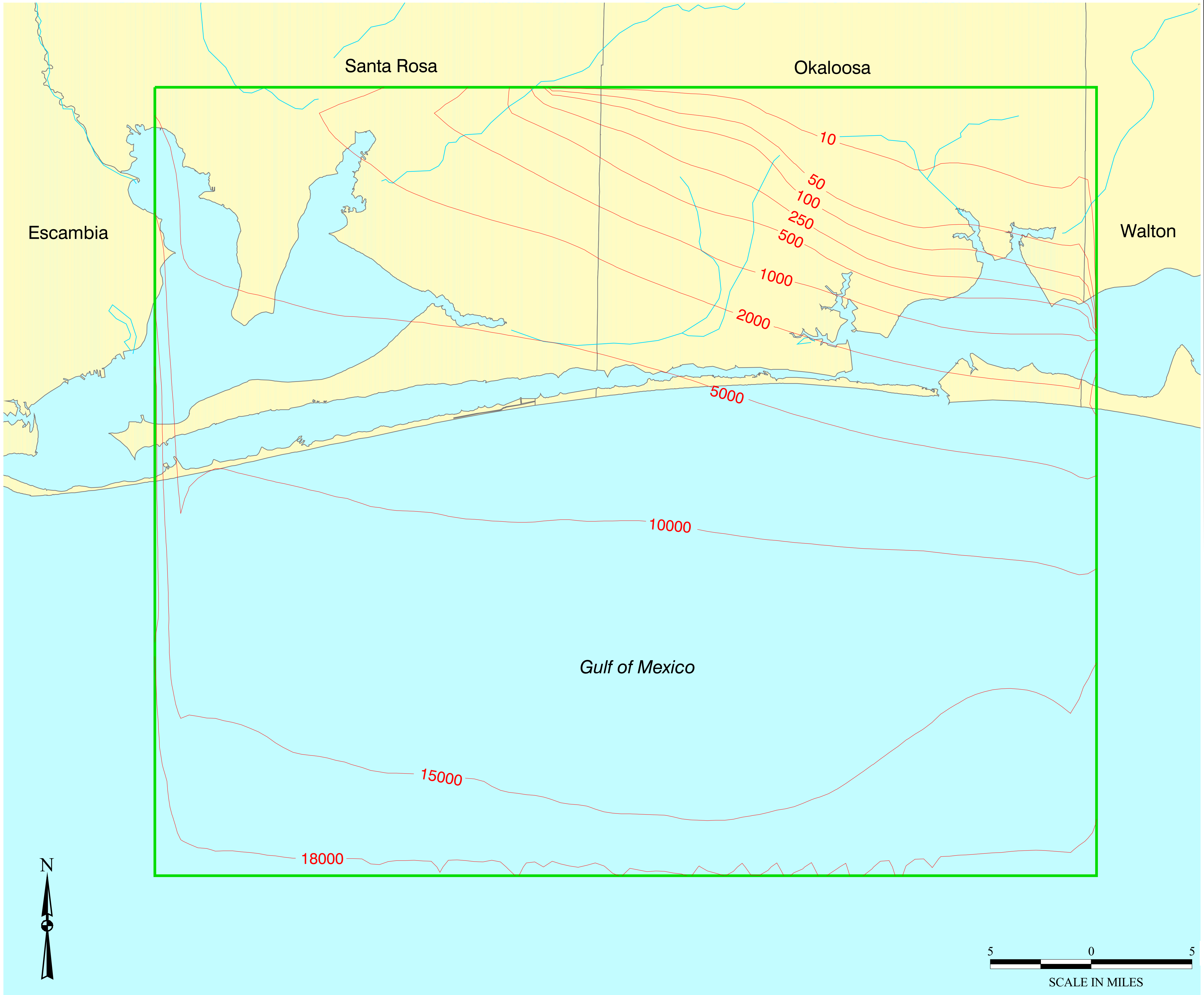
Location Map



Filename: X:/NWF002/003-07/Maps/chloride_16_1998.mxd
Project: NWF002-003-07
Revised: 07/25/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.48
1998 Chloride Concentration for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)



Northwest Florida Water Management District

Legend

County Boundary

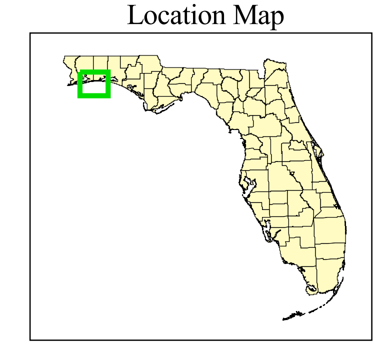
Hydrology

– 250 – Chloride Concentration (mg/l)

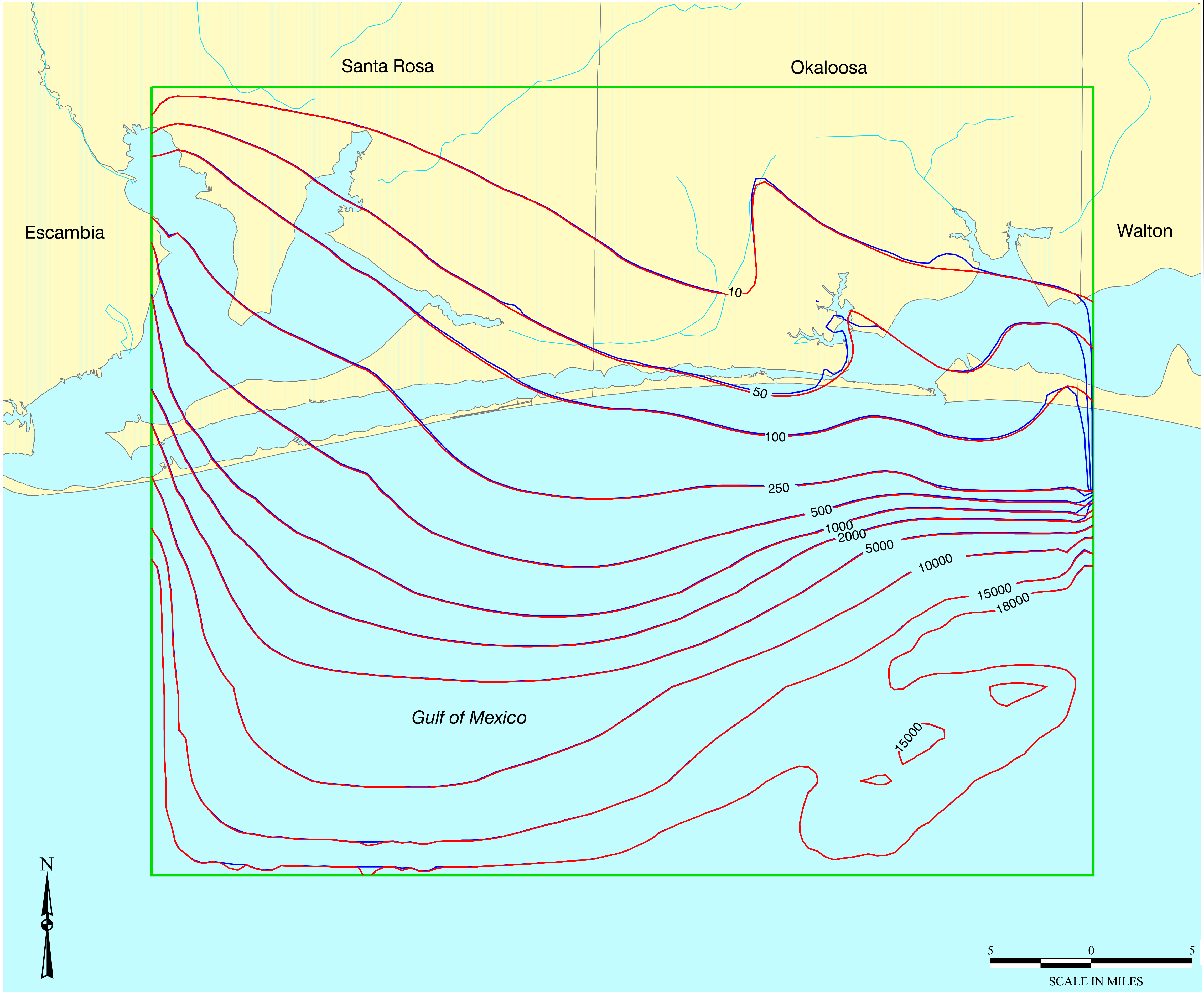
Model Boundary

Note: Effective porosity = 0.25

Location Map



Filename: X:\NWF002\003-07\Old_figures\chloride_07_1998.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 07/22/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.49
Pre-Development and 1998 Chloride Concentrations for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)

Northwest Florida Water Management District

Legend

County Boundary

Hydrology

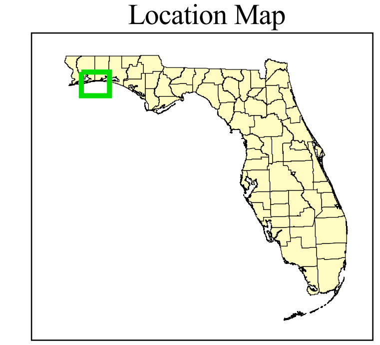
Model Boundary

250 Pre-Development Chloride Concentration (mg/l) (nx, ny, nz) = (146,72,21)

250 1998 Chloride Concentration (mg/l) (nx, ny, nz) = (146,72,21)

Note: Effective porosity = 0.25

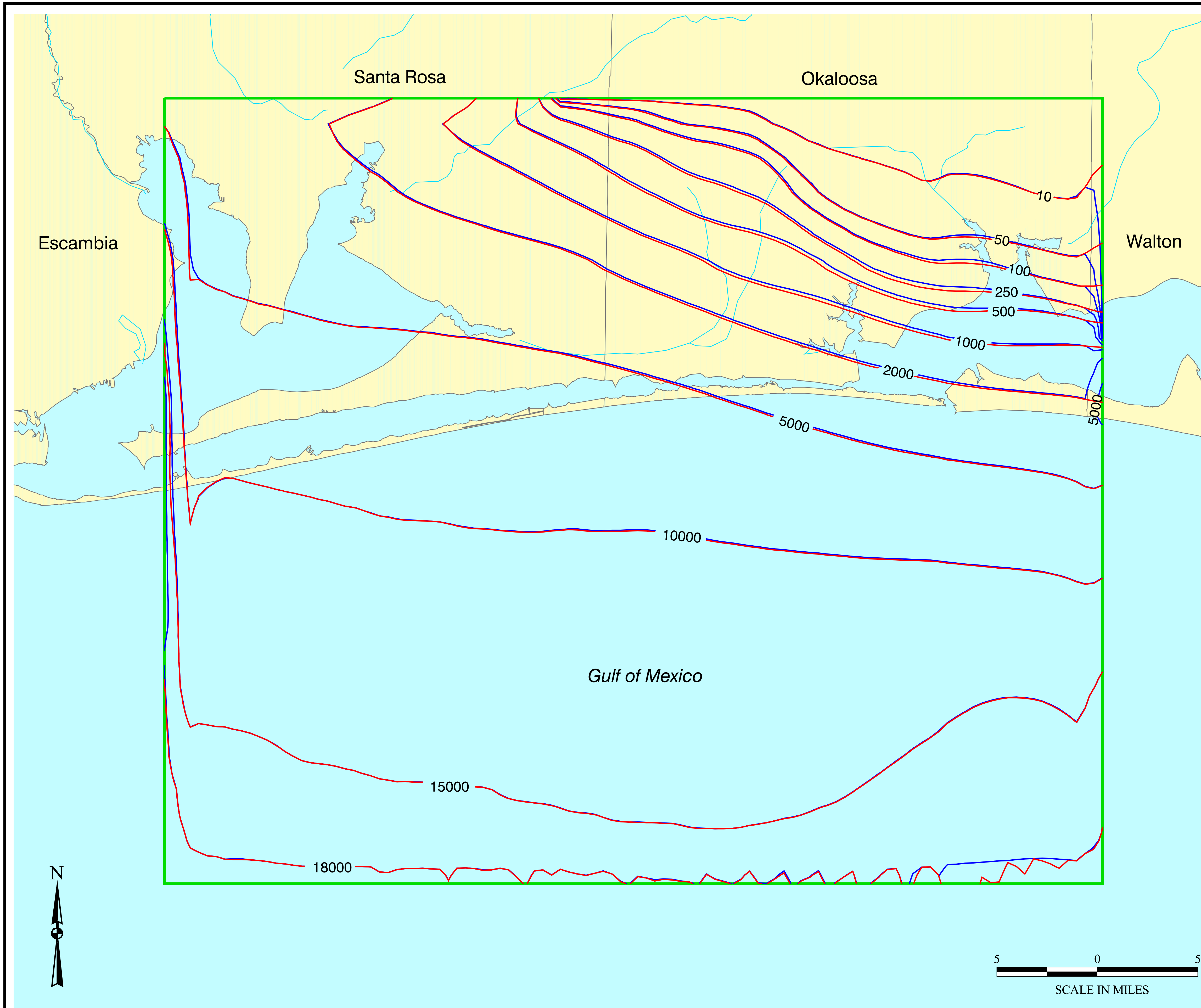
Location Map



Filename: X:\NWF002\003-07\Old_figures\chloride_16_pre-1998.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 07/22/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.50
Pre-Development and
1998 Chloride Concentrations for the
Lower Floridan Aquifer
(Nodal Layer 7, mid-aquifer)



Northwest Florida Water Management District

Legend

County Boundary

Hydrology

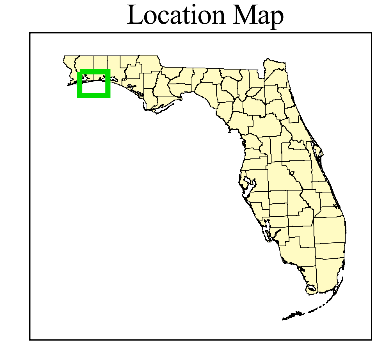
Model Boundary

250 Pre-Development Chloride Concentration (mg/l) (nx, ny, nz) = (146,72,21)

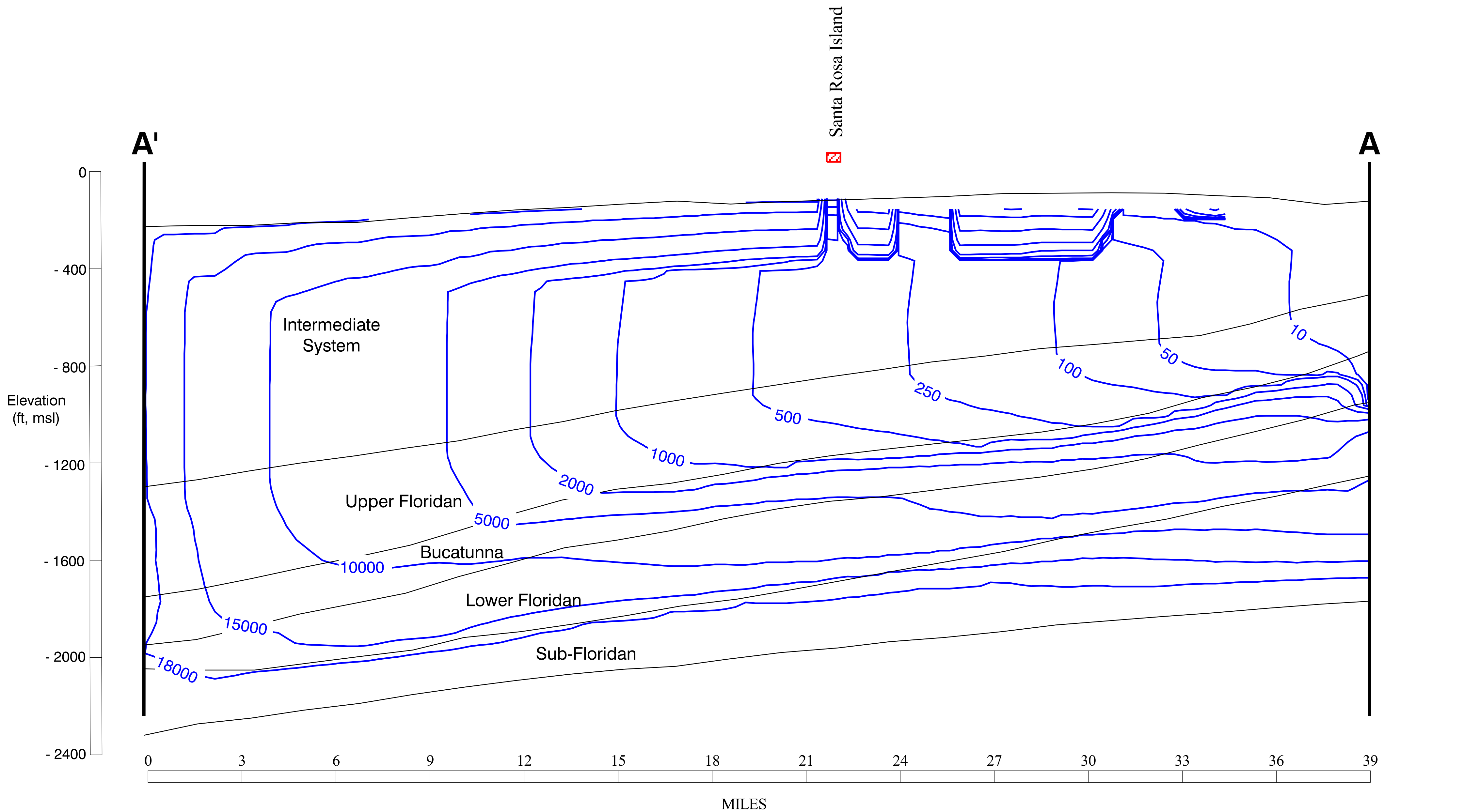
250 1998 Chloride Concentration (mg/l) (nx, ny, nz) = (146,72,21)

Note: Effective porosity = 0.25

Location Map



Filename: X:\NWF002\003-07\Old_figures\chloride_07_pre-1998.apr
Project: NWF002-003-07
Created: 05/15/02 tbraswell
Revised: 07/22/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.51
1998 Chloride Concentration for Cross-Section A-A'

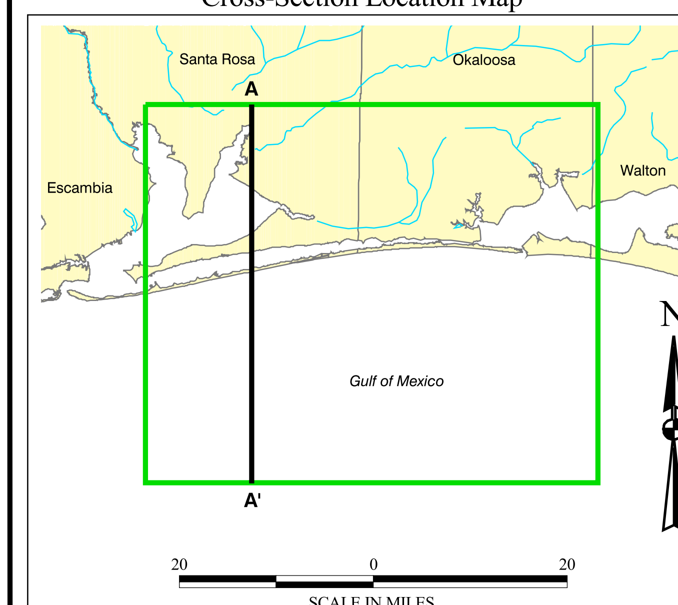
Northwest Florida Water Management District

Legend

Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map

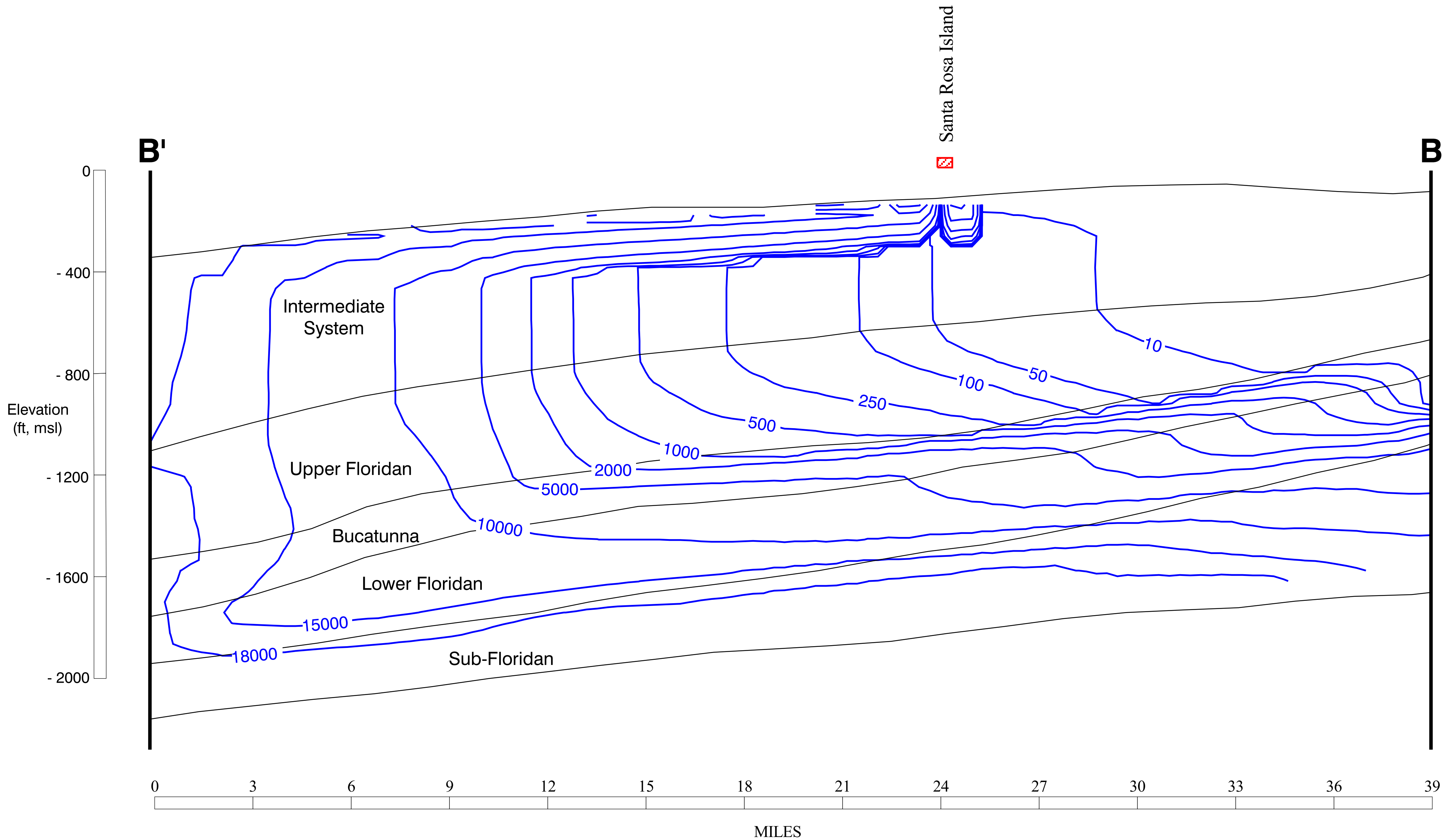


Filename: X:\NWF002\003-07\Old_figures\aa'Chlor_1998.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 11/08/04 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.52
1998 Chloride Concentration for Cross-Section B-B'

Northwest Florida Water Management District

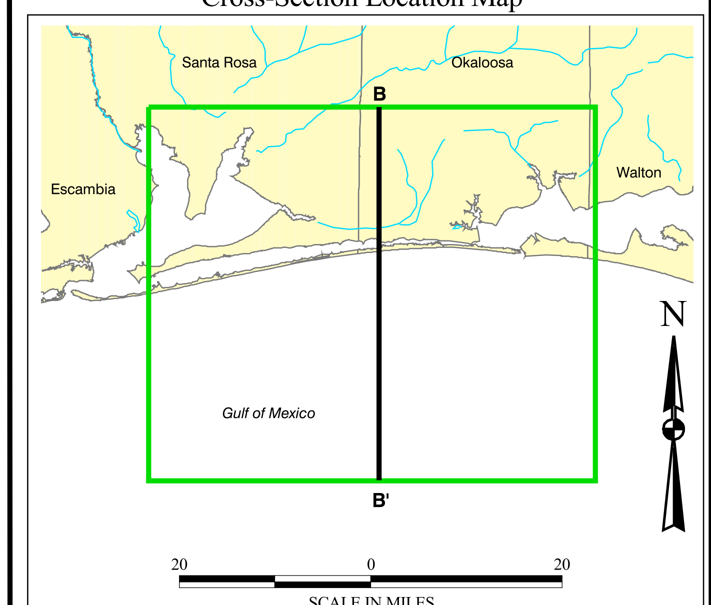


Legend

Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map

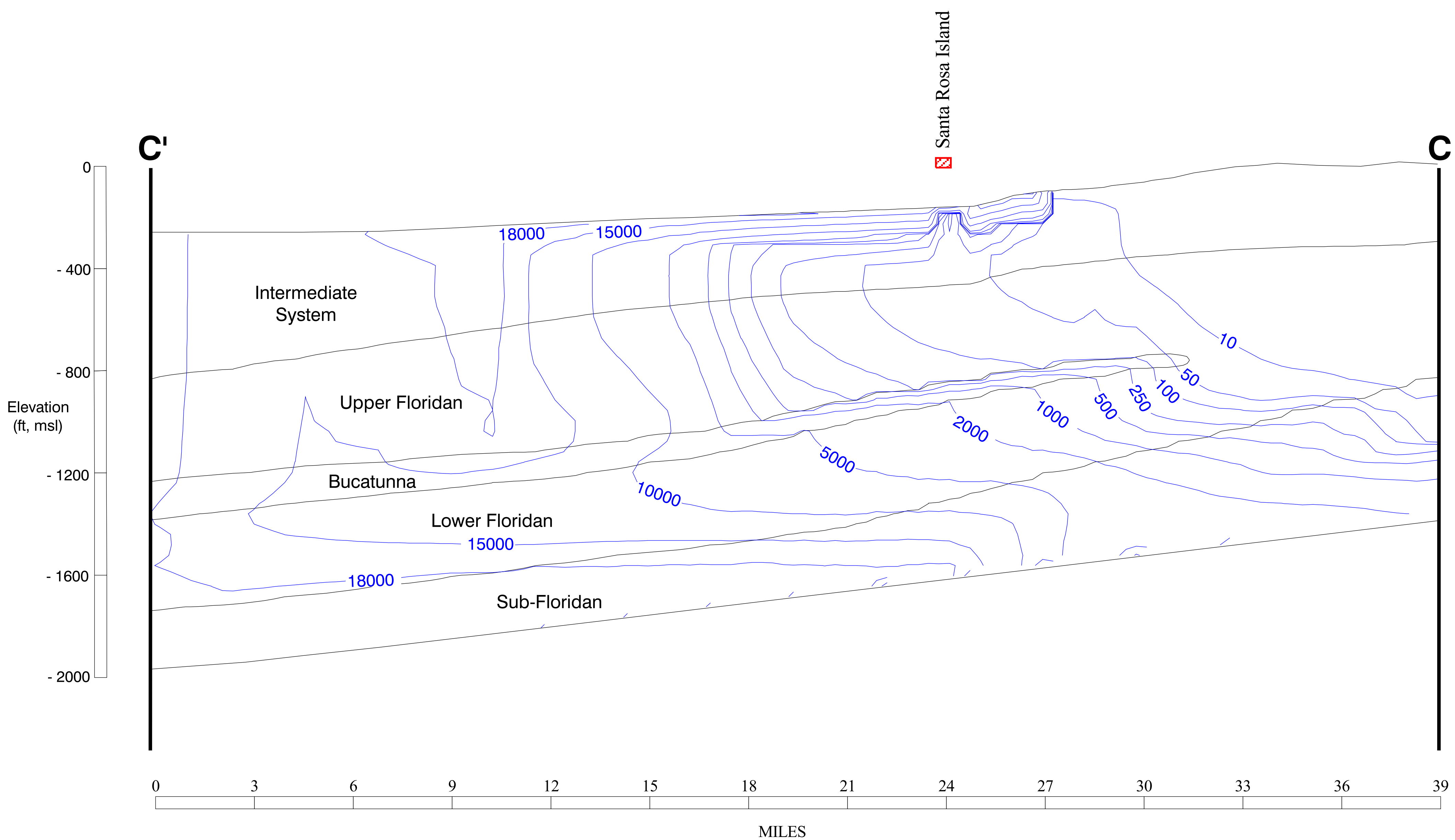


Filename: X:\NWF002\003-07\Old_Figures\bb'Chlor_1998.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 04/29/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.53
1998 Chloride Concentration for Cross-Section C-C'

Northwest Florida Water Management District

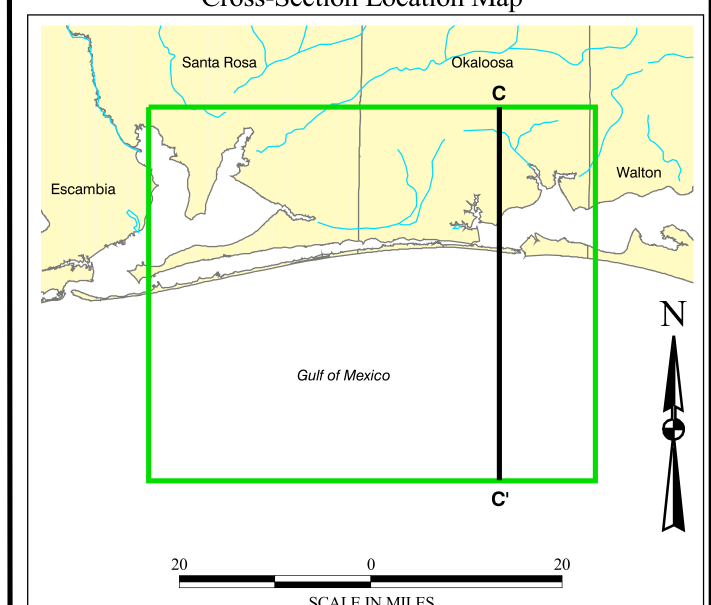


Legend

Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map



Filename: X:\NWF002\003-07\cc'chlor_1998.apr
Project: NWF002-003-07
Created: 05/28/02 tbraswell
Revised: 08/05/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

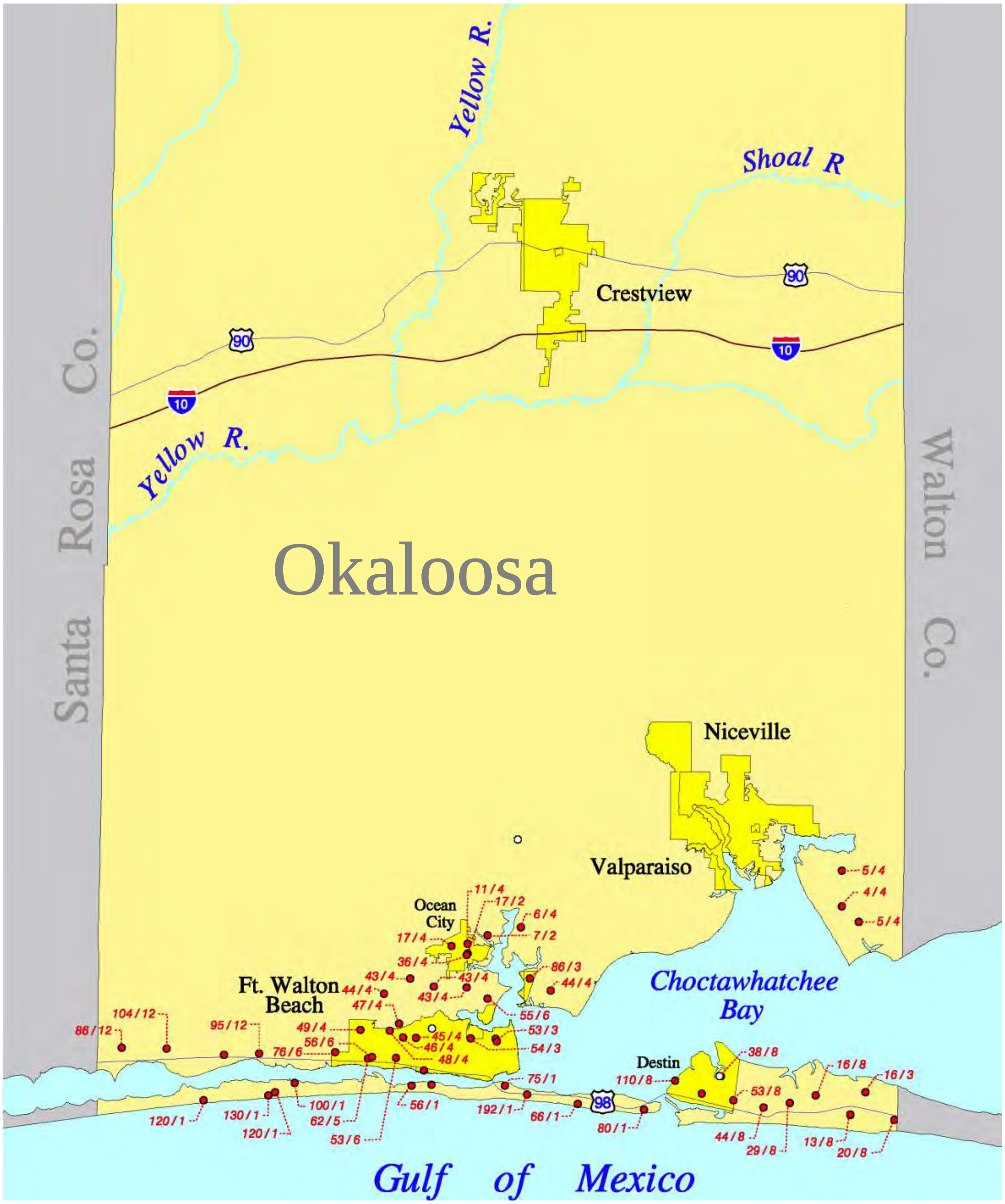
Filename: X:\NWF002\003-07\Old_figures\SR_Mean_Chloride.cdr
Project: NWF002-003-07
Created by: ACarriger 04/29/03
Revised: 11/08/04 acarriger
Source:

Legend

- Mean Chloride Concentration in mg/L / Number of Samples
- Wells Open to Lower Floridan Aquifer
- Major City
- U. S. Highway
- Interstate Highway

N

Figure 4.54
Santa Rosa County
Mean Chloride Concentration in the Floridan Aquifer System
1998 - 2000



0 5 10

SCALE IN MILES

Filename: X:\NWF002\003-07\Old_figures\Okaloosa_Mean_Chloride.cdr
Project: NWF002-003-07
Created by: ACarriger 04/29/03
Revised: 11/08/04 acarriger
Source:

Legend

- Mean Chloride Concentration in mg/L / Number of Samples
- Wells Open to Lower Floridan Aquifer
- Major City
- U. S. Highway
- Interstate Highway

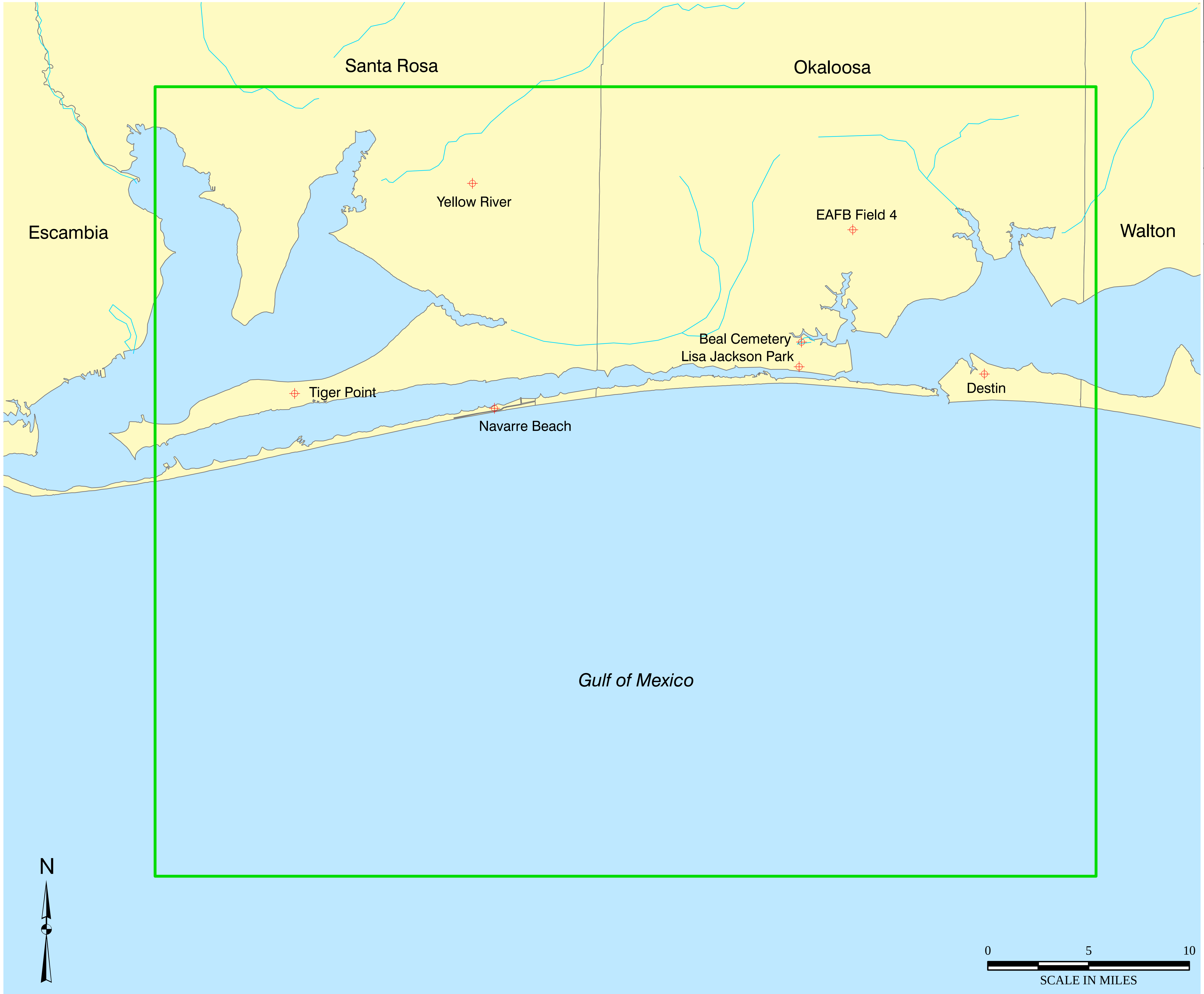
N

Figure 4.55
Okaloosa County
Mean Chloride Concentration
in the Floridan Aquifer System
1998 - 2000

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.56
Chloride Concentration
Profile Location Map

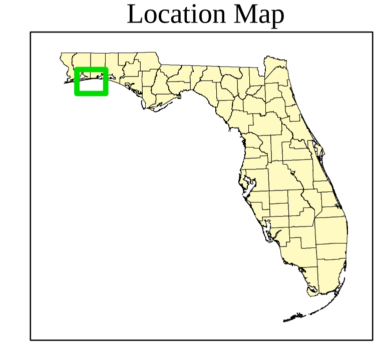
Northwest Florida
Water Management District



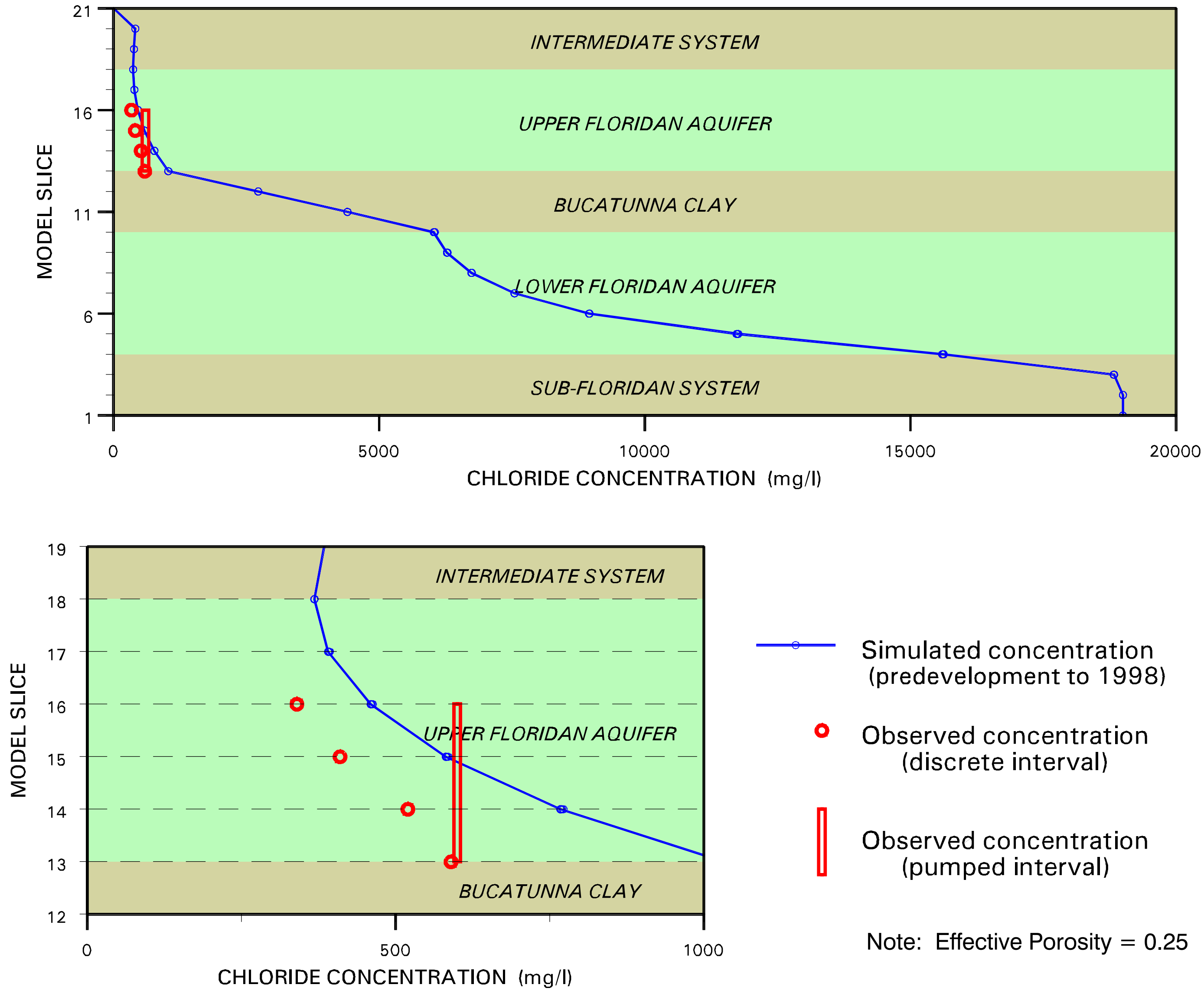
Legend

- County Boundary
- Hydrology
- Model Boundary

Location Map



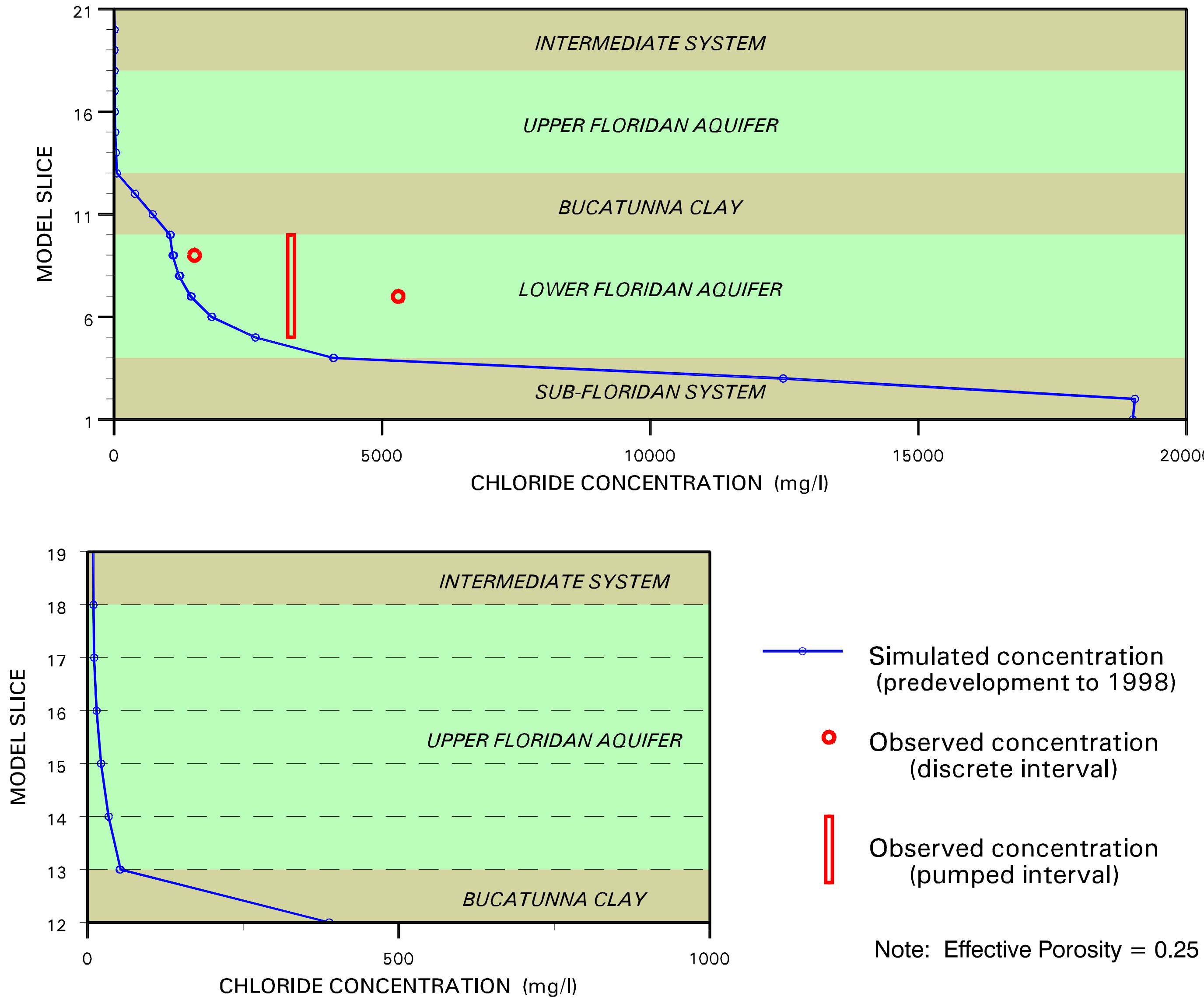
Filename: X:/NWF002/003-07/Maps/chloride_profile.mxd
Project: NWF002-003-07
Revised: 07/20/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005



Filename: X:\NWF002\003-07\Old_figures\Concentration_Profiles.cdr
Project: NWF002-003-07
Created by: ACarriger 03/29/03
Revised: 11/08/04 asc
Source:

Figure 4.57

Tiger Point Concentration Profile

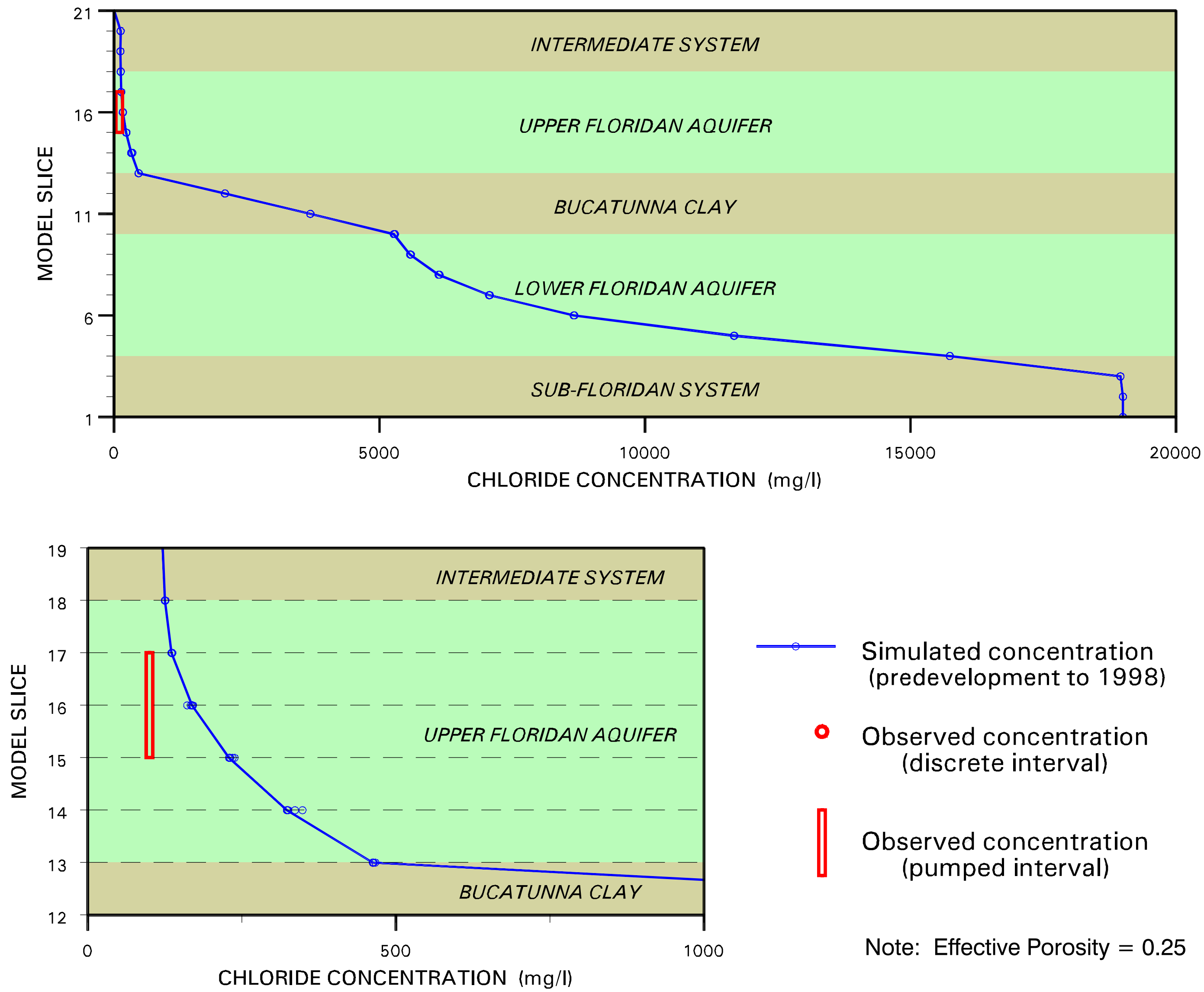


HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Old_figures\Concentration_Profiles.cdr
Project: NWF002-003-07
Created by: ACarriger 03/29/03
Revised: 11/08/04 asc
Source:

Figure 4.58

Yellow River Concentration Profile

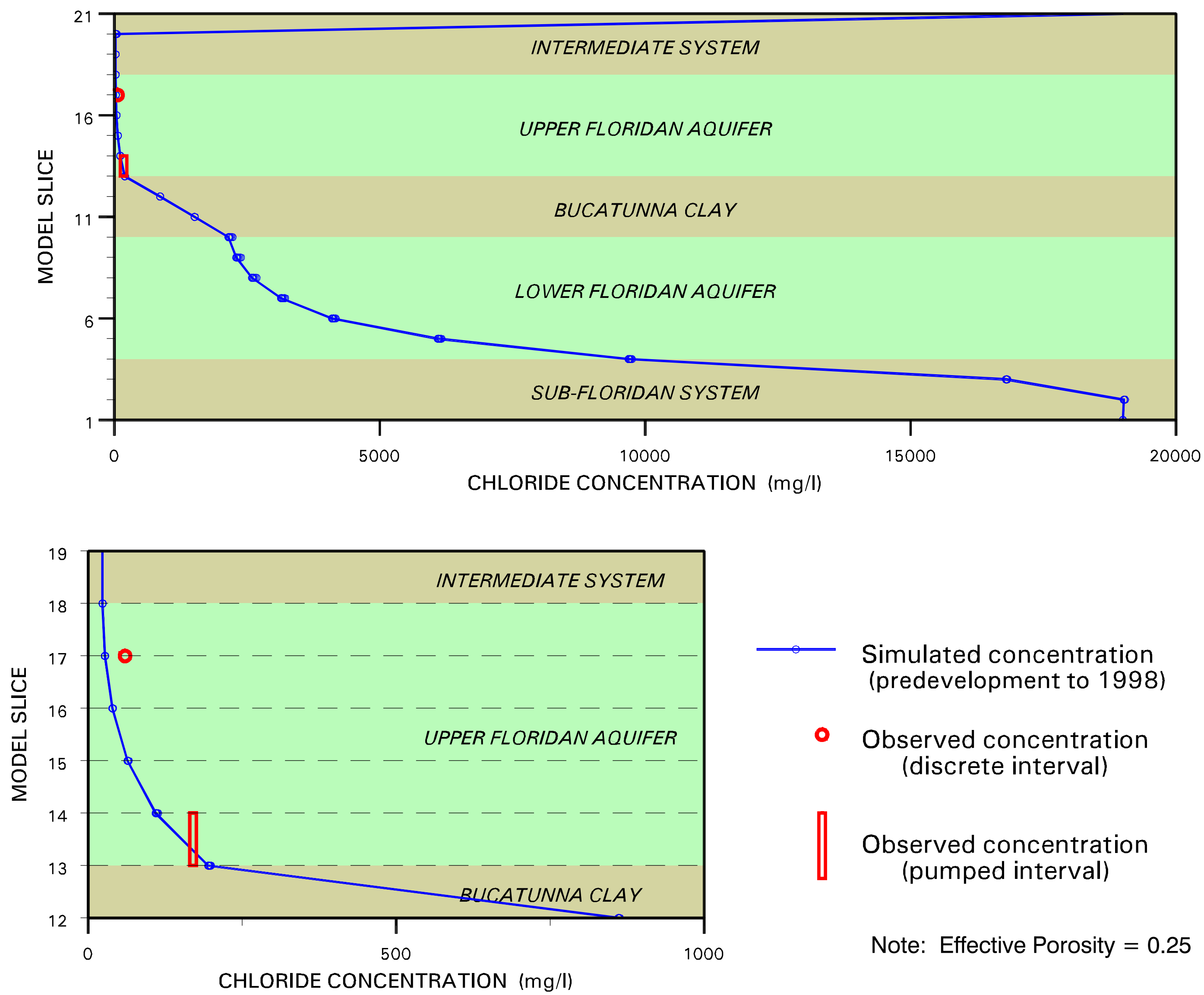


HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Old_figures\Concentration_Profiles.cdr
Project: NWF002-003-07
Created by: ACarriger 03/29/03
Revised: 11/08/04 asc
Source:

Figure 4.59

Navarre Beach Concentration Profile

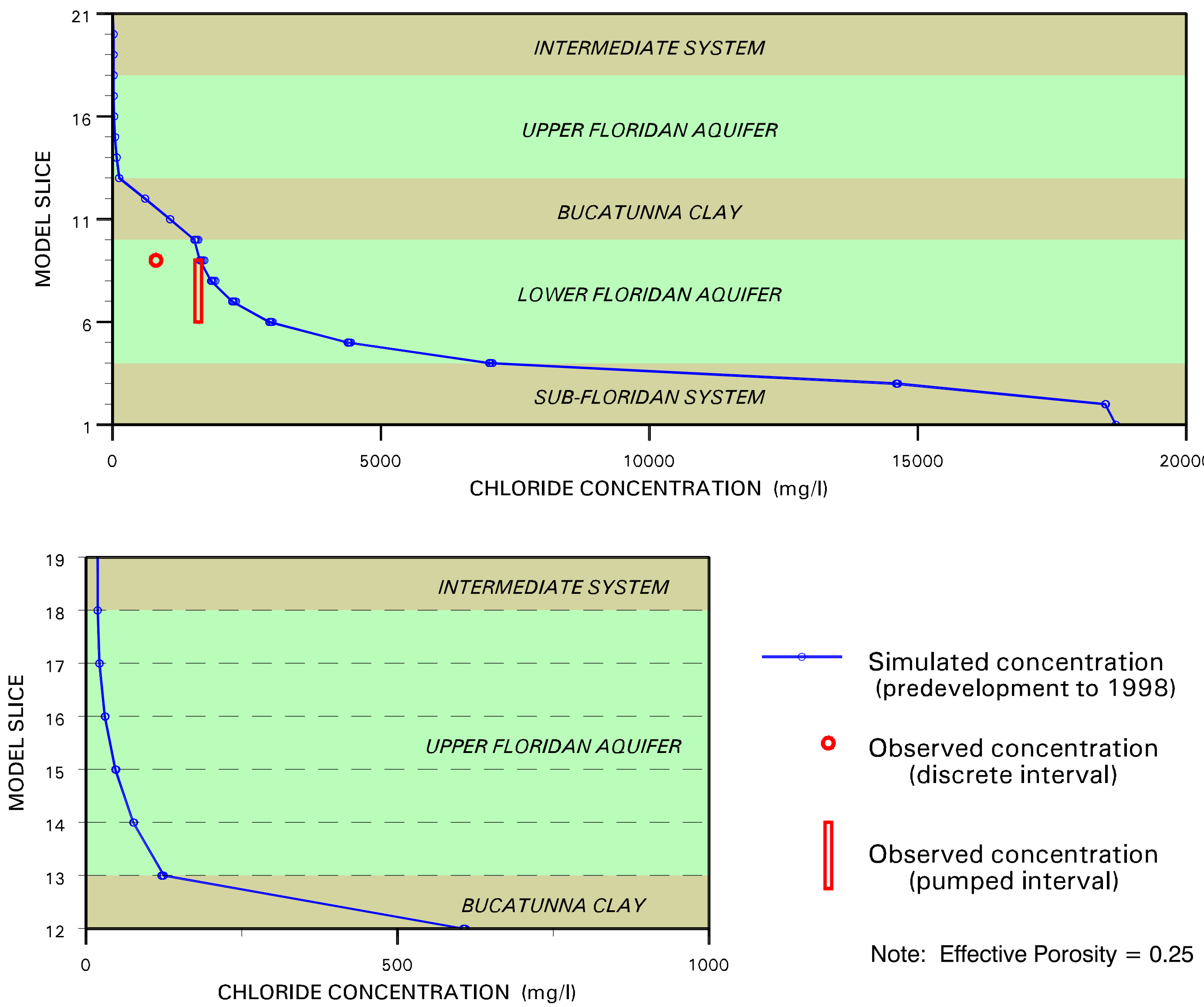


HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Old_figures\Concentration_Profiles.cdr
Project: NWF002-003-07
Created by: ACarriger 03/29/03
Revised: 11/08/04 asc
Source:

Figure 4.60

Lisa Jackson Park Concentration Profile

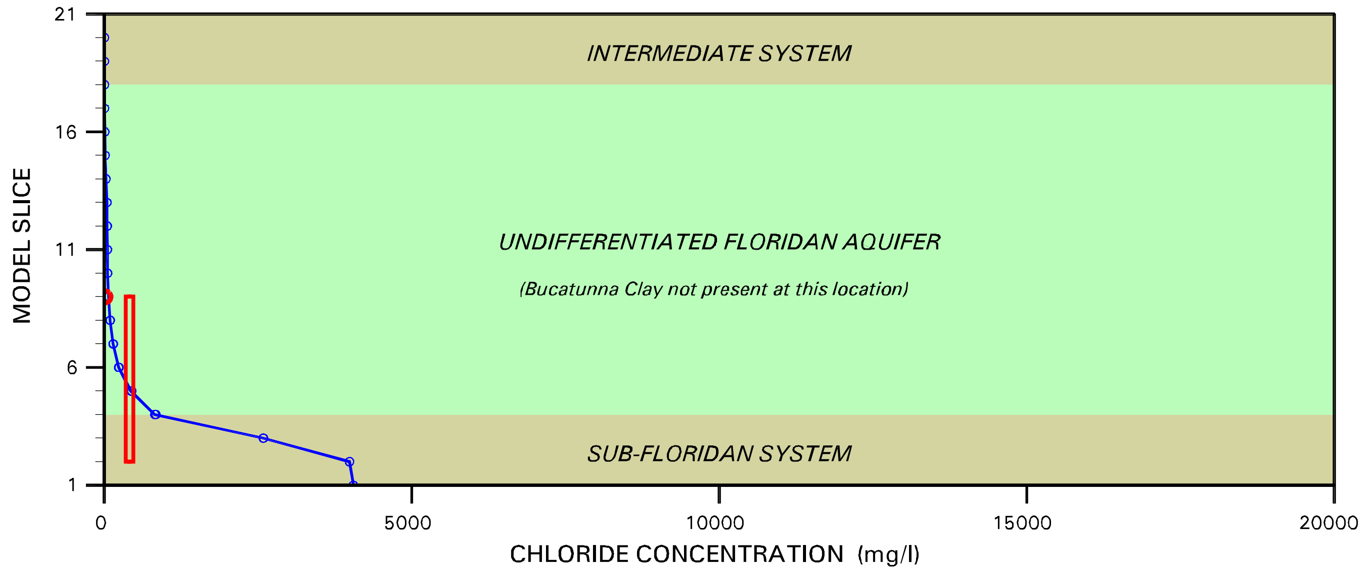


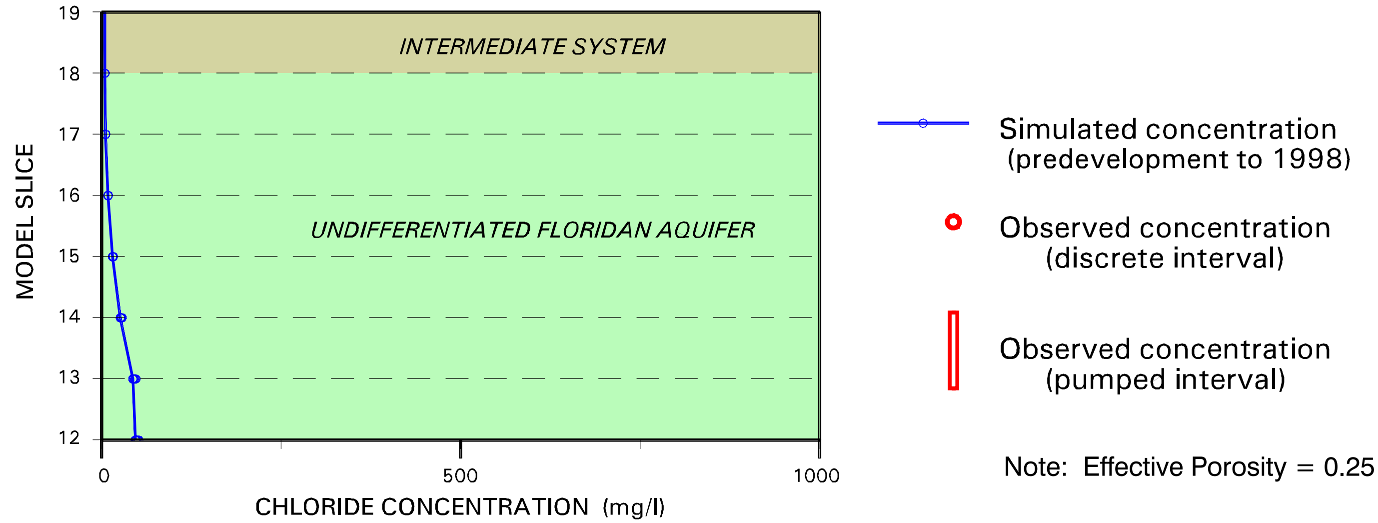
HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Old_figures\Concentration_Profiles.cdr
Project: NWF002-003-07
Created by: ACarriger 03/29/03
Revised: 11/08/04 asc
Source:

Figure 4.61

Beal Cemetery Concentration Profile





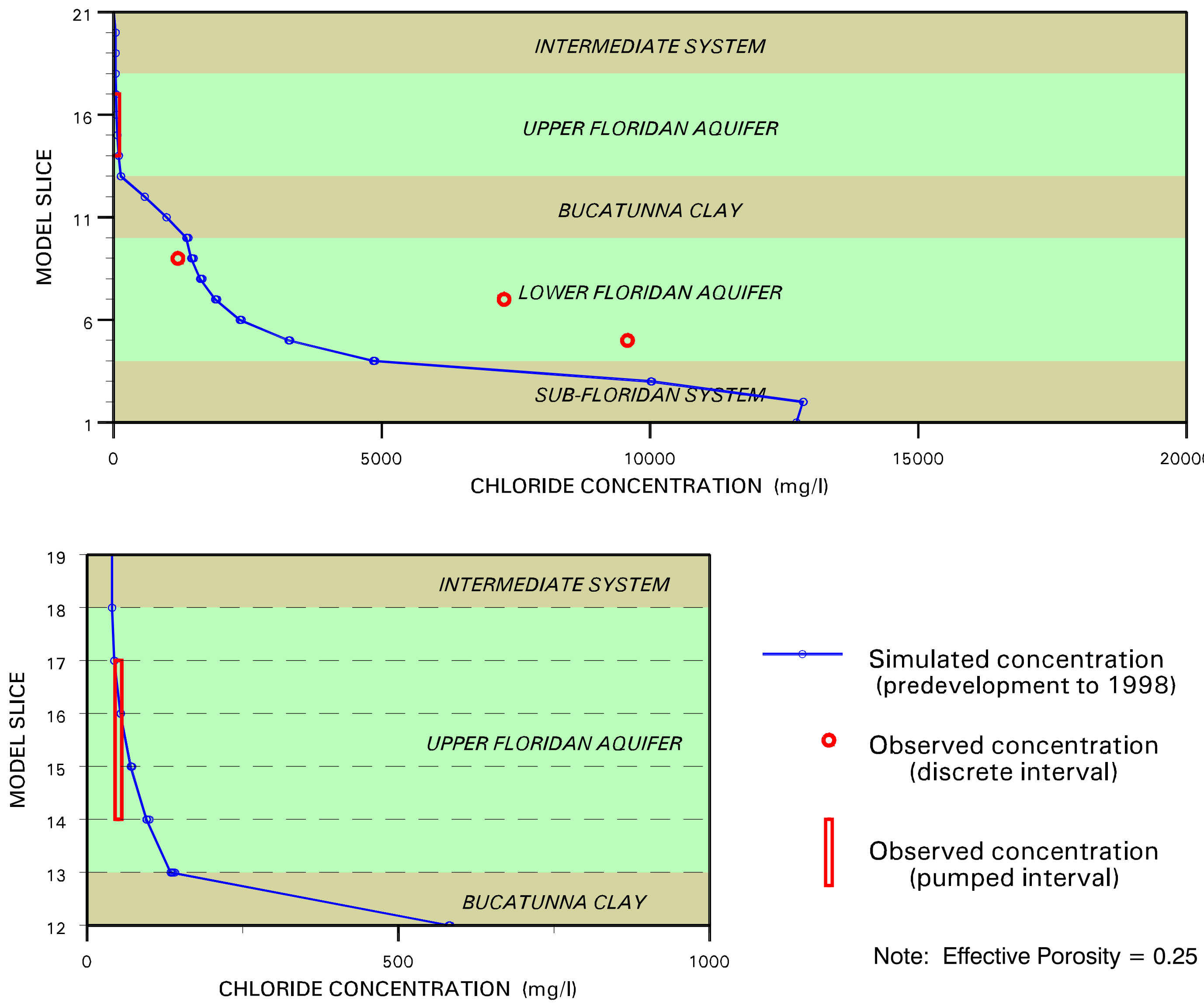
Note: Effective Porosity = 0.25

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Old_figures\Concentration_Profiles.cdr
Project: NWF002-003-07
Created by: ACarriger 03/29/03
Revised: 11/08/04 asc
Source:

Figure 4.62

EAFB Field 4 Concentration Profile

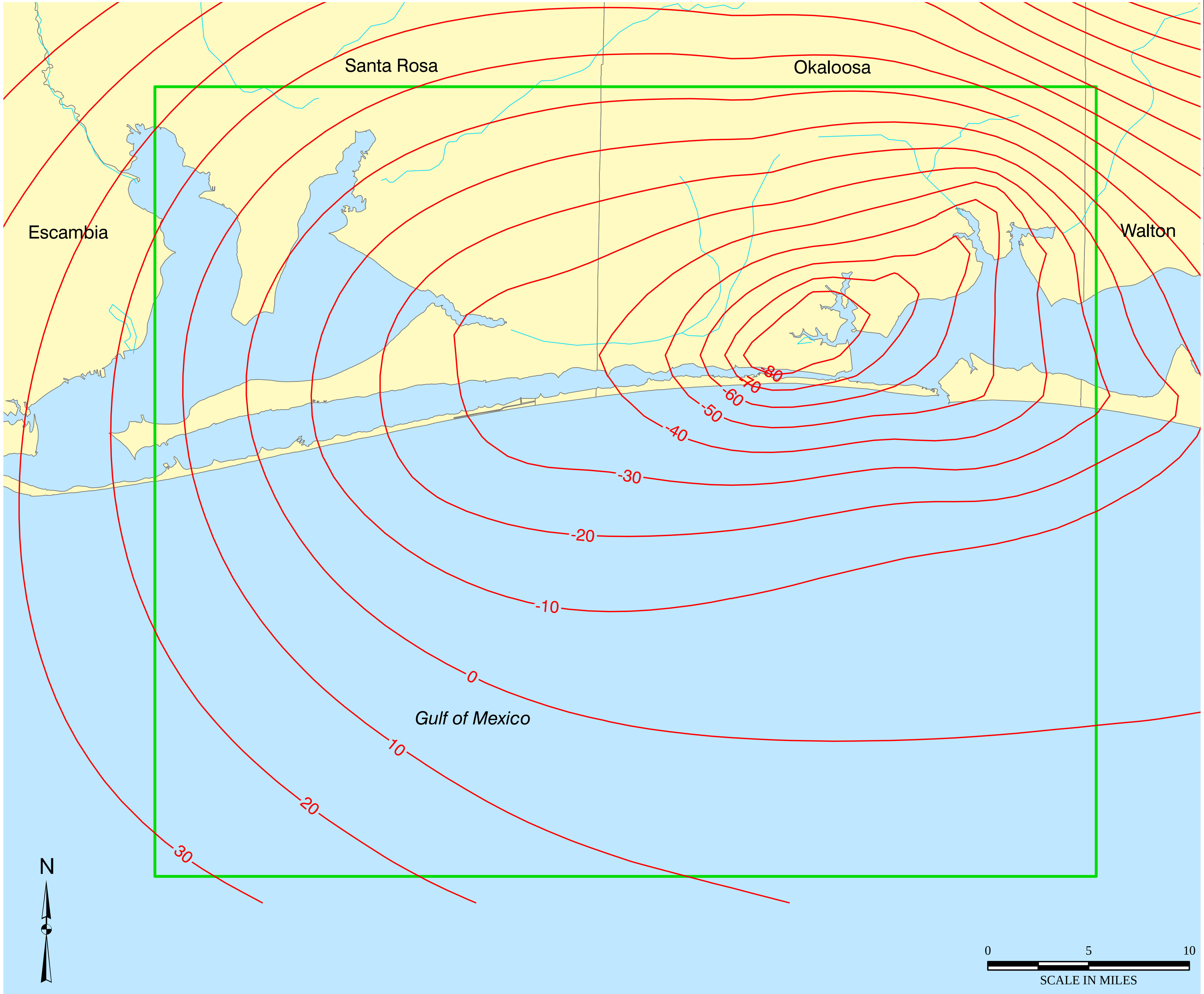


HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Old_figures\Concentration_Profiles.cdr
Project: NWF002-003-07
Created by: ACarriger 03/29/03
Revised: 11/08/04 asc
Source:

Figure 4.63

Destin Concentration Profile



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.64
1990 MODFLOW Simulation
Head for the
Upper Floridan Aquifer
(Layer 3)

Northwest Florida Water Management District

Legend

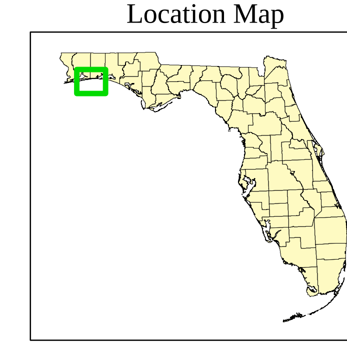
County Boundary

Hydrology

—20— Head (ft)

Model Boundary

Location Map

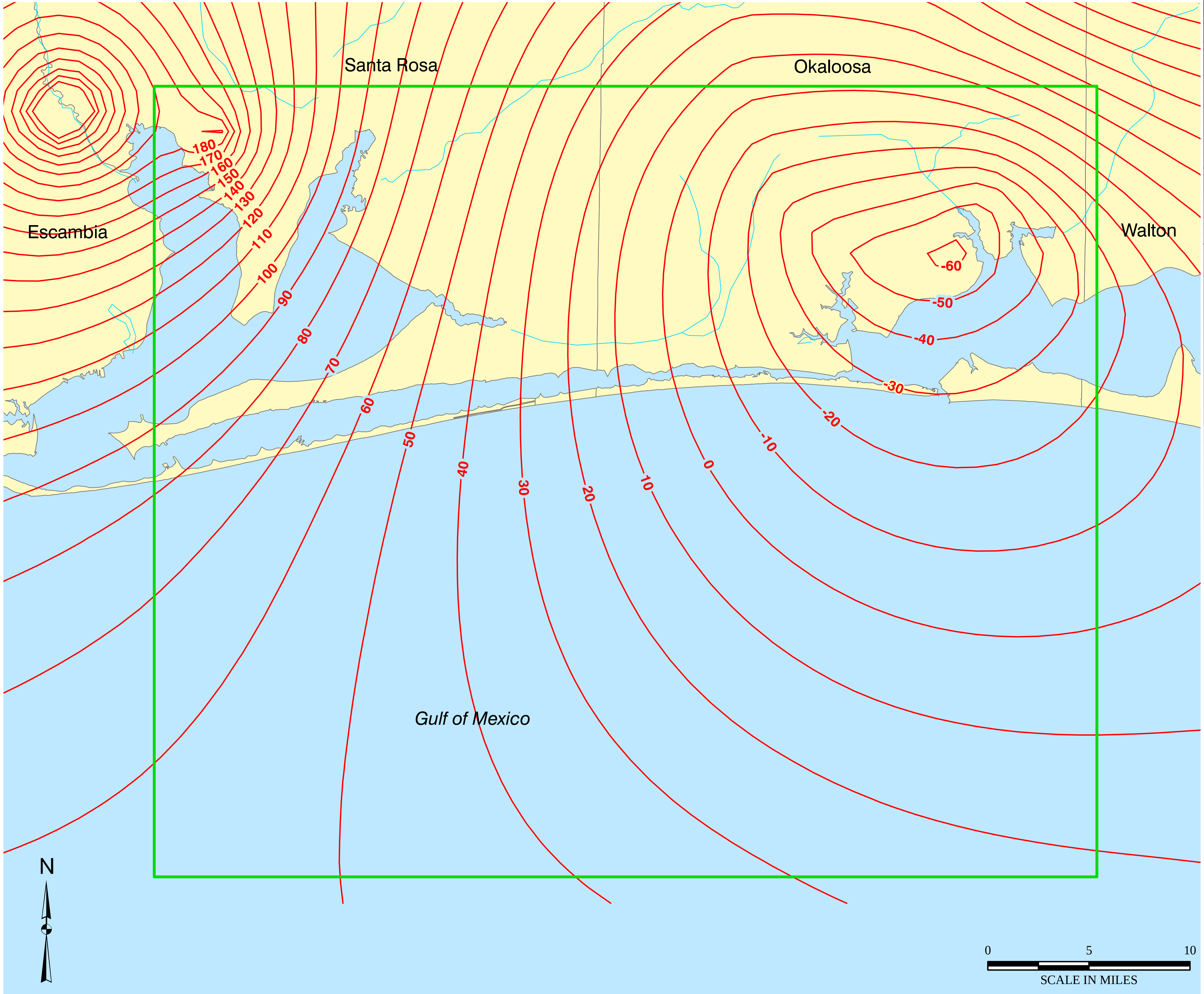


Filename: X:/NWF002/003-07/l3_hd_1990.mxd
Project: NWF002-003-06
Revised: 04/1105 CF
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.65
1990 MODFLOW Simulation
Head for the
Lower Floridan Aquifer
(Layer 5)

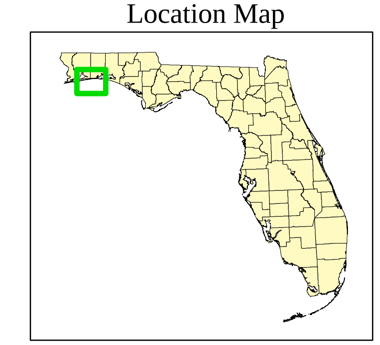
Northwest Florida Water Management District



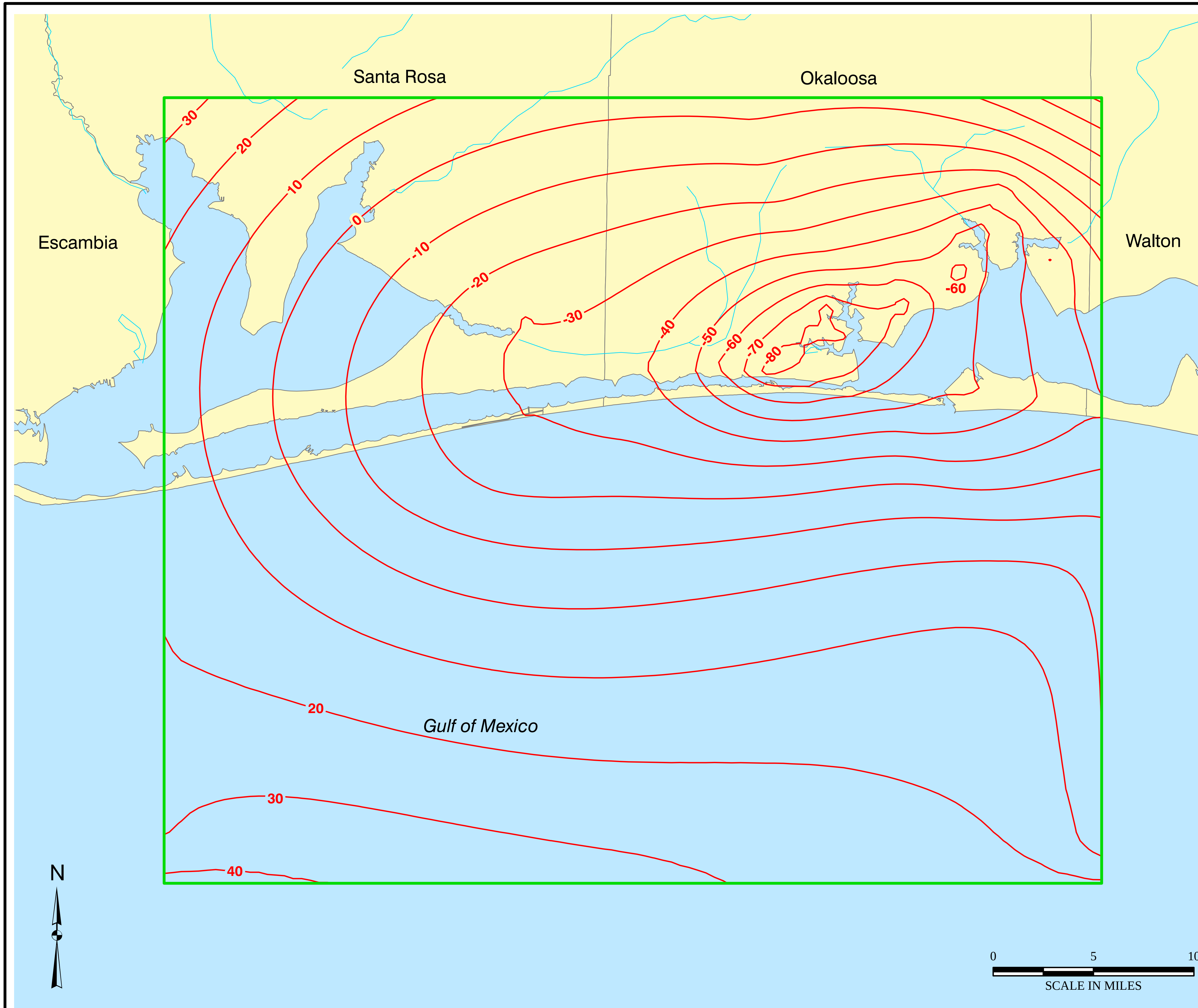
Legend

- County Boundary
- Hydrology
- 20 Head (ft)
- Model Boundary

Location Map



Filename: X:/NWF002/004-06/Maps/l5_hd_1990.mxd
Project: NWF002-004-06
Revised: 04/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.66
1990 Equivalent Freshwater Head for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)

Northwest Florida Water Management District

Legend

- County Boundary
- Hydrology
- 20 Equivalent Freshwater Head (ft)
- Model Boundary

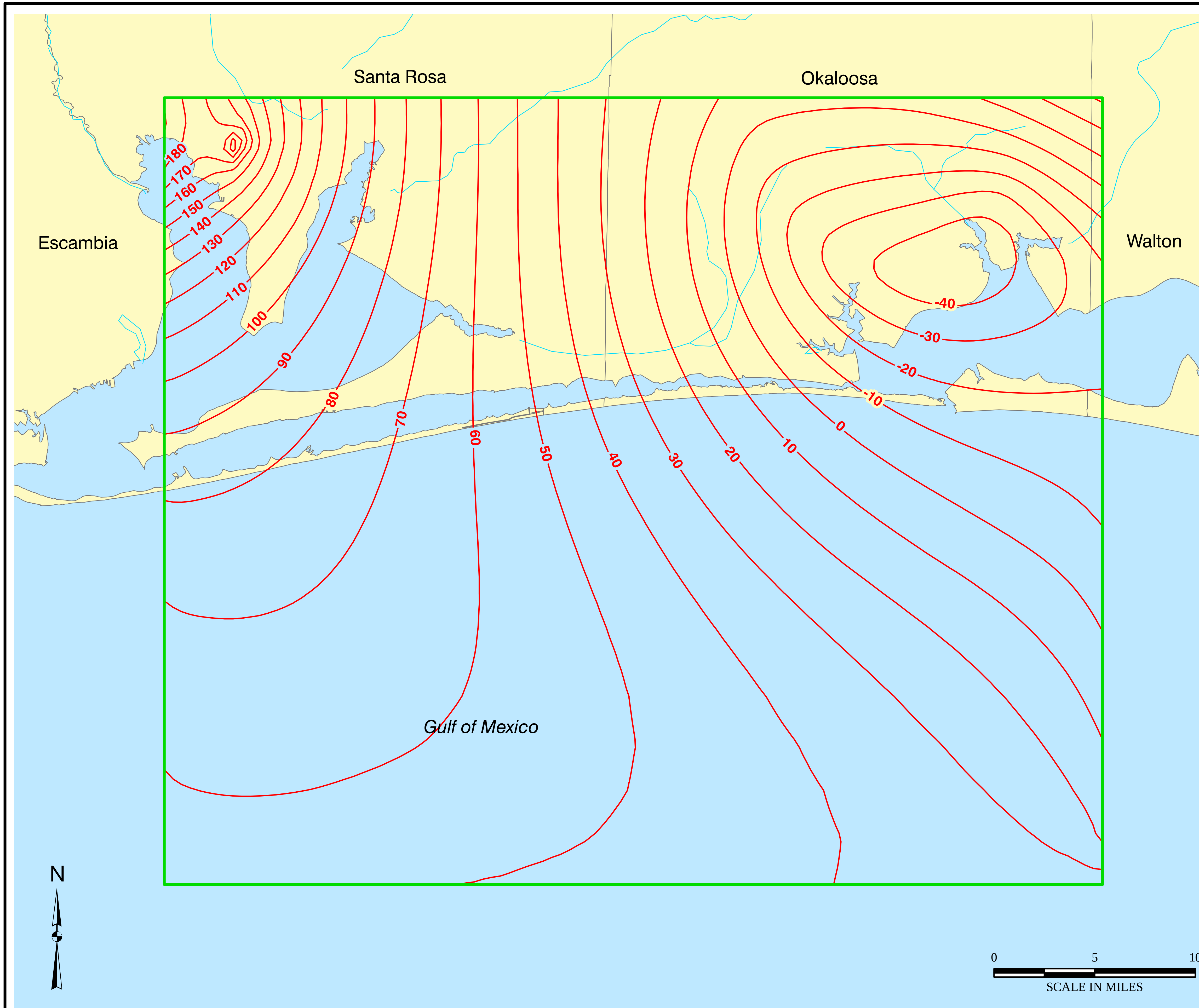
Location Map

Filename: X:/NWF002/004-06/Maps/l16_efhd_1990.mxd.mxd
Project: NWF002-004-06
Revised: 04/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.67
1990 Equivalent Freshwater Head for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)

Northwest Florida Water Management District



Legend

County Boundary
Hydrology
20 Equivalent Freshwater Head (ft)
Model Boundary

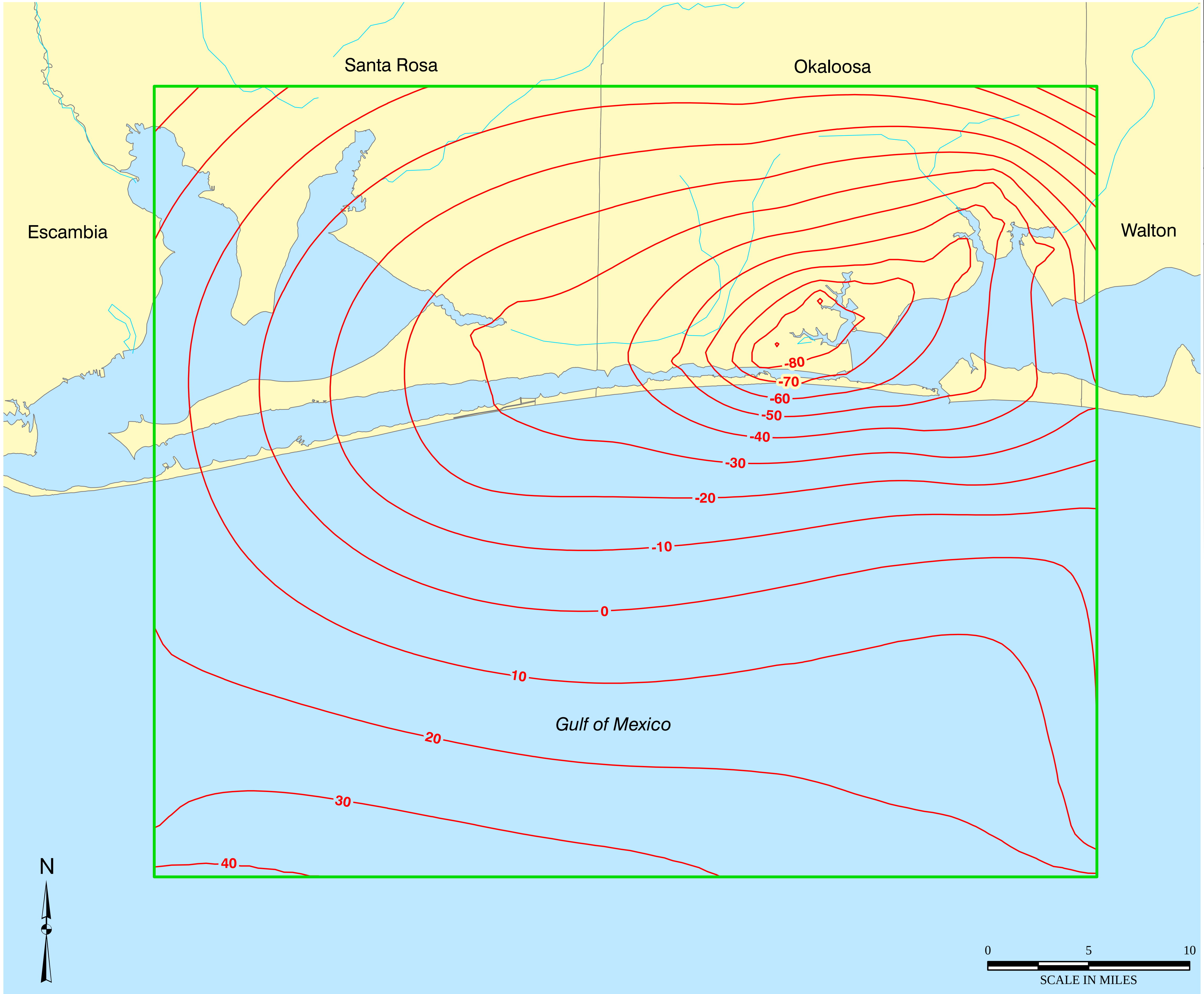
Location Map

Filename: X:/NWF002/004-06/Maps/l7_efhd_1990.mxd.mxd
Project: NWF002-004-06
Revised: 04/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.68
1990 Equivalent Freshwater Head for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer) Reduced Flow from Bottom

Northwest Florida Water Management District



Legend

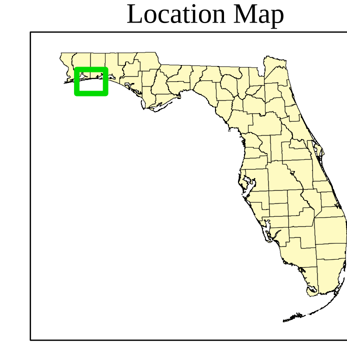
County Boundary

Hydrology

20 Equivalent Freshwater Head (ft)

Model Boundary

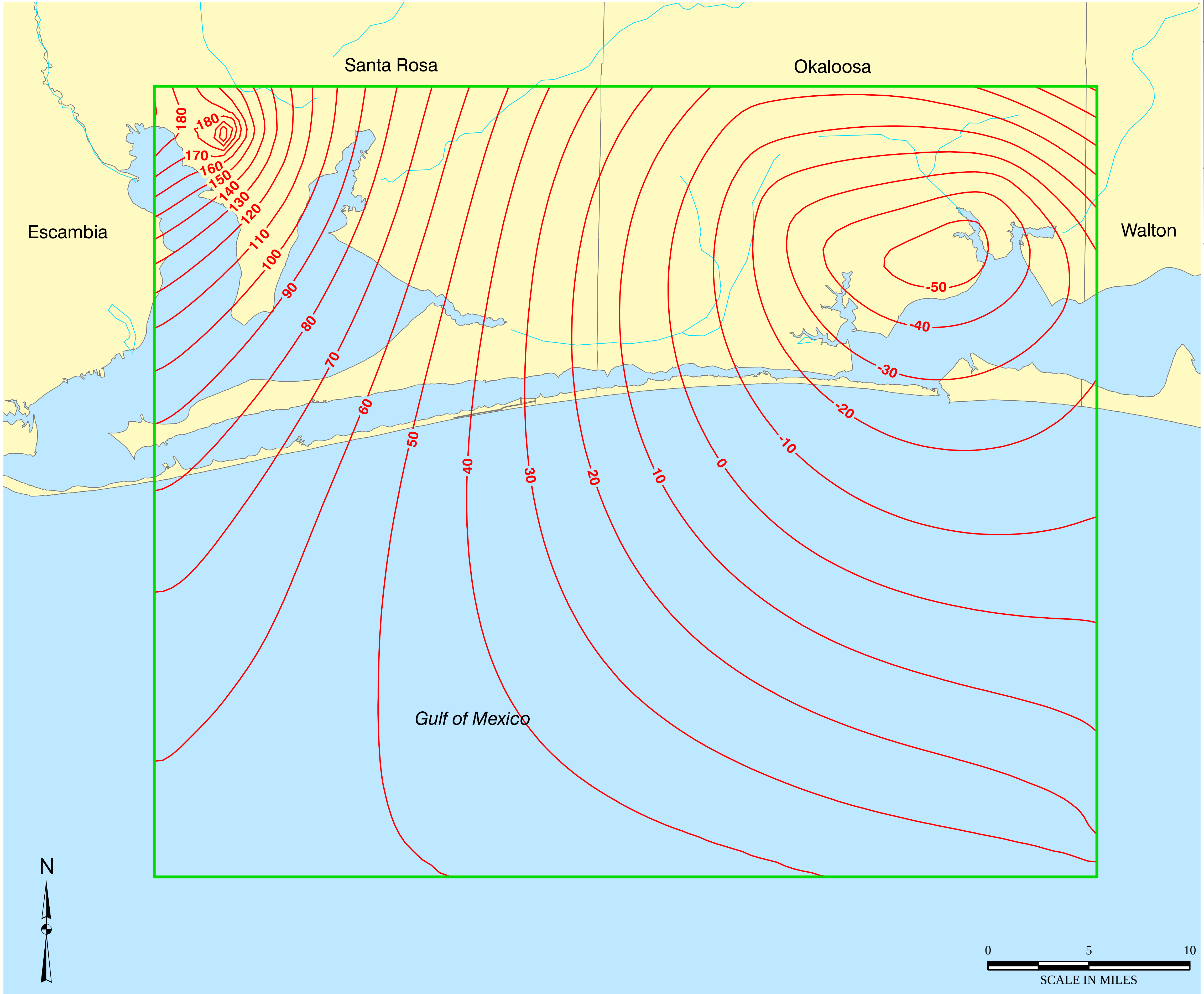
Location Map



Filename: X:/NWF002/004-06/Maps/l16_efhd_rfb_1990.mxd
Project: NWF002-004-06
Revised: 04/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 4.69
1990 Equivalent Freshwater Head for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer) Reduced Flow from Bottom



Northwest Florida Water Management District

Legend

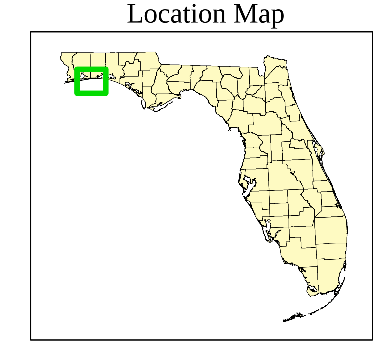
County Boundary

Hydrology

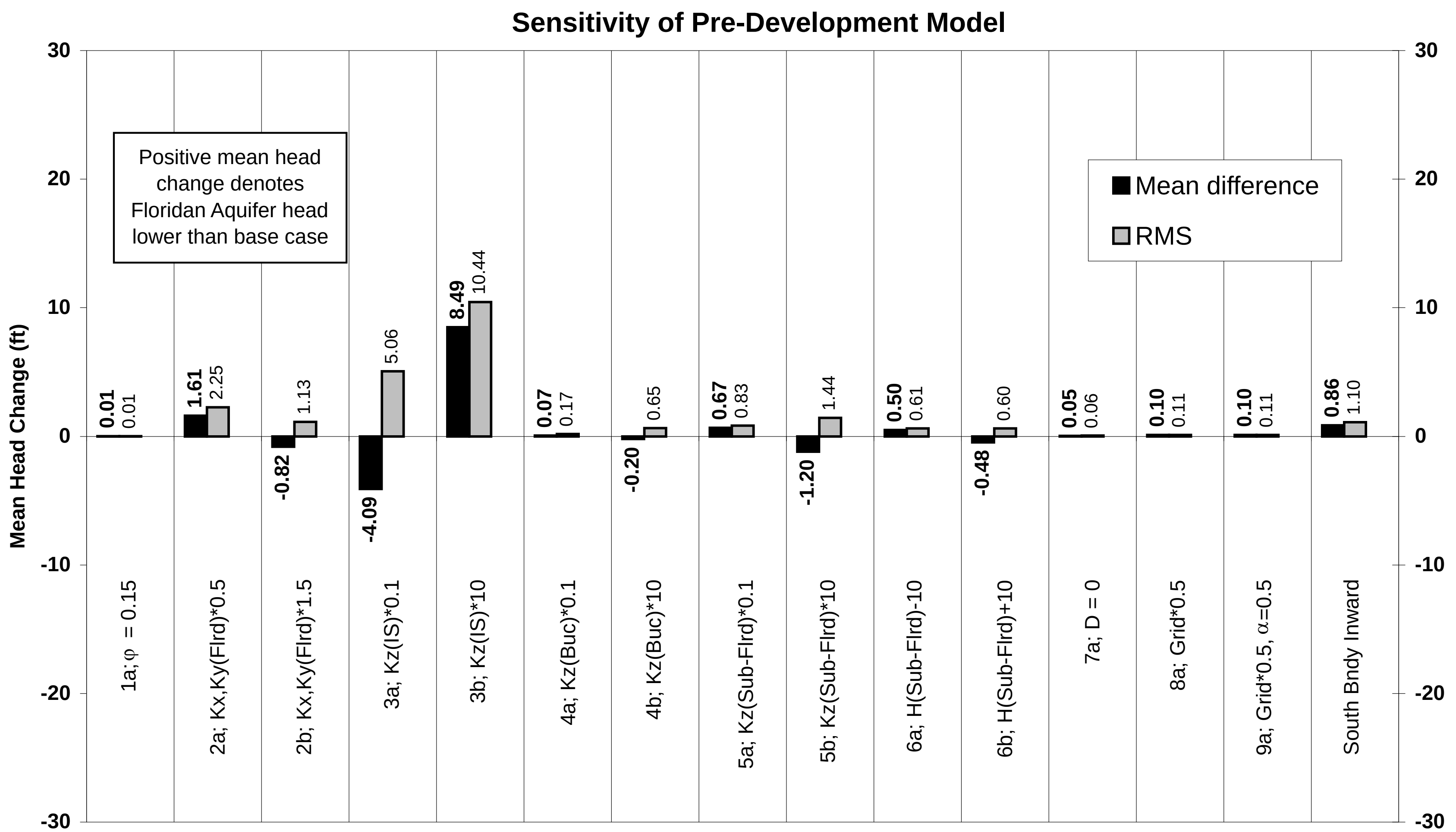
20 Equivalent Freshwater Head (ft)

Model Boundary

Location Map



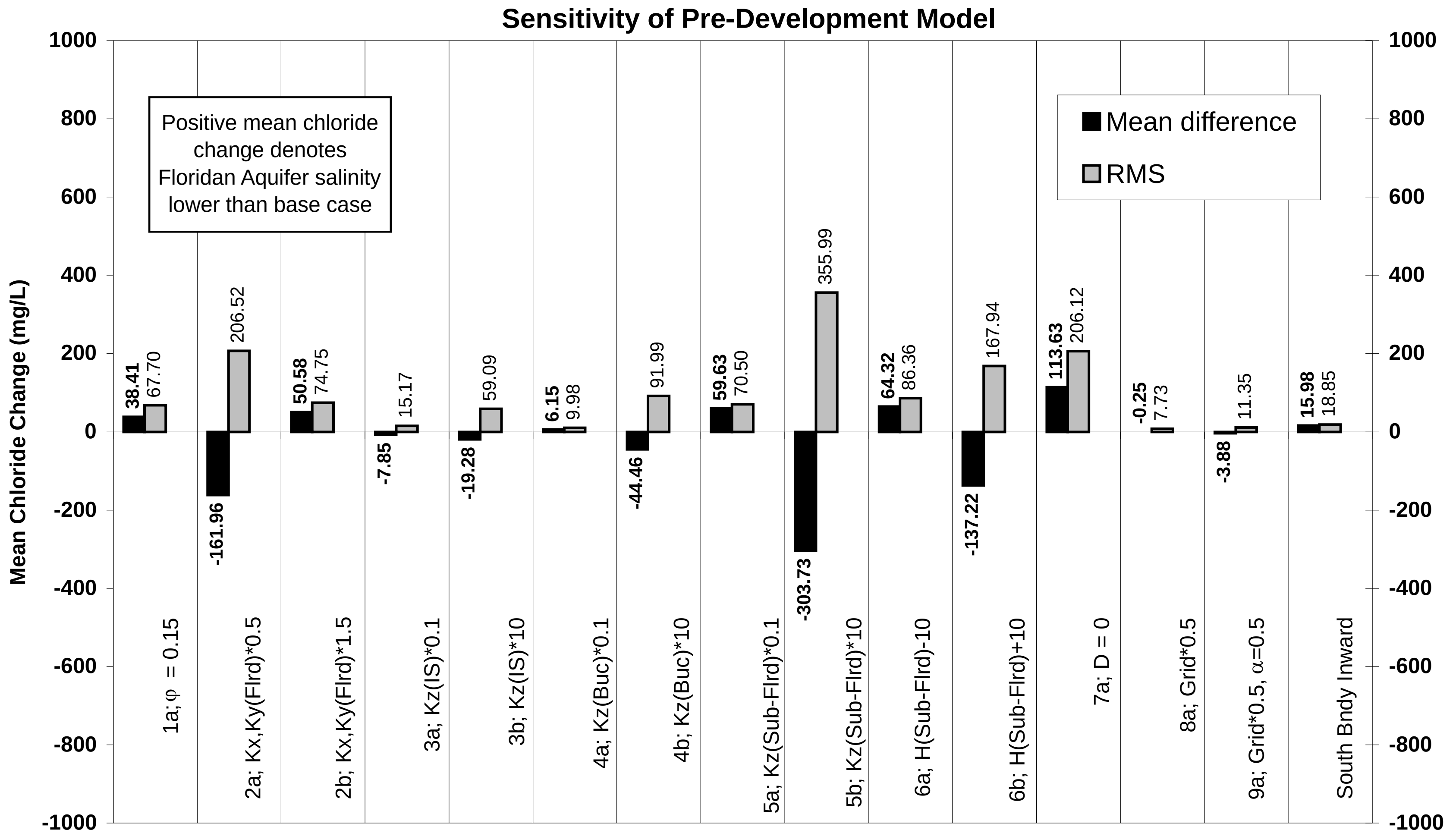
Filename: X:/NWF002/004-06/Maps/l7_efhd_rfb_1990.mxd.mxd
Project: NWF002-004-06
Revised: 04/27/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-1.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 04/27/05 asc
Source: HydroGeoLogic, Inc.

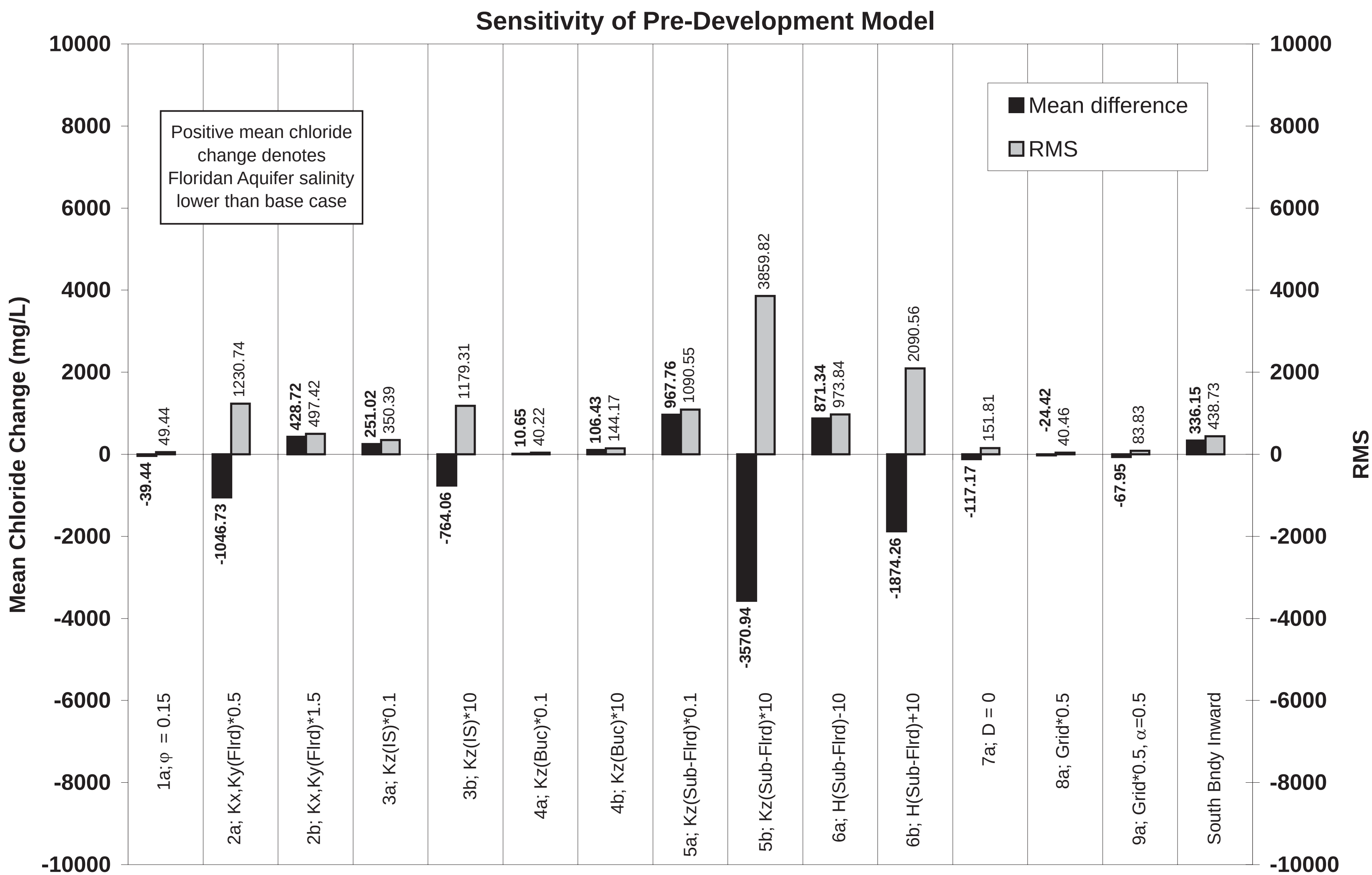
Figure 5.1
RMS and Mean Head Change from Pre-Development Base Case for the Upper and Lower Floridan Aquifers Combined



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-2.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 04/29/05 asc
Source: HydroGeoLogic, Inc.

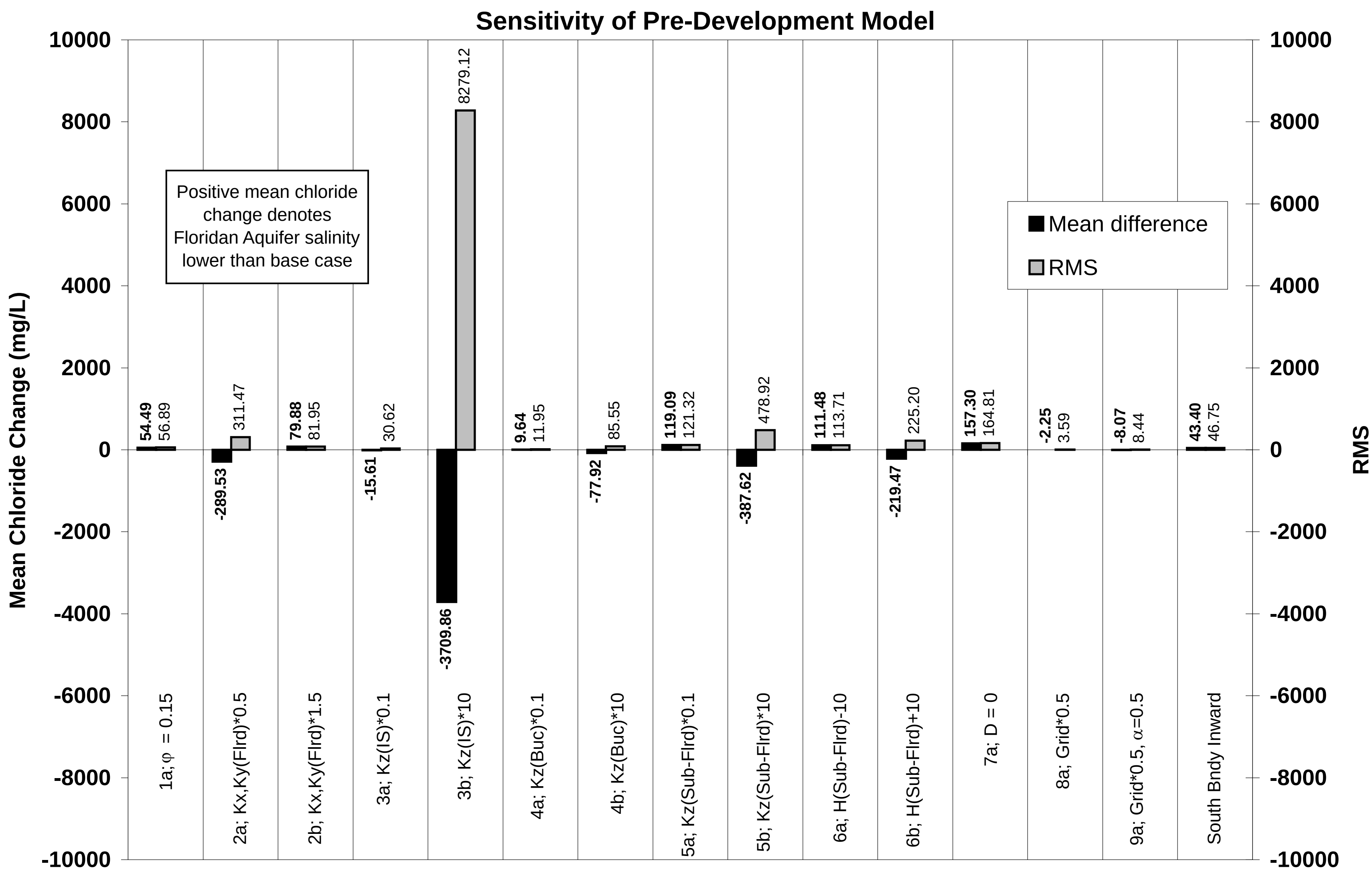
Figure 5.2
RMS and Mean Chloride Change from Pre-Development Base Case for the Upper Floridan Aquifer



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-3.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 04/29/05 asc
Source: HydroGeoLogic, Inc.

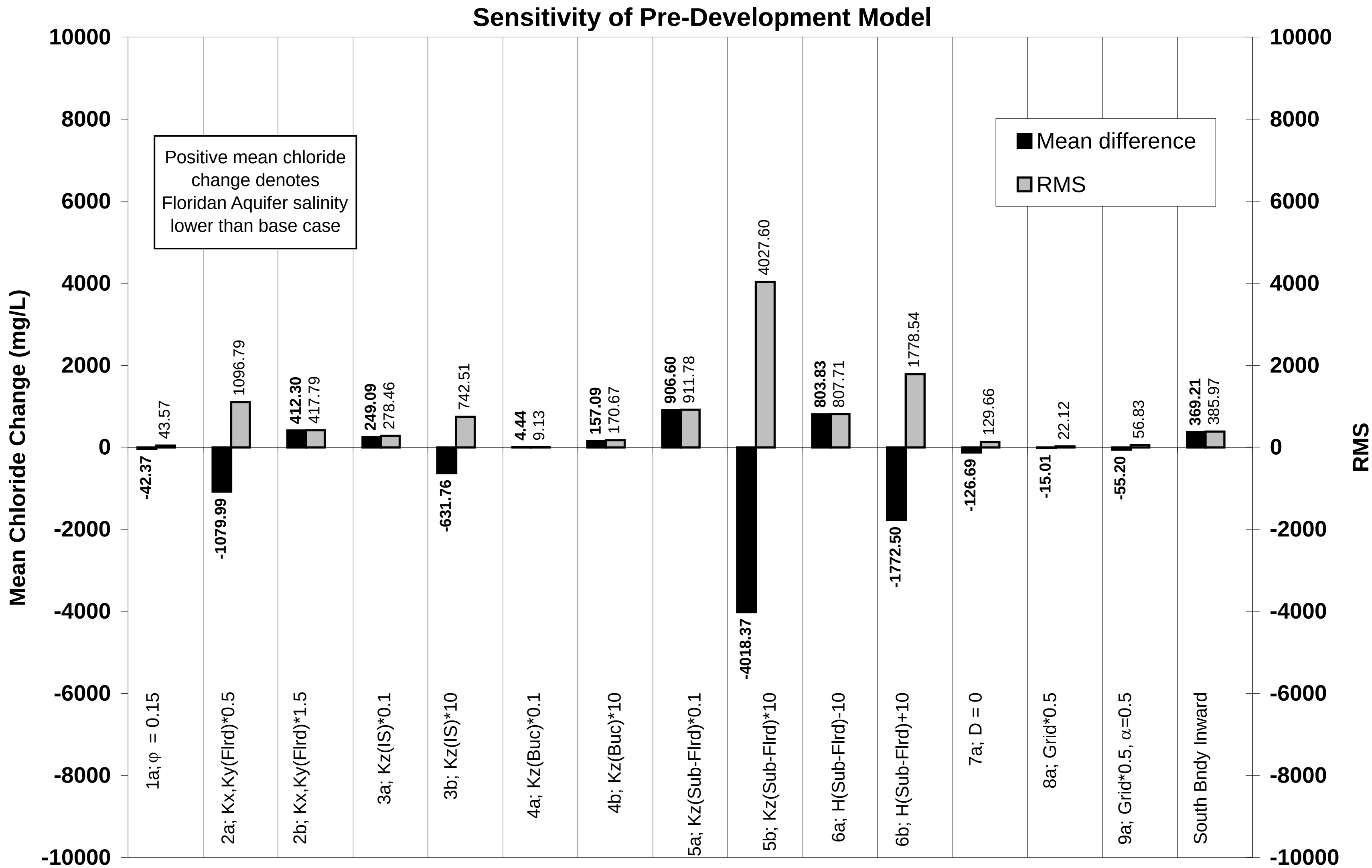
Figure 5.3
RMS and Mean Chloride Change from Pre-Development Base Case for the Lower Floridan Aquifer



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-4.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 04/29/05 asc
Source: HydroGeoLogic, Inc.

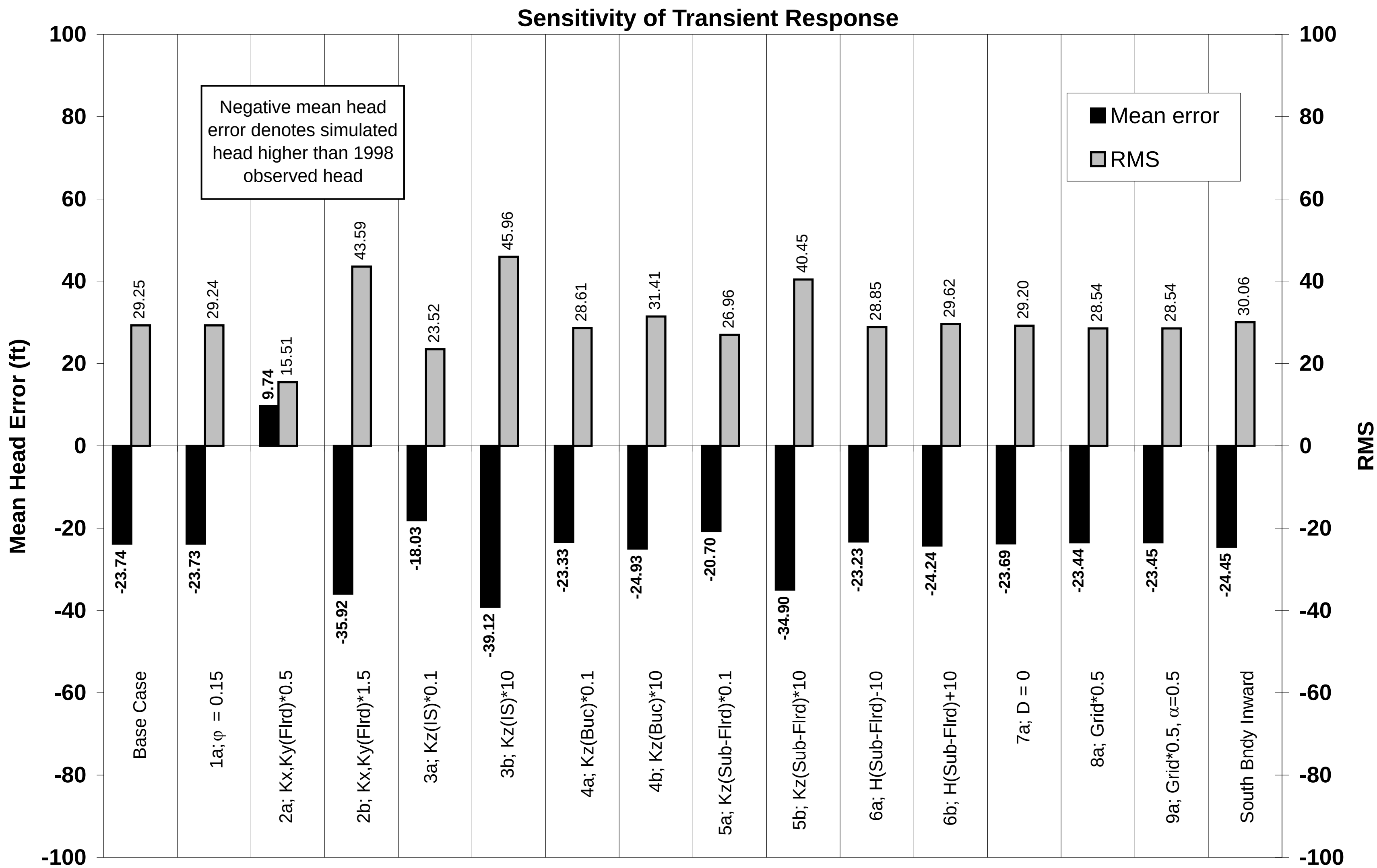
Figure 5.4
RMS and Mean Chloride Change from Pre-Development Base Case for the Upper Floridan Aquifer at Select Nodes 3 miles Offshore



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-5.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 04/27/05 asc
Source: HydroGeoLogic, Inc.

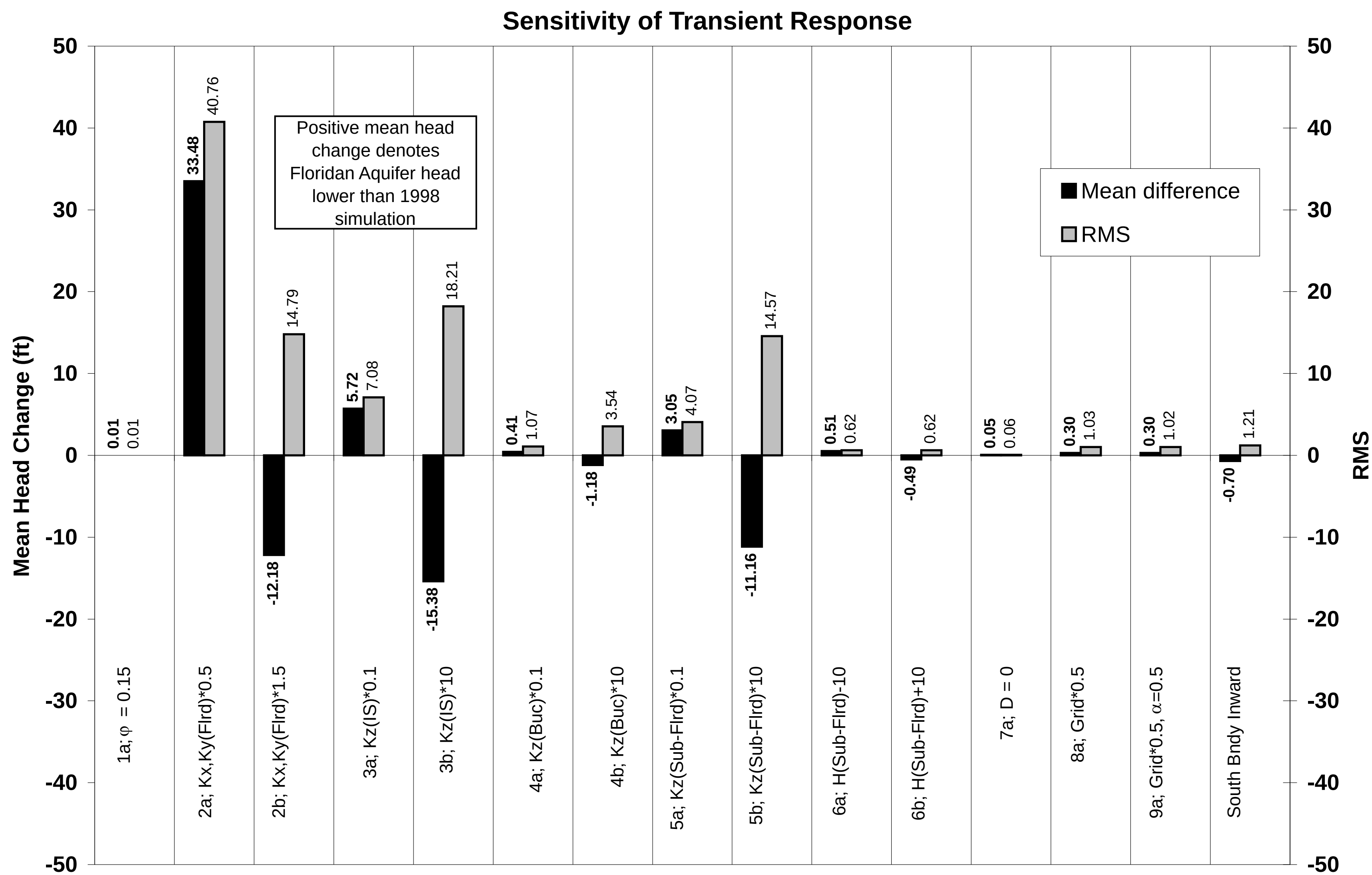
Figure 5.5
RMS and Mean Chloride Change from Pre-Development Base Case for the Lower Floridan Aquifer at Select Nodes near the Bucatunna Clay Pinchout



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-9.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 07/21/05 asc
Source: HydroGeoLogic, Inc.

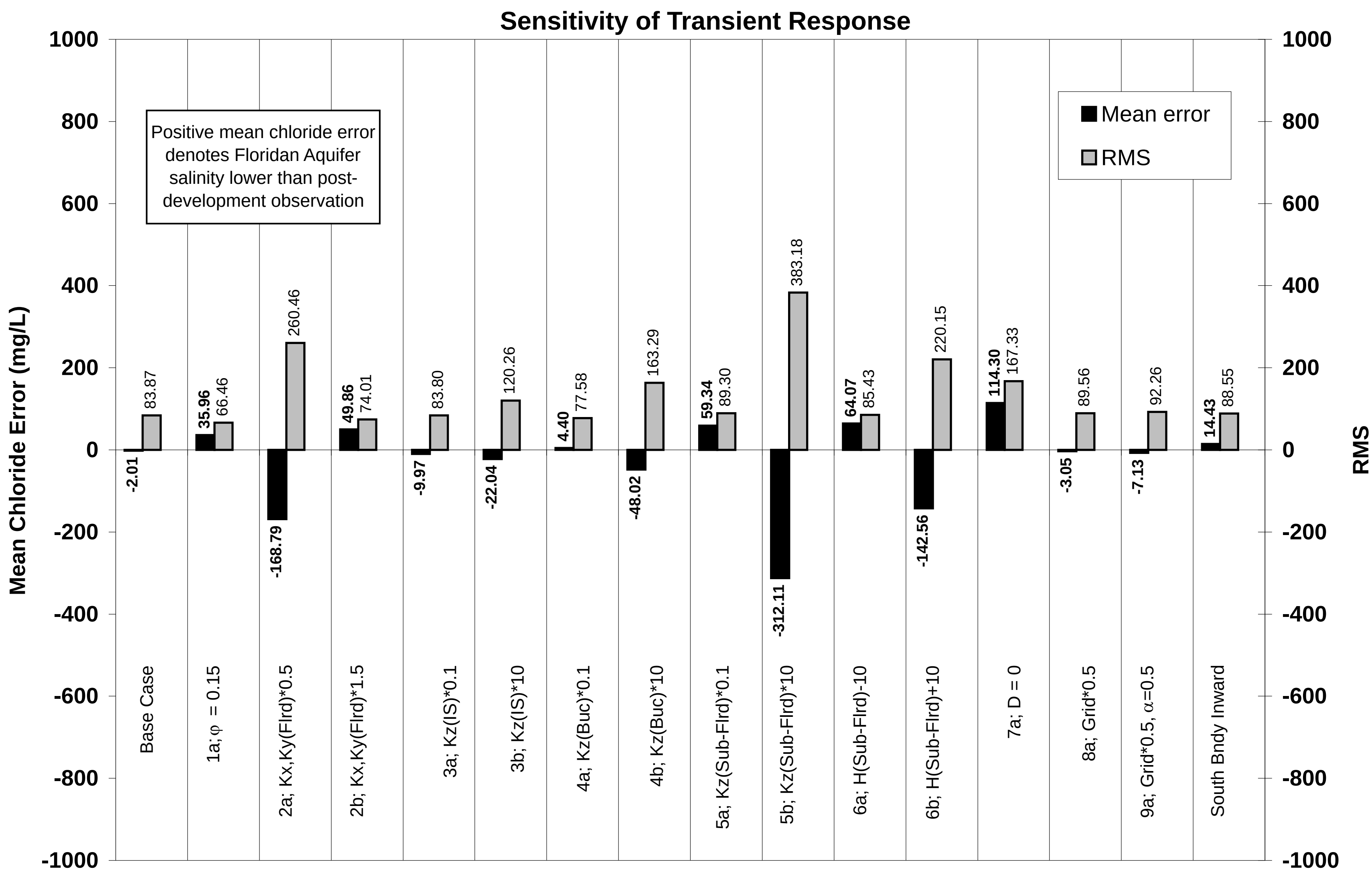
Figure 5.6
RMS and Mean Head Error for the Upper and Lower Floridan Aquifers Combined



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-6.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 07/21/05 asc
Source: HydroGeoLogic, Inc.

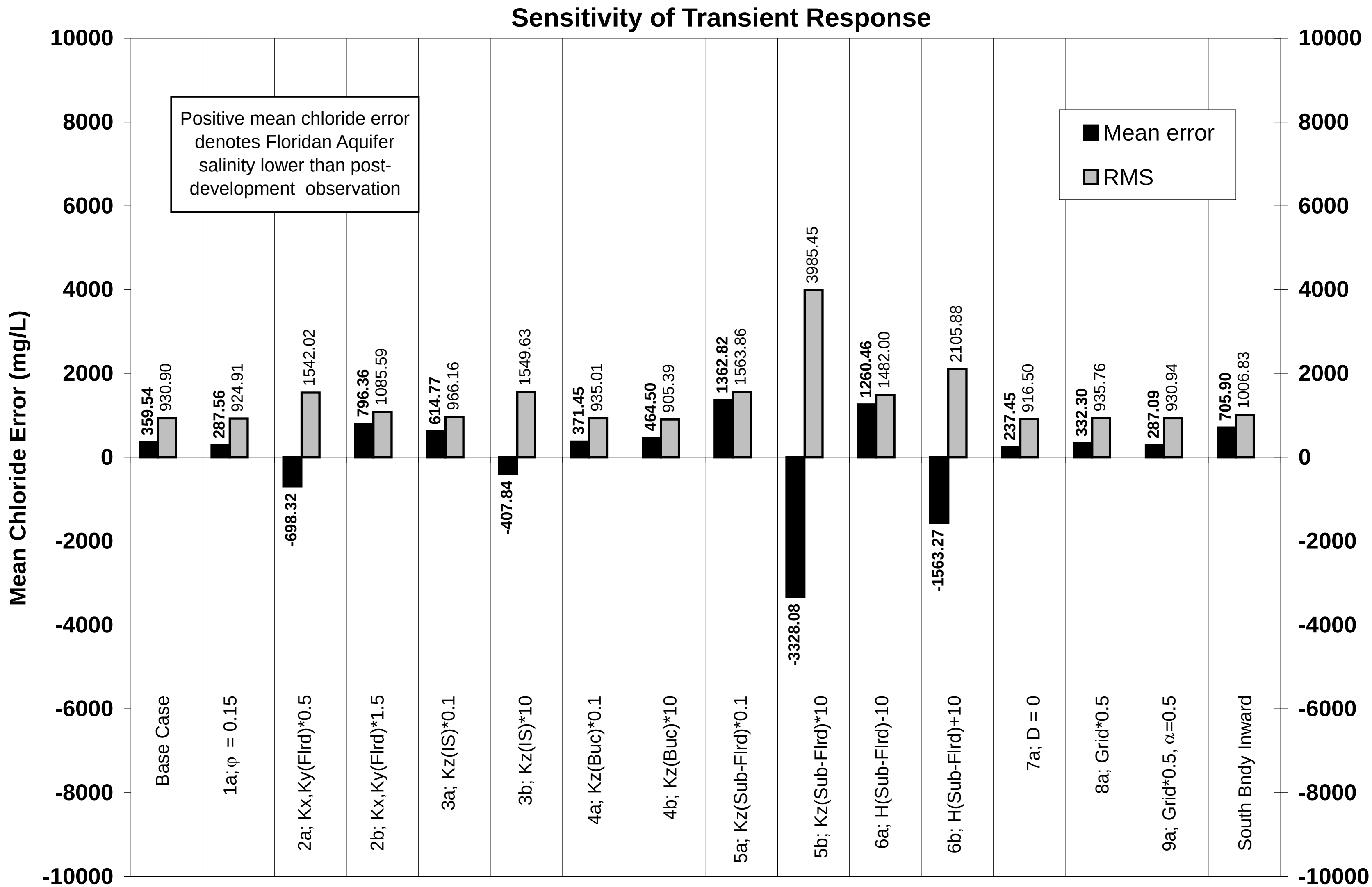
Figure 5.7
RMS and Mean Head Change from Post-Development Base Case for the Upper and Lower Floridan Aquifers Combined



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-10.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 07/21/05 asc
Source: HydroGeoLogic, Inc.

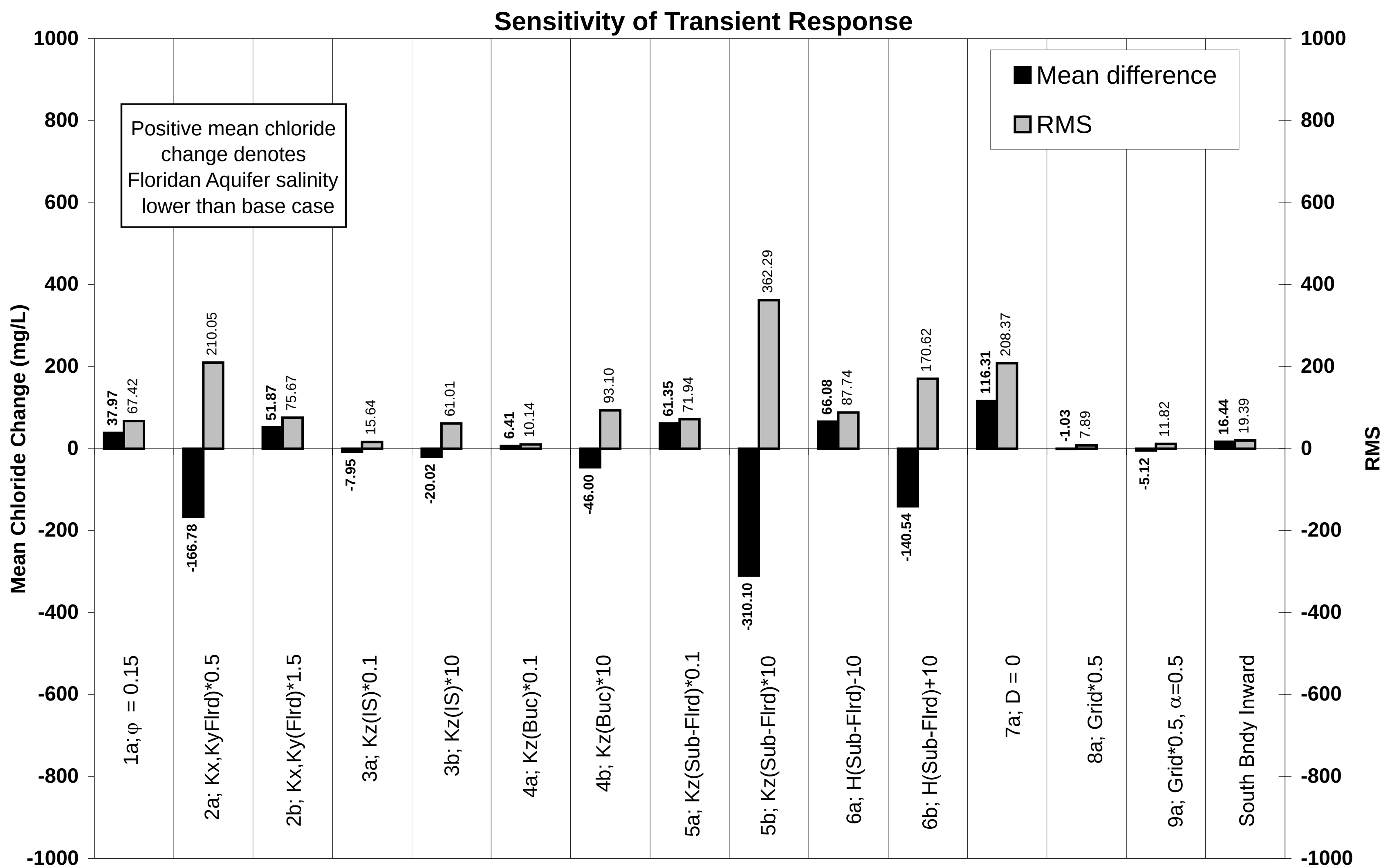
Figure 5.8
RMS and Mean Chloride Error for the Upper Floridan Aquifer



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-11.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 07/21/05 asc
Source: HydroGeoLogic, Inc.

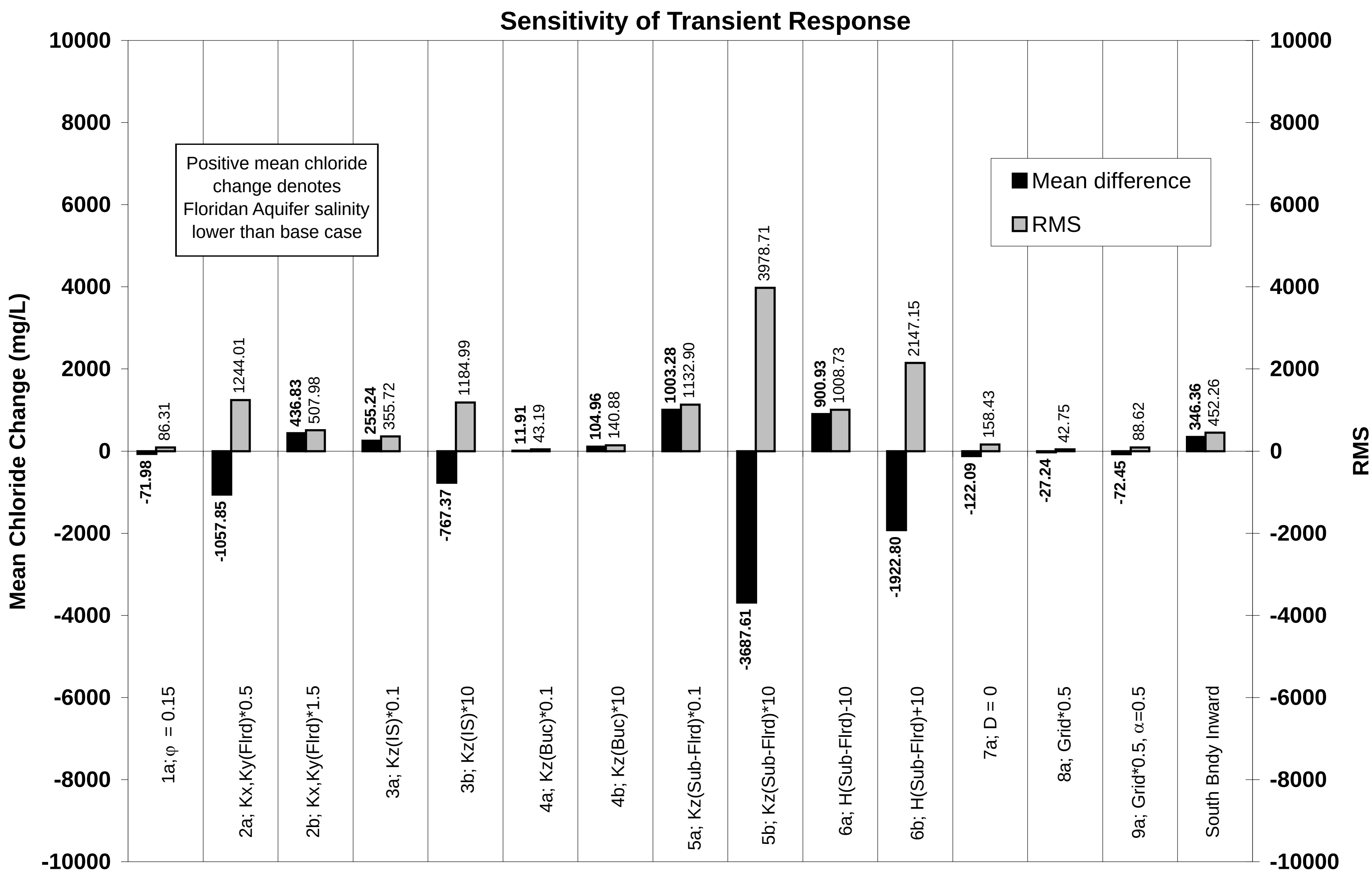
Figure 5.9
RMS and Mean Chloride Error for the Lower Floridan Aquifer



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-7.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 07/21/05 asc
Source: HydroGeoLogic, Inc.

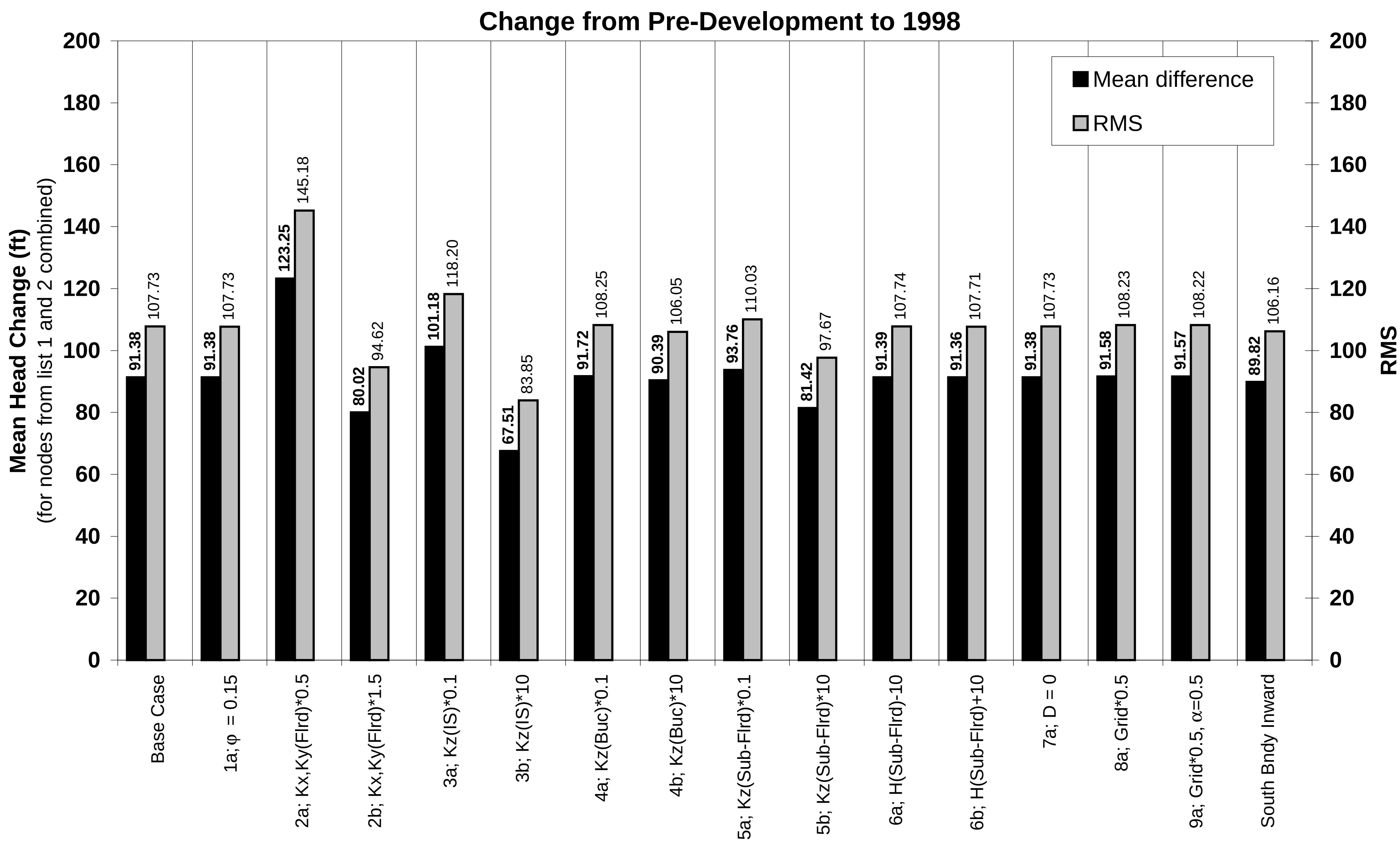
Figure 5.10
RMS and Mean Chloride Change from Post-Development Base Case for the Upper Floridan Aquifer



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-8.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 07/21/05 asc
Source: HydroGeoLogic, Inc.

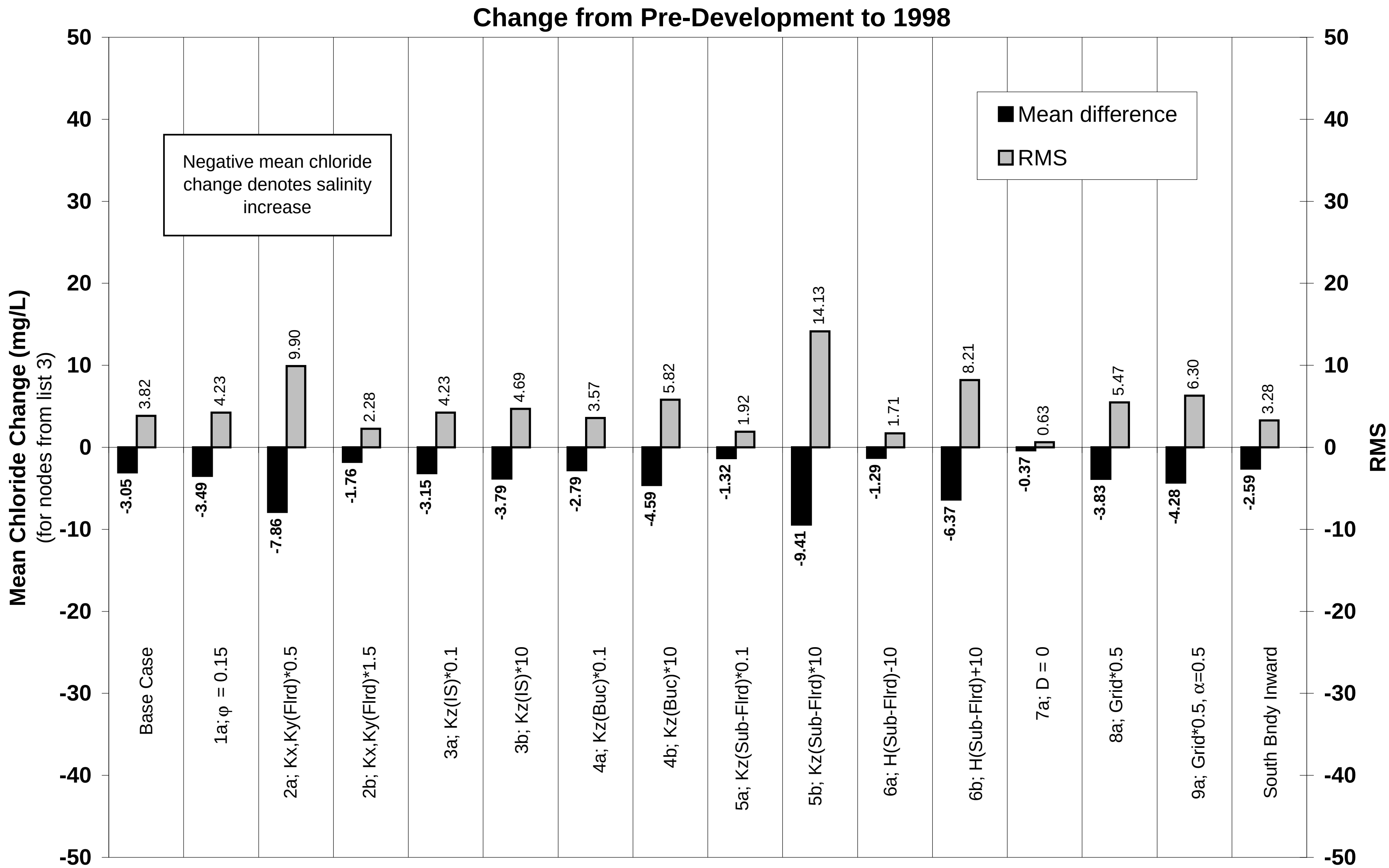
Figure 5.11
RMS and Mean Chloride Change from Post-Development Base Case for the Lower Floridan Aquifer



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-6a.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 04/13/05 cf
Source: HydroGeoLogic, Inc.

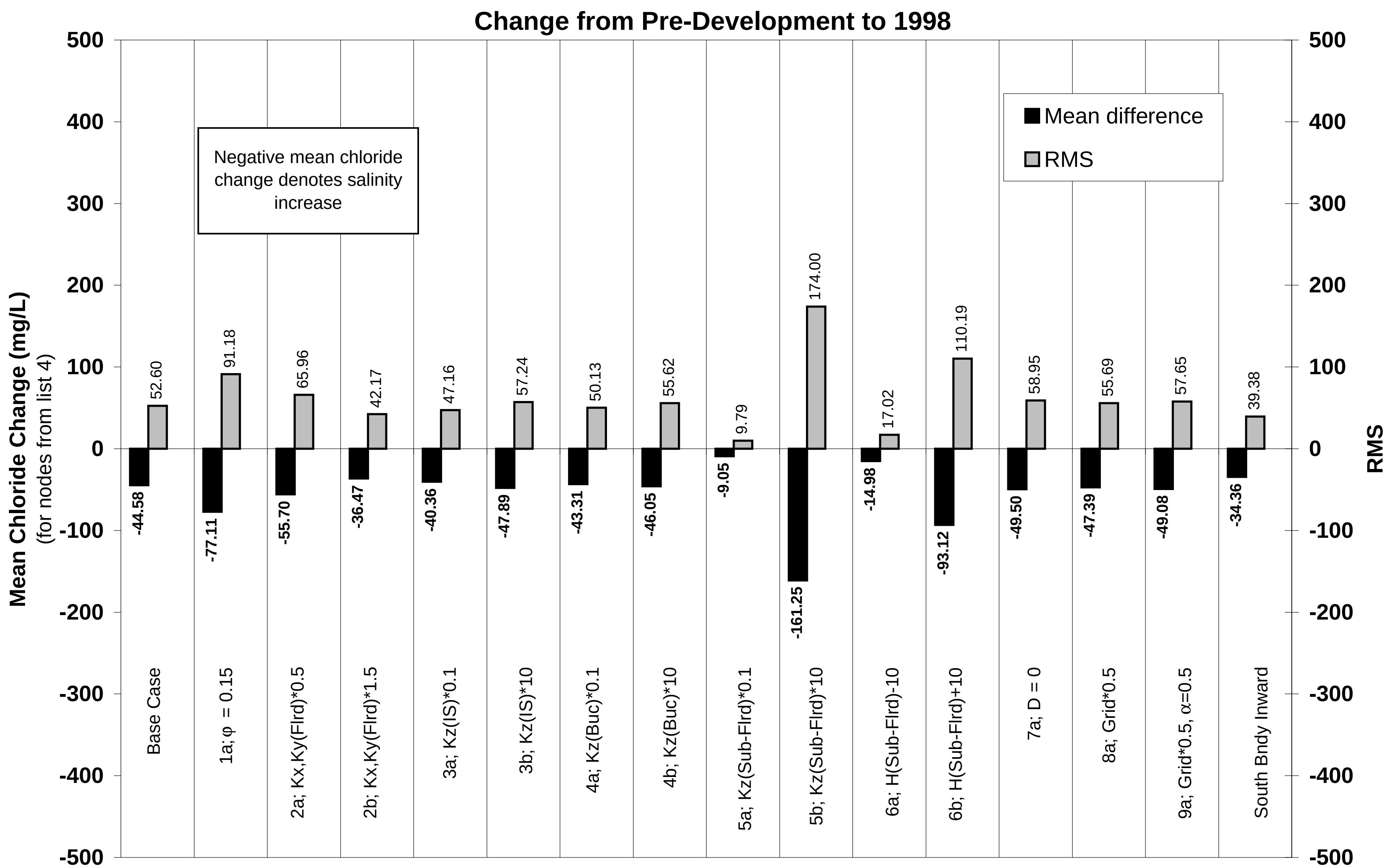
Figure 5.12
RMS and Mean Drawdown from Pre-Development to 1998 for the Upper and Lower Floridan Aquifers Combined



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\chart-7a.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 04/27/05 asc
Source: HydroGeoLogic, Inc.

Figure 5.13
RMS and Mean Chloride Change from Pre-Development to 1998 for the Upper Floridan Aquifer



HydroGeoLogic, Inc.—Northwest Florida Water Management District

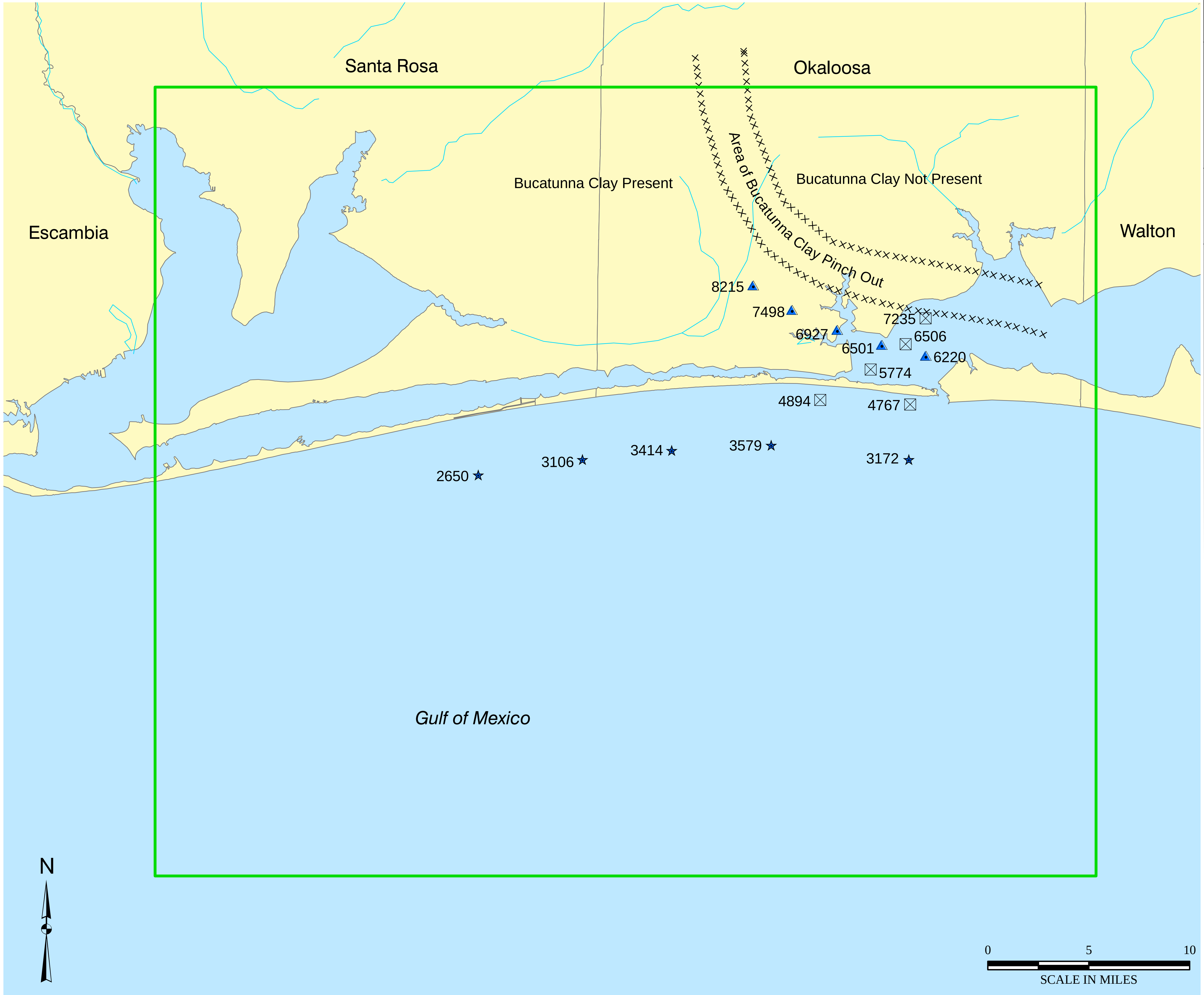
Filename: X:\NWF002\003-07\chart-8a.cdr
Project: NWF002-004-06
Created by: cfarmer 11/02/04
Revised: 04/27/05 asc
Source: HydroGeoLogic, Inc.

Figure 5.14
RMS and Mean Chloride Change from Pre-Development to 1998 for the Lower Floridan Aquifer

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 5.15
Selected Locations for Assessment of Model Results (with Location Reference Number)

Northwest Florida Water Management District



Legend

County Boundary

Hydrology

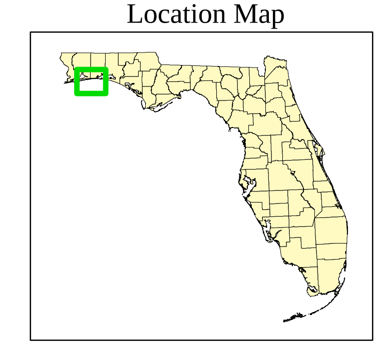
Intermediate System (Element Layer 19)

Upper Floridan Aquifer (Element Layer 16, Node Slice 16)

Lower Floridan Aquifer (Element Layer 8, Node Slice 9)

Model Boundary

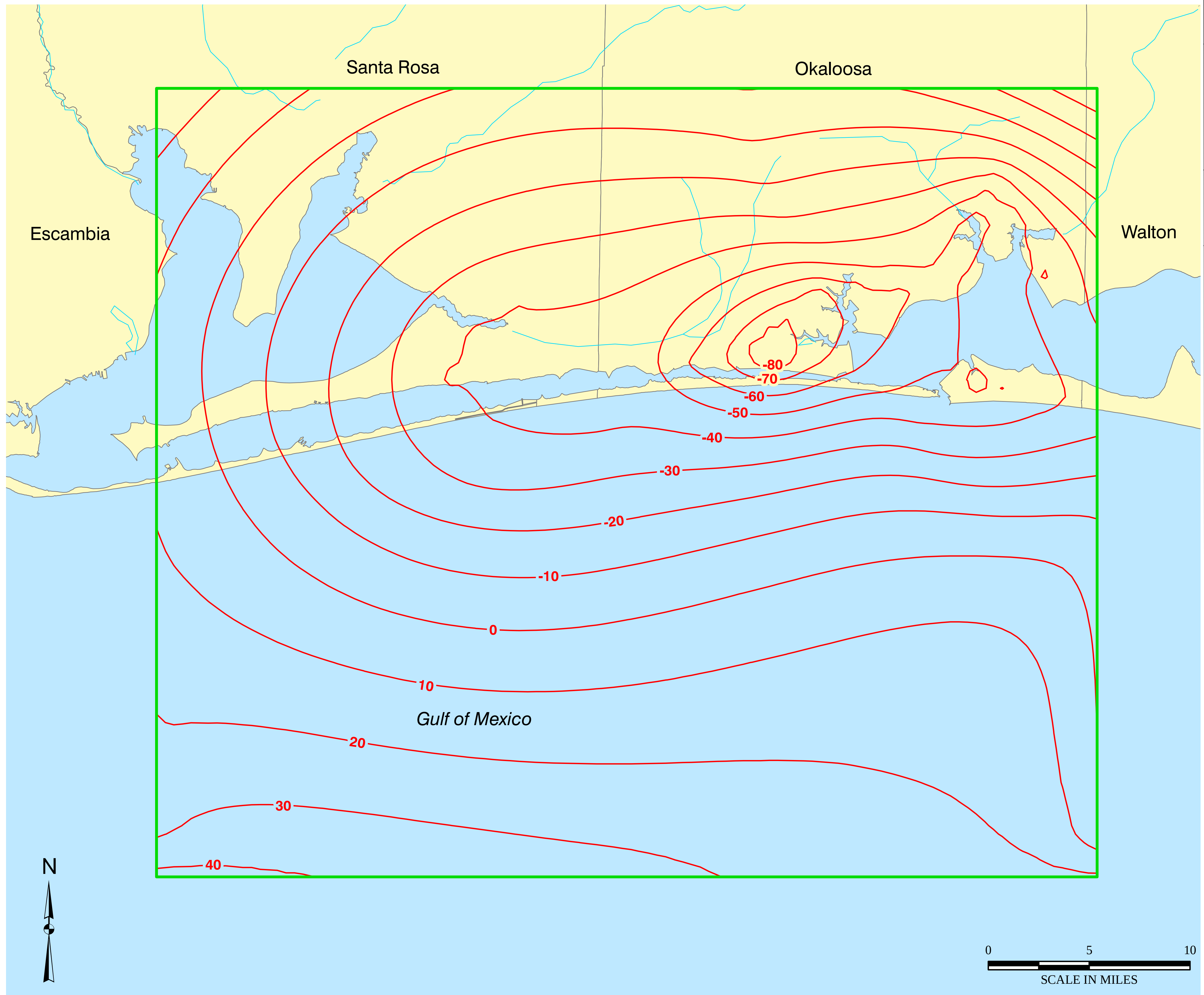
Location Map



Filename: X:/NWF002/003-07/Model_Assess_locations.mxd
Project: NWF002-004-06
Revised: 04/22/05 ASC
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 6.1
Predictive Simulation Equivalent Freshwater Head at Year 2050 for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)



Northwest Florida Water Management District

Legend

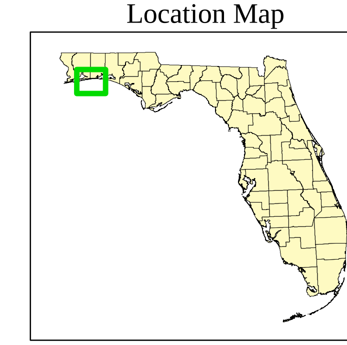
County Boundary

Hydrology

— 20 — Equivalent Freshwater Head (ft)
(nx, ny, nz) = (146,72,21)

Model Boundary

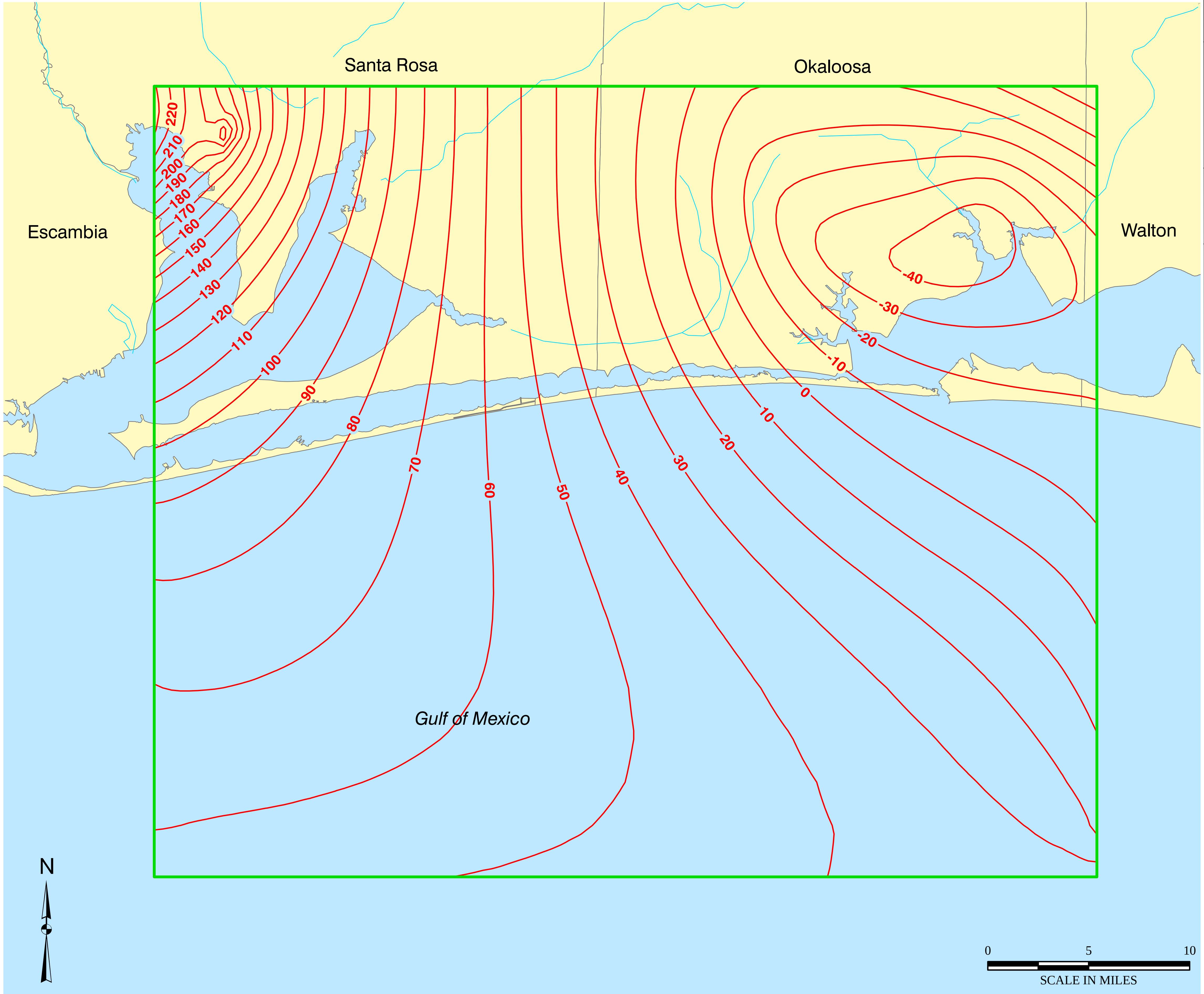
Location Map



Filename: X:/NWF002/004-06/Maps/psefh_L16.mxd
Project: NWF002-004-06
Revised: 04/13/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005

Figure 6.2
Predictive Simulation Equivalent Freshwater Head at Year 2050 for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)

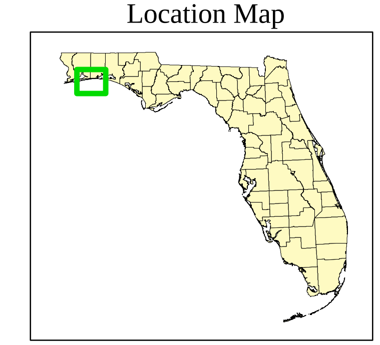
Northwest Florida Water Management District



Legend

- County Boundary
- Hydrology
- 20 Equivalent Freshwater Head (ft) (nx, ny, nz) = (146,72,21)
- Model Boundary

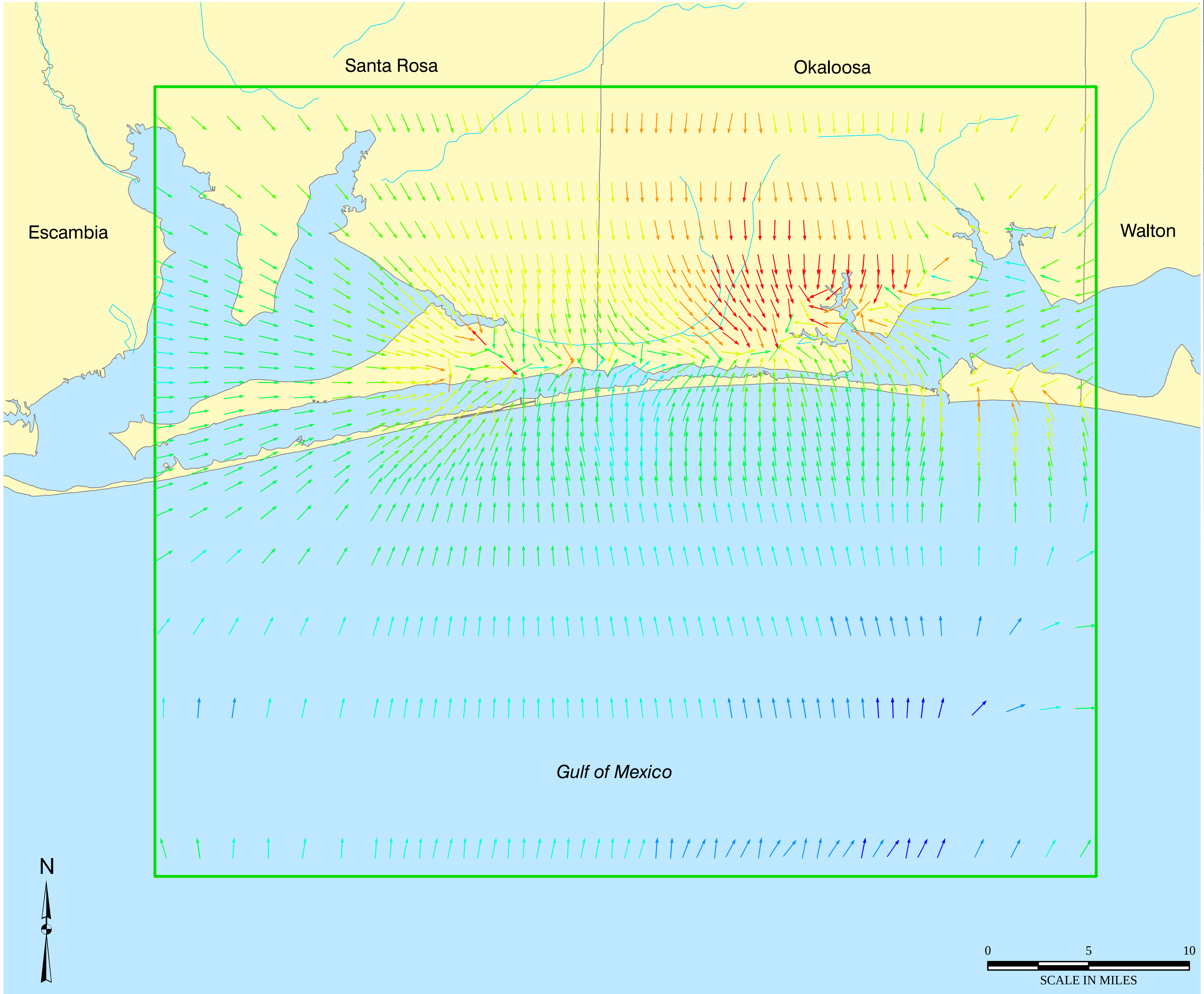
Location Map



Filename: X:/NWF002/004-06/Maps/psefh_L7.mxd
Project: NWF002-004-06
Revised: 04/13/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 6.3
Predictive Simulation Darcy Velocity at Year 2050 for the Upper Floridan Aquifer (Elemental Layer 15, mid-aquifer)



Northwest Florida Water Management District

Legend

County Boundary

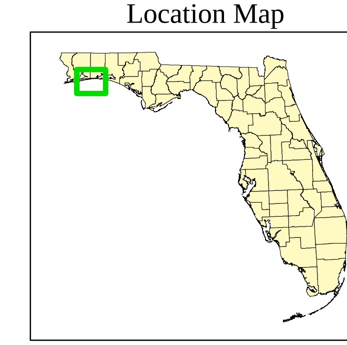
Hydrology

Model Boundary

Velocities (ft/d)

0.03
0.02
0.012
0.008
0.004
0.002
0.001

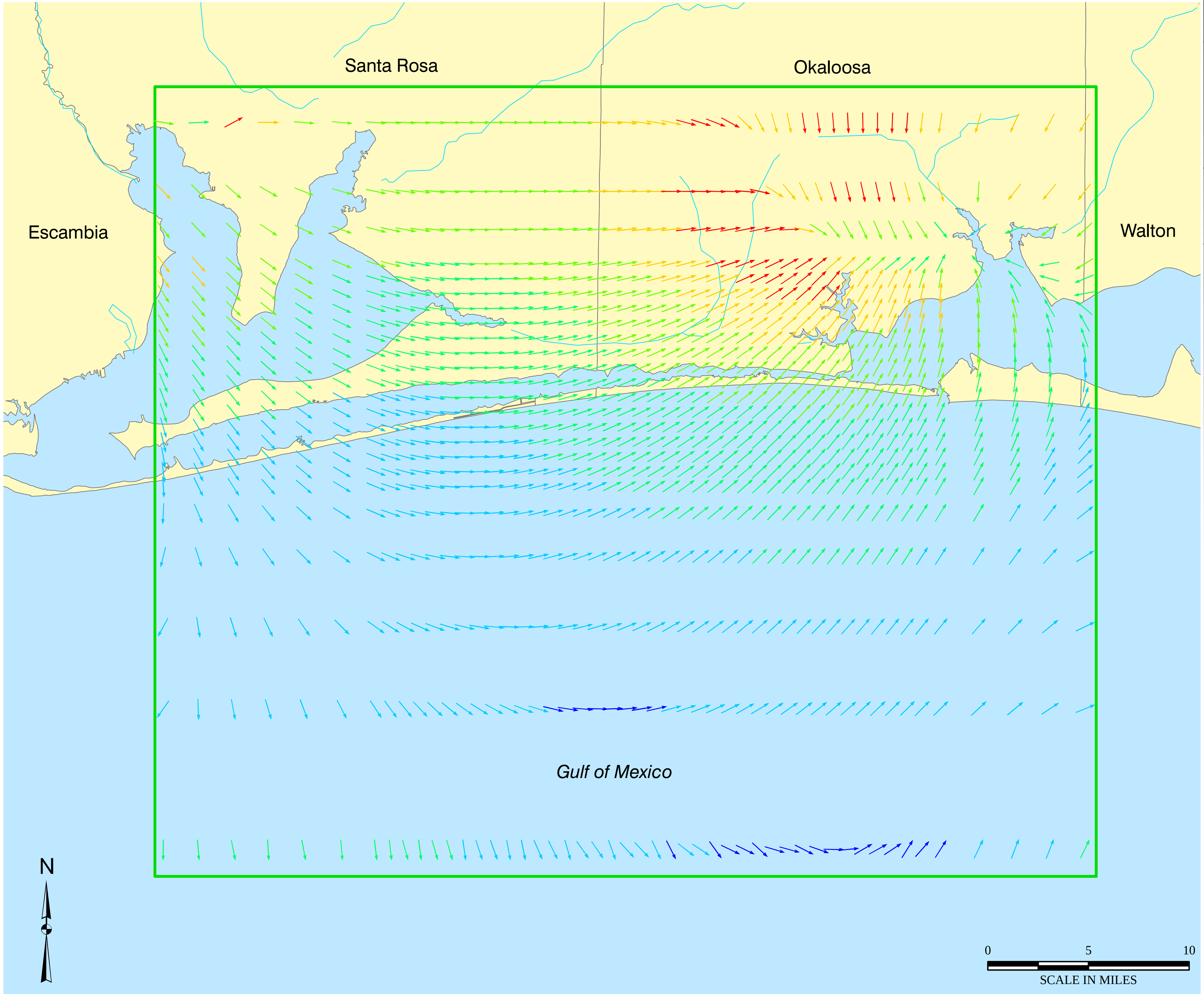
Location Map



Filename: X:/NWF002/004-06/Map/Vel_lay15.mxd
Project: NWF002-004-06
Revised: 04/13/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 6.4
Predictive Simulation Darcy Velocity at Year 2050 for the Lower Floridan Aquifer (Elemental Layer 6, mid-aquifer)



Northwest Florida Water Management District

Legend

County Boundary

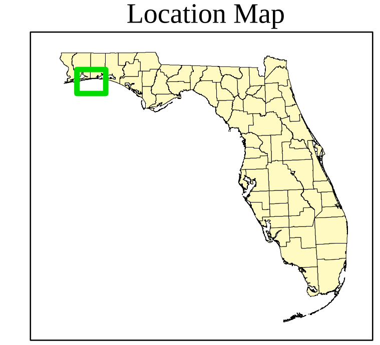
Hydrology

Model Boundary

Velocities (ft/d)

0.012
0.009
0.006
0.003
0.001

Location Map

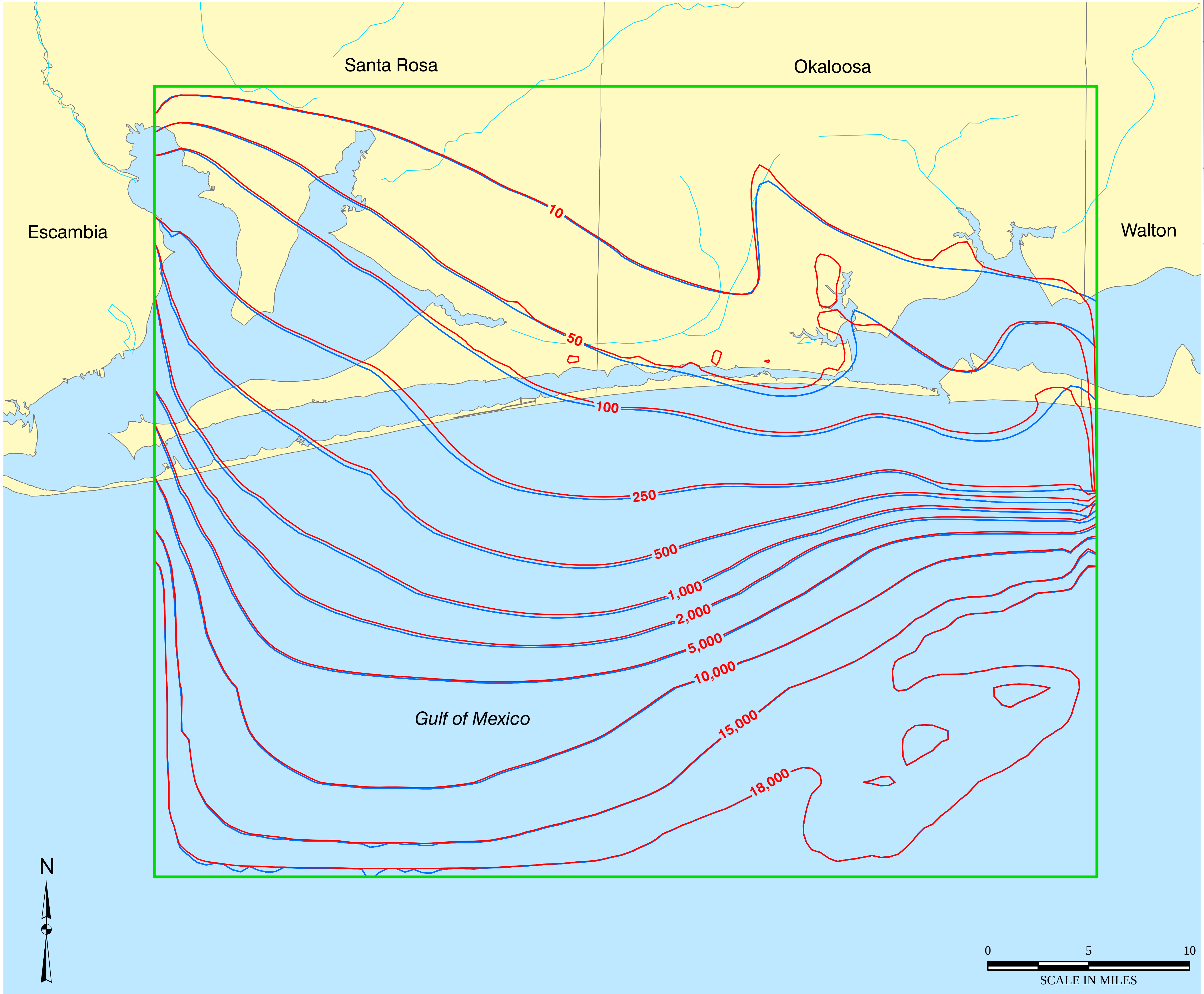


Filename: X:/NWF002/003-07/Map/Vel_lay06.mxd
Project: NWF002-003-07
Revised: 07/21/05 acarriger
Map Source: HydroGeoLogic GIS Database 2002

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 6.5
Pre-Development and 2050 Predictive Simulation Chloride Concentrations for the Upper Floridan Aquifer (Nodal Layer 16, mid-aquifer)

Northwest Florida Water Management District



Legend

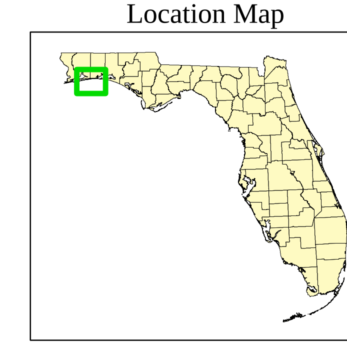
County Boundary

Hydrology

50 Predictive Chloride Concentration (mg/l) (nx, ny, nz) = (146, 72, 21)

50 Pre-Development Chloride Concentration (mg/l)

Model Boundary

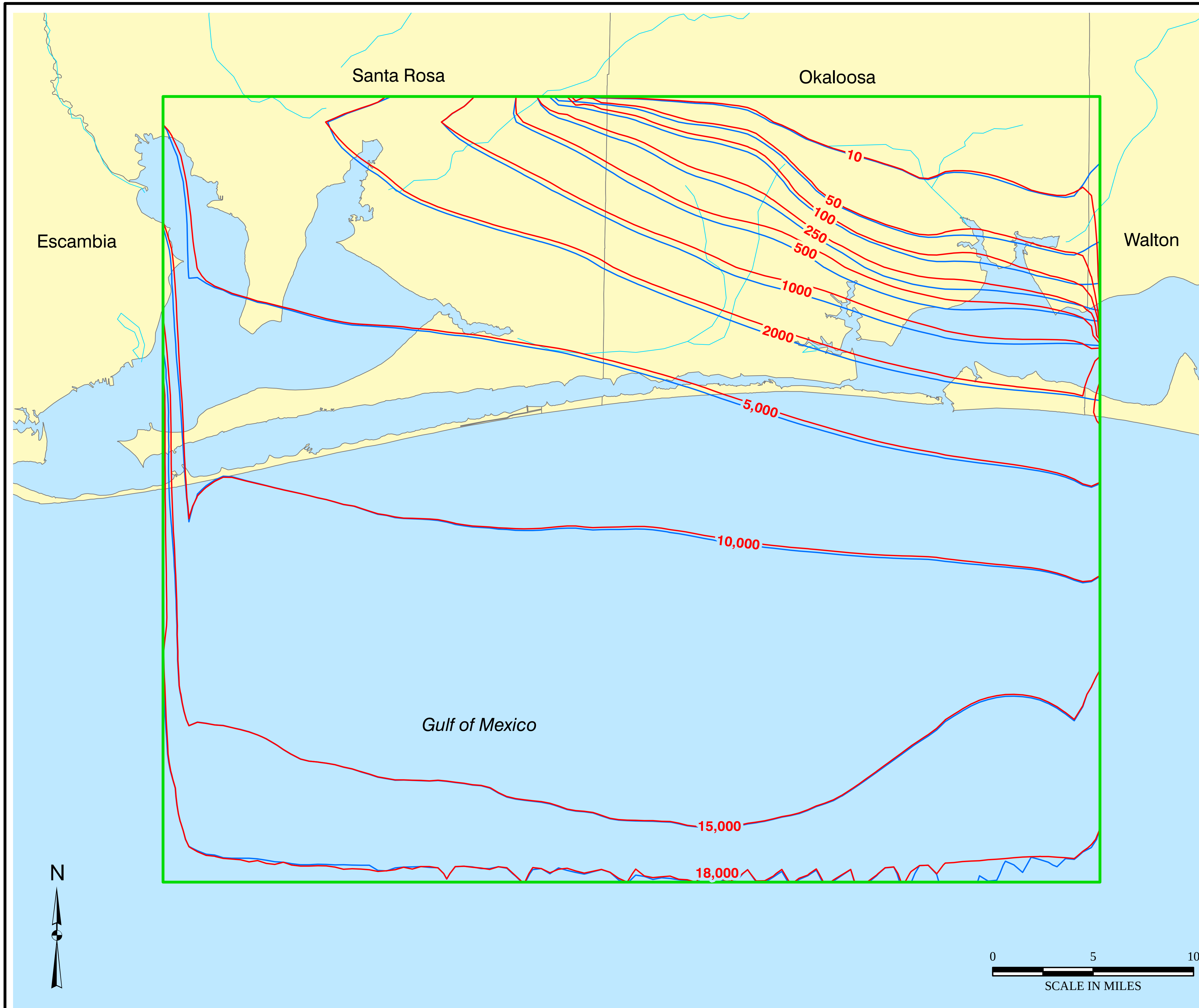


Filename: X:/NWF002/004-06/Maps/Chlor_Conc_PreDev-2050_L16.mxd
Project: NWF002-004-06
Revised: 04/13/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 6.6
Pre-Development and 2050 Predictive Simulation Chloride Concentrations for the Lower Floridan Aquifer (Nodal Layer 7, mid-aquifer)

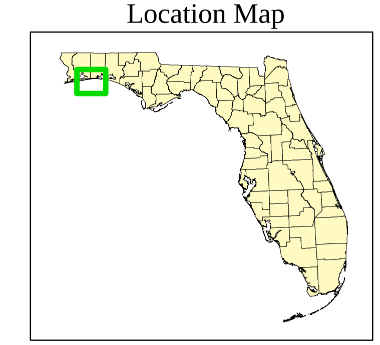
Northwest Florida Water Management District



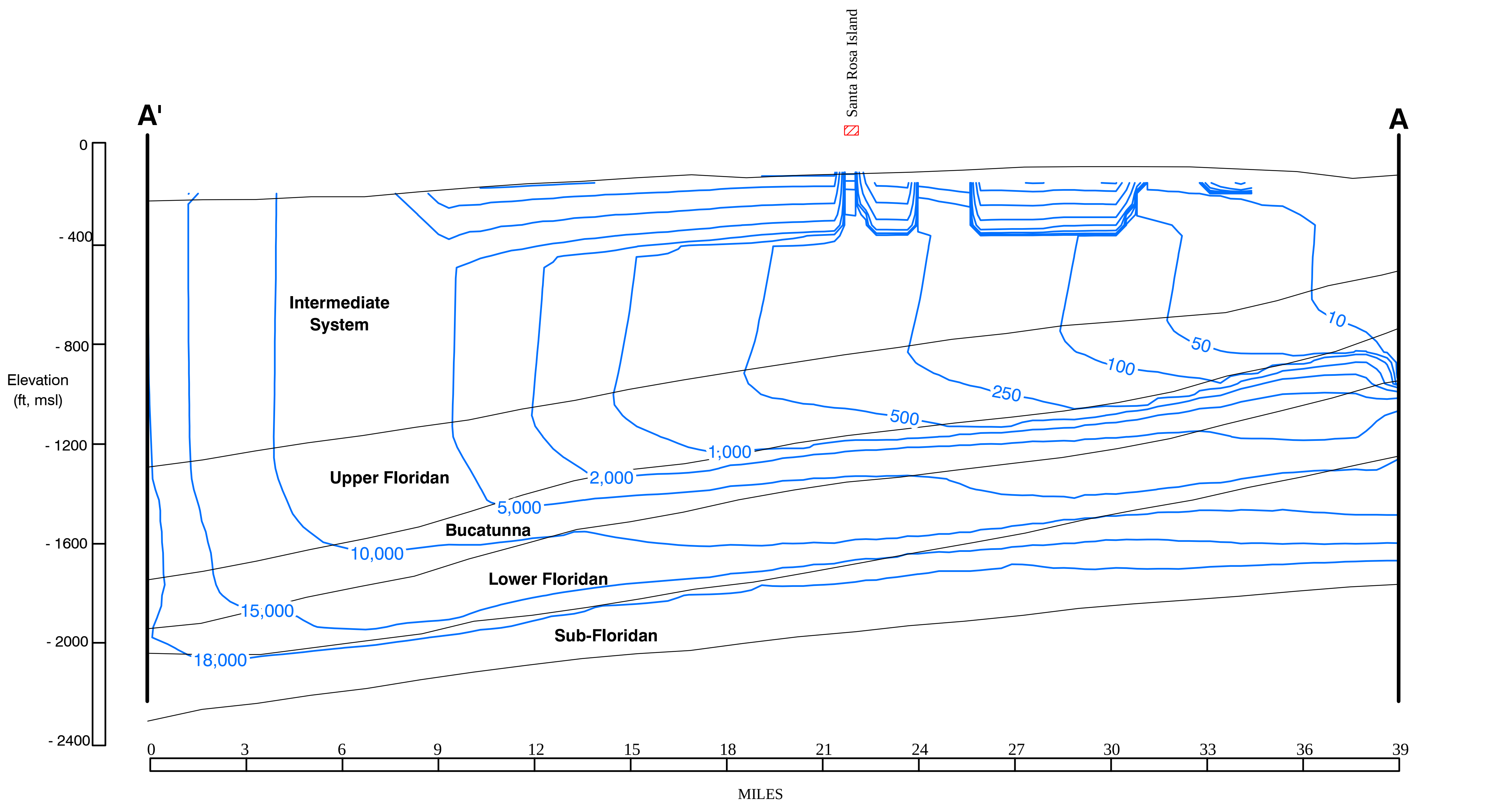
Legend

- County Boundary
- Hydrology
- 50 Predictive Chloride Concentration (mg/l) (nx, ny, nz) = (146, 72, 21)
- 50 Pre-Development Chloride Concentration (mg/l)
- Model Boundary

Location Map



Filename: X:/NWF002/004-06/Maps/ Chlor_Conc_PreDev-2050_L7.mxd
Project: NWF002-004-06
Revised: 04/13/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 6.7
2050 Predictive Simulation Chloride Concentration for Cross-Section A-A'

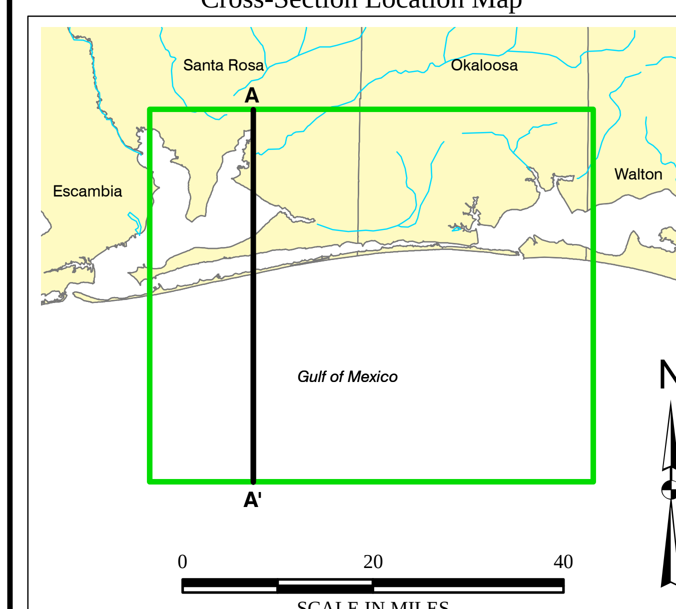
Northwest Florida Water Management District

Legend

Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map

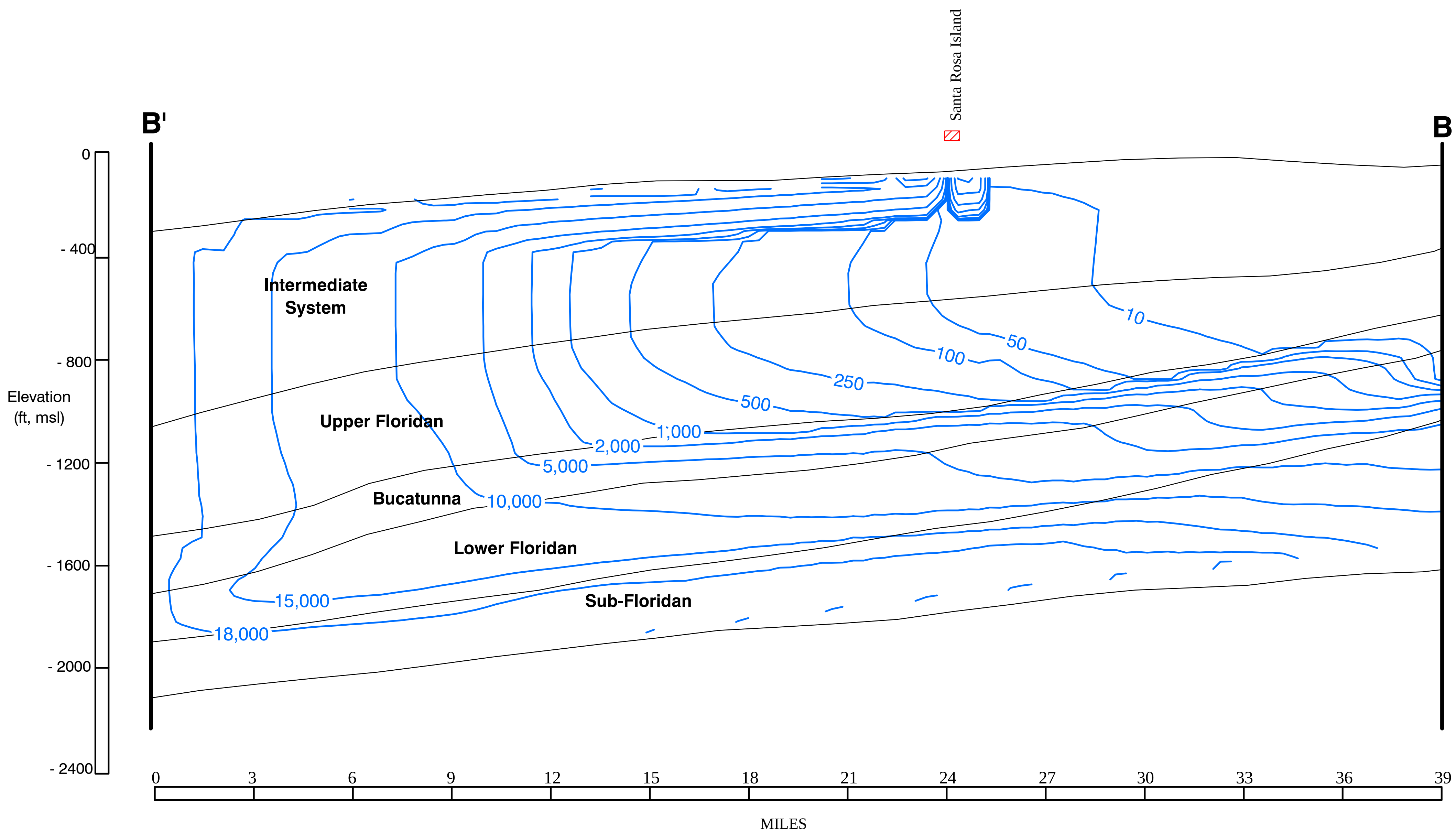


Filename: X:/NWF002/004-06/Maps/aa'chlor_2050_x-sec.mxd
Project: NWF002-004-06
Revised: 04/13/05 tbraswell
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 6.8
2050 Predictive Simulation Chloride Concentration for Cross-Section B-B'

Northwest Florida Water Management District

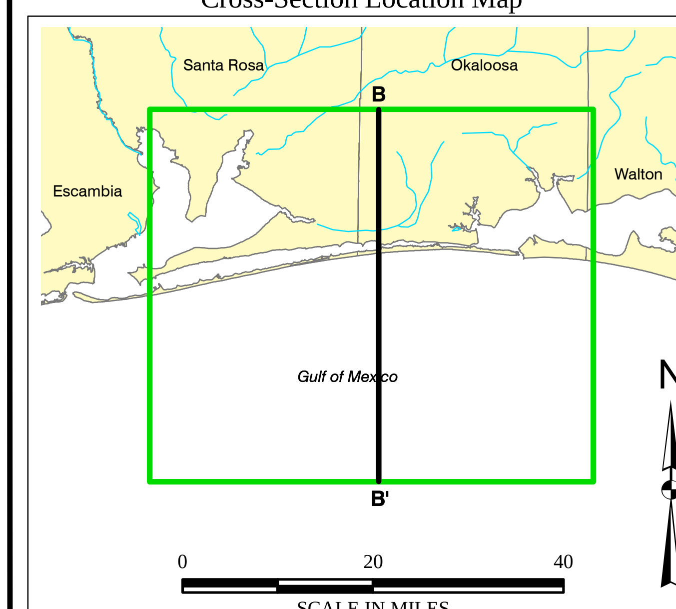


Legend

Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map

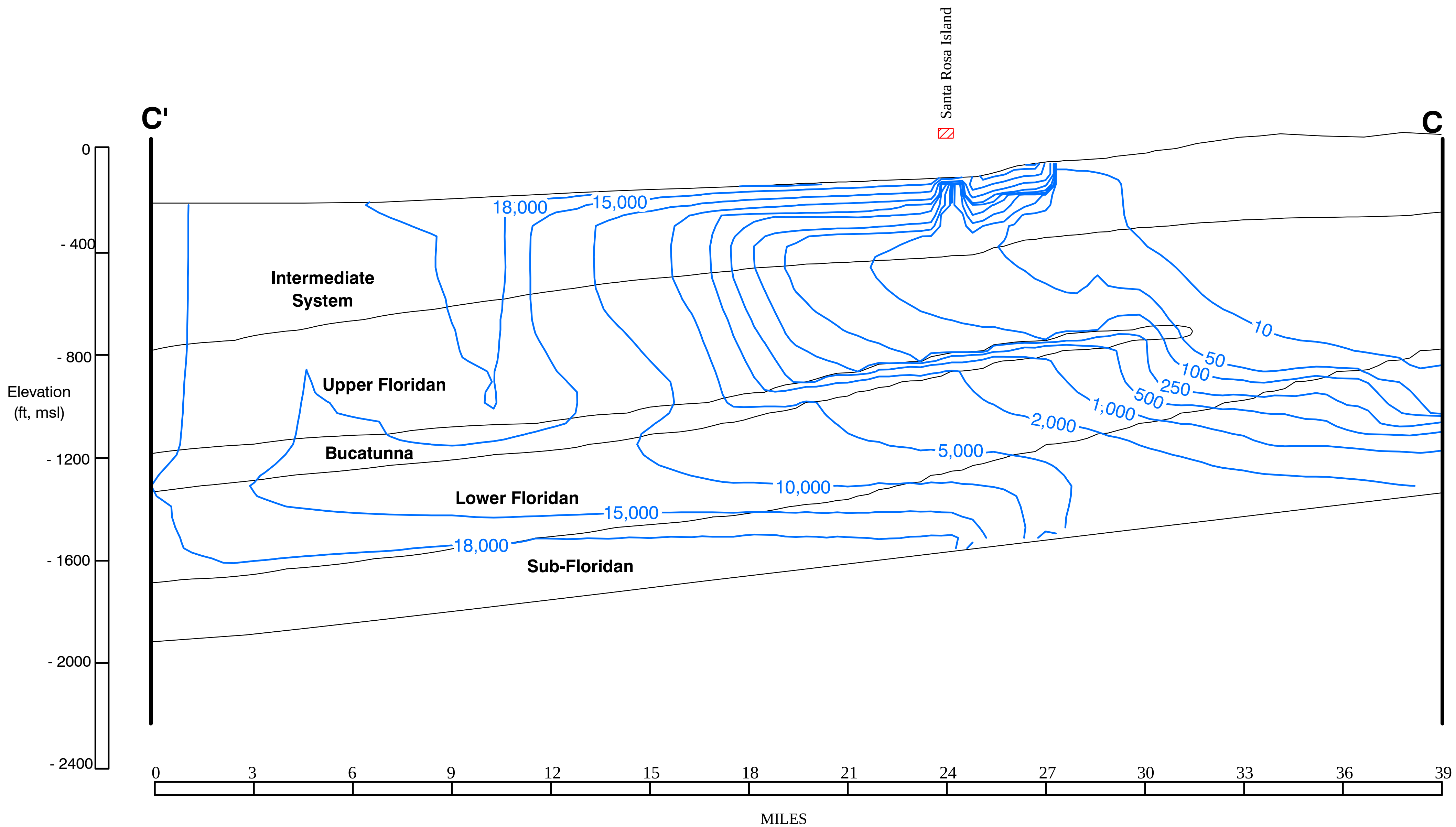


Filename: X:/NWF002/004-06/Maps/bb'chlor_2050_x-sec.mxd
Project: NWF002-004-06
Revised: 04/26/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005

HydroGeoLogic, Inc.—Northwest Florida Water Management District

Figure 6.9
2050 Predictive Simulation
Chloride Concentration
for Cross-Section C-C'

Northwest Florida Water Management District

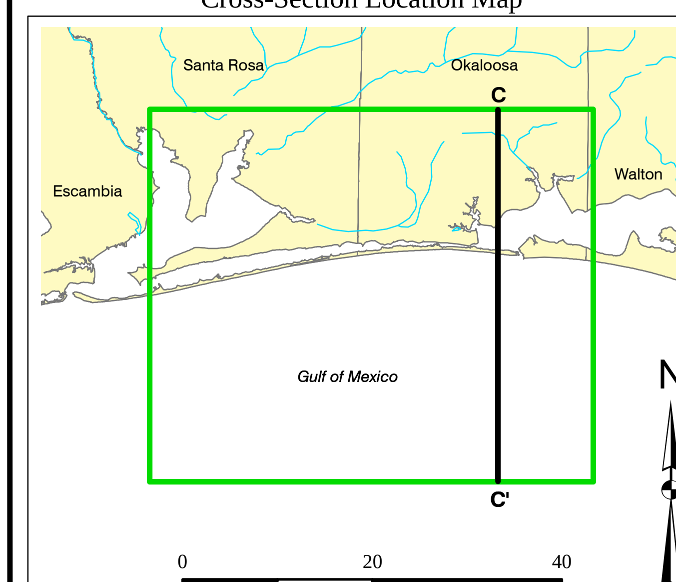


Legend

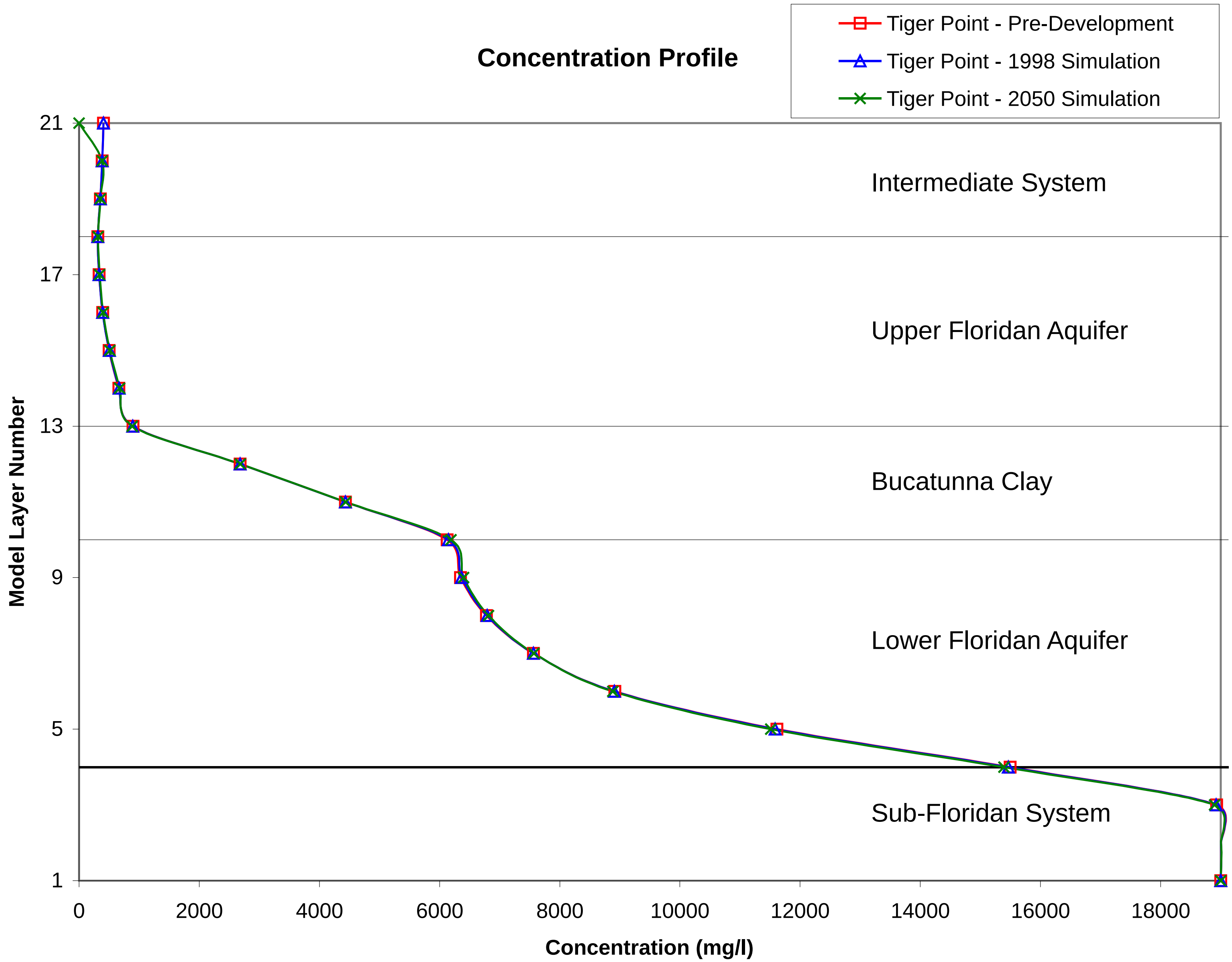
Chloride Concentration Contour (mg/L)

Vertical Exaggeration 41:1

Cross-Section Location Map



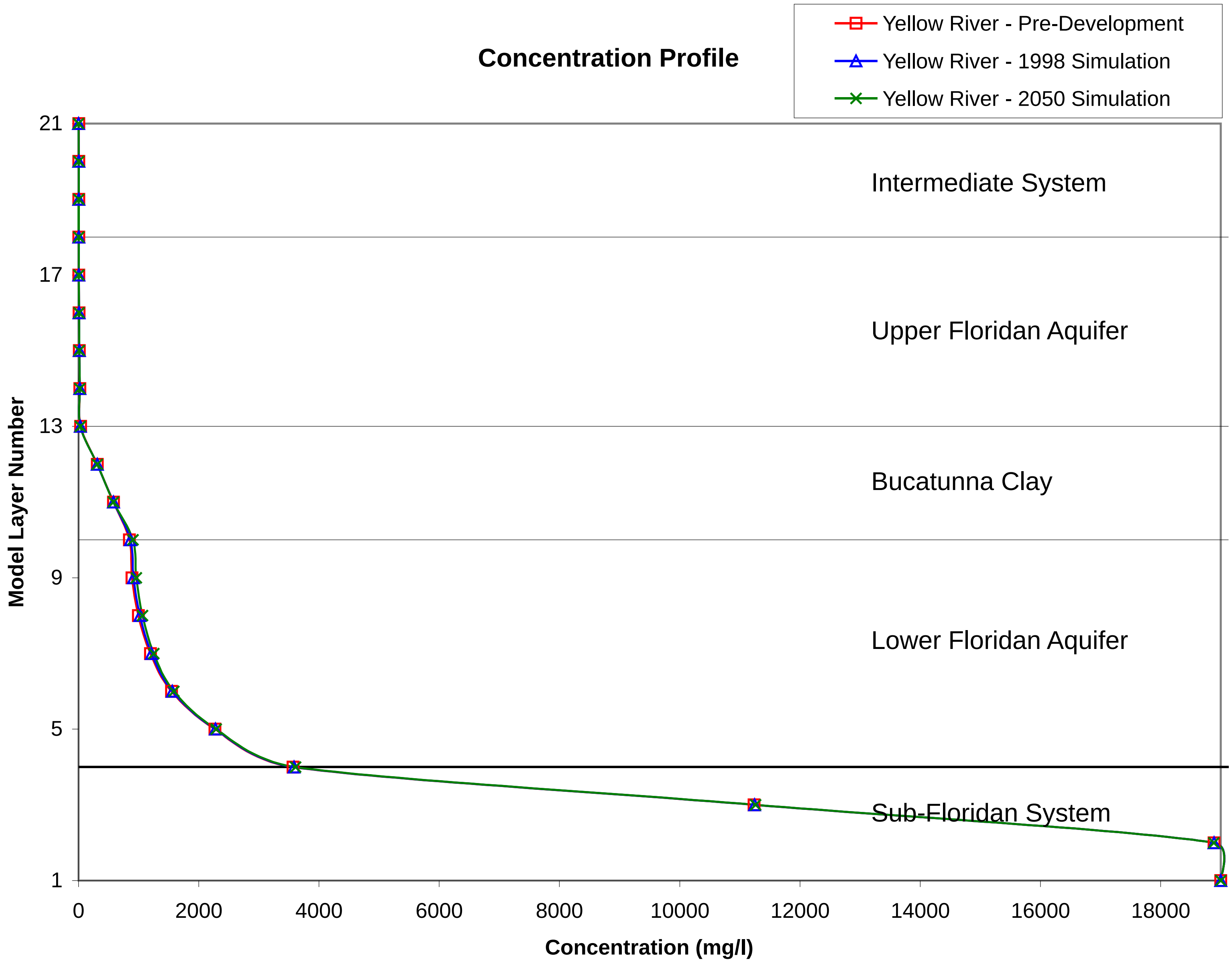
Filename: X:/NWF002/003-07/Maps/cc'chlor_2050_x-sec.mxd
Project: NWF002-003-07
Revised: 08/08/05 acarriger
Map Source: HydroGeoLogic GIS Database 2005



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Tiger_Point.cdr
Project: NWF002-003-07
Created by: cfarmer 11/08/04
Revised: 04/13/05 cf
Source: HydroGeoLogic, Inc.

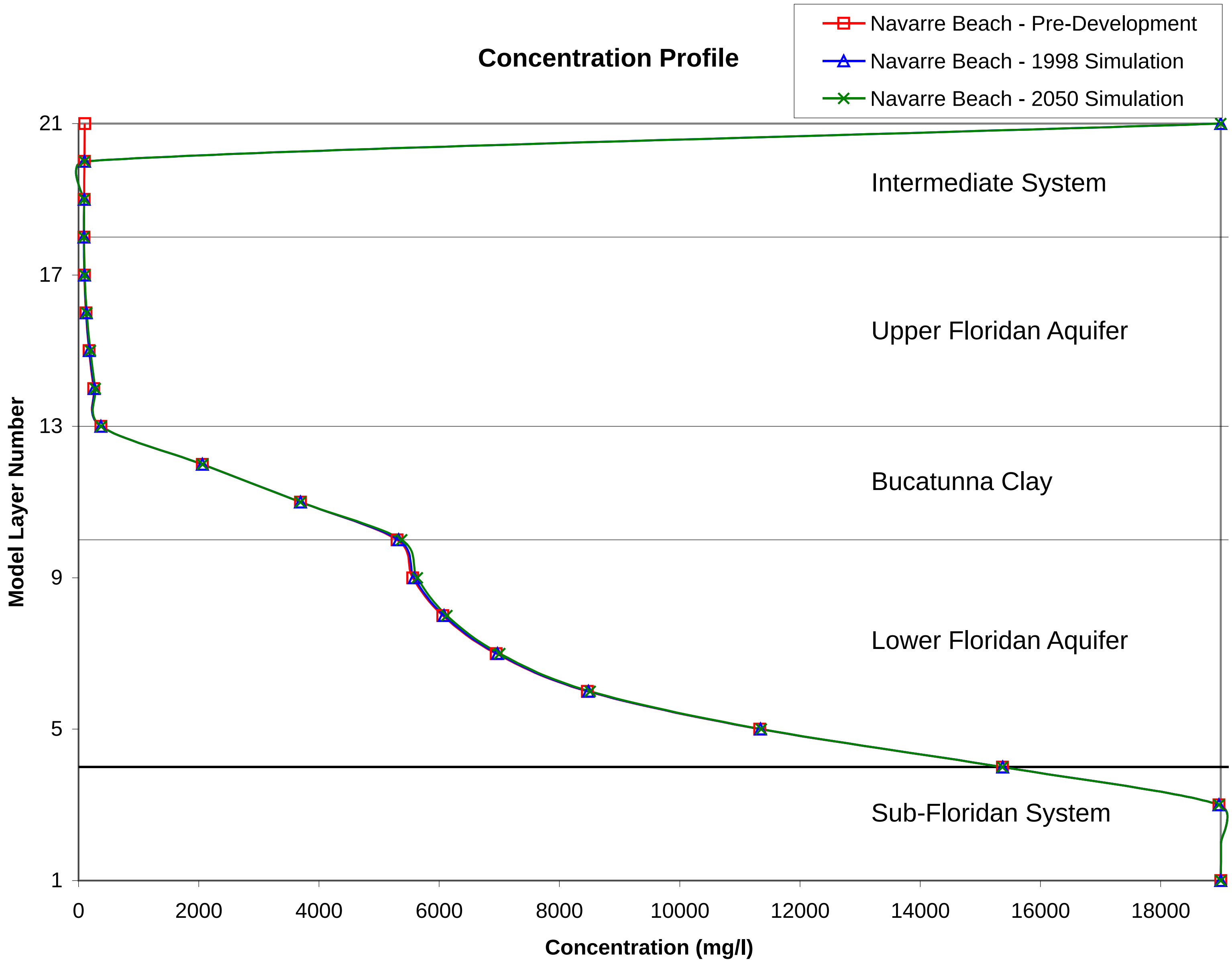
Figure 6.10
Concentration Profile at Tiger Point
for Pre-Development, 1998 and 2050 Simulations



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Yellow_River.cdr
Project: NWF002-004-06
Created by: cfarmer 11/08/04
Revised: 04/13/05 cf
Source: HydroGeoLogic, Inc.

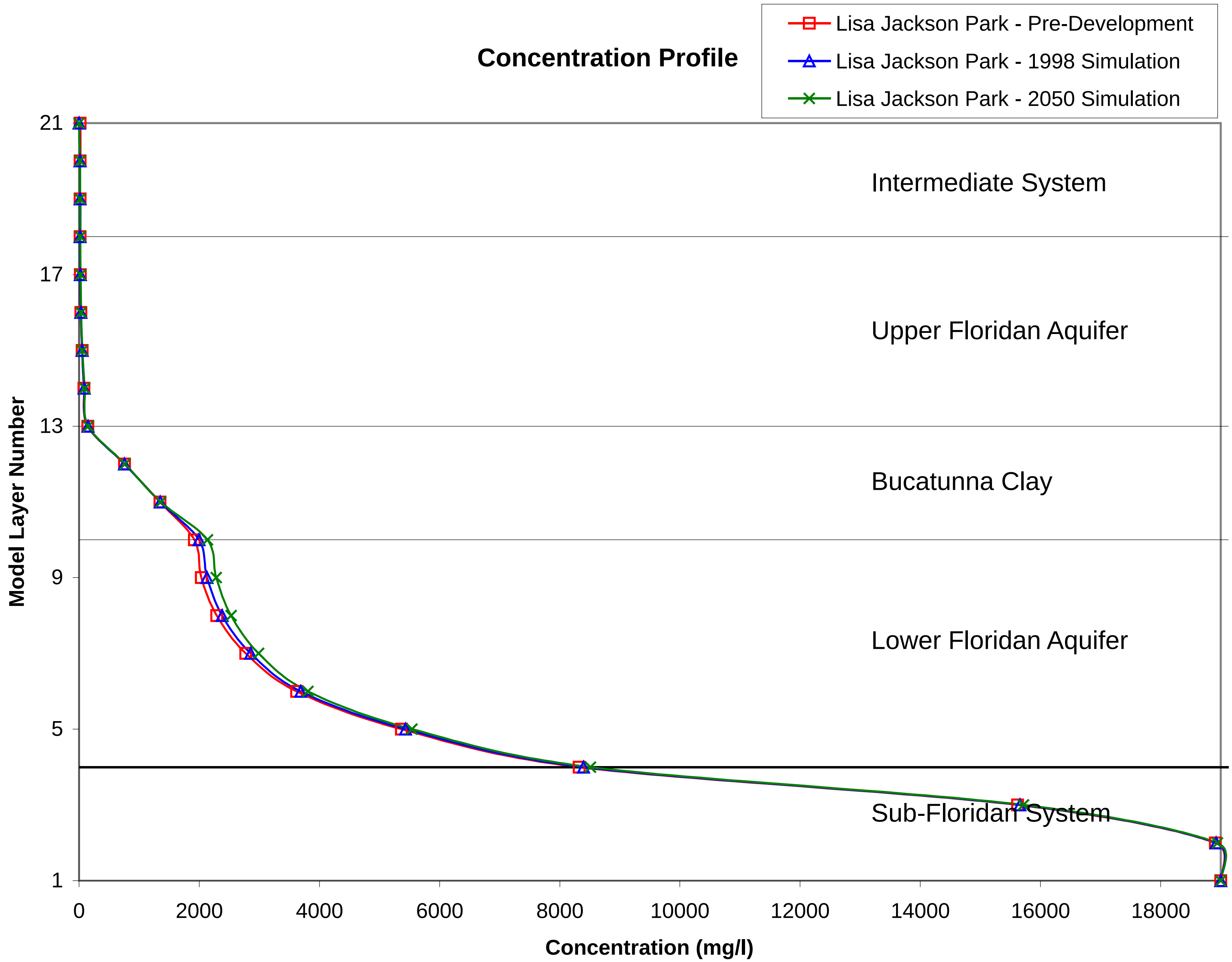
Figure 6.11
Concentration Profile at Yellow River
for Pre-Development, 1998 and 2050 Simulations



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Navarre_Beach.cdr
Project: NWF002-004-06
Created by: cfarmer 11/08/04
Revised: 04/13/05 cf
Source: HydroGeoLogic, Inc.

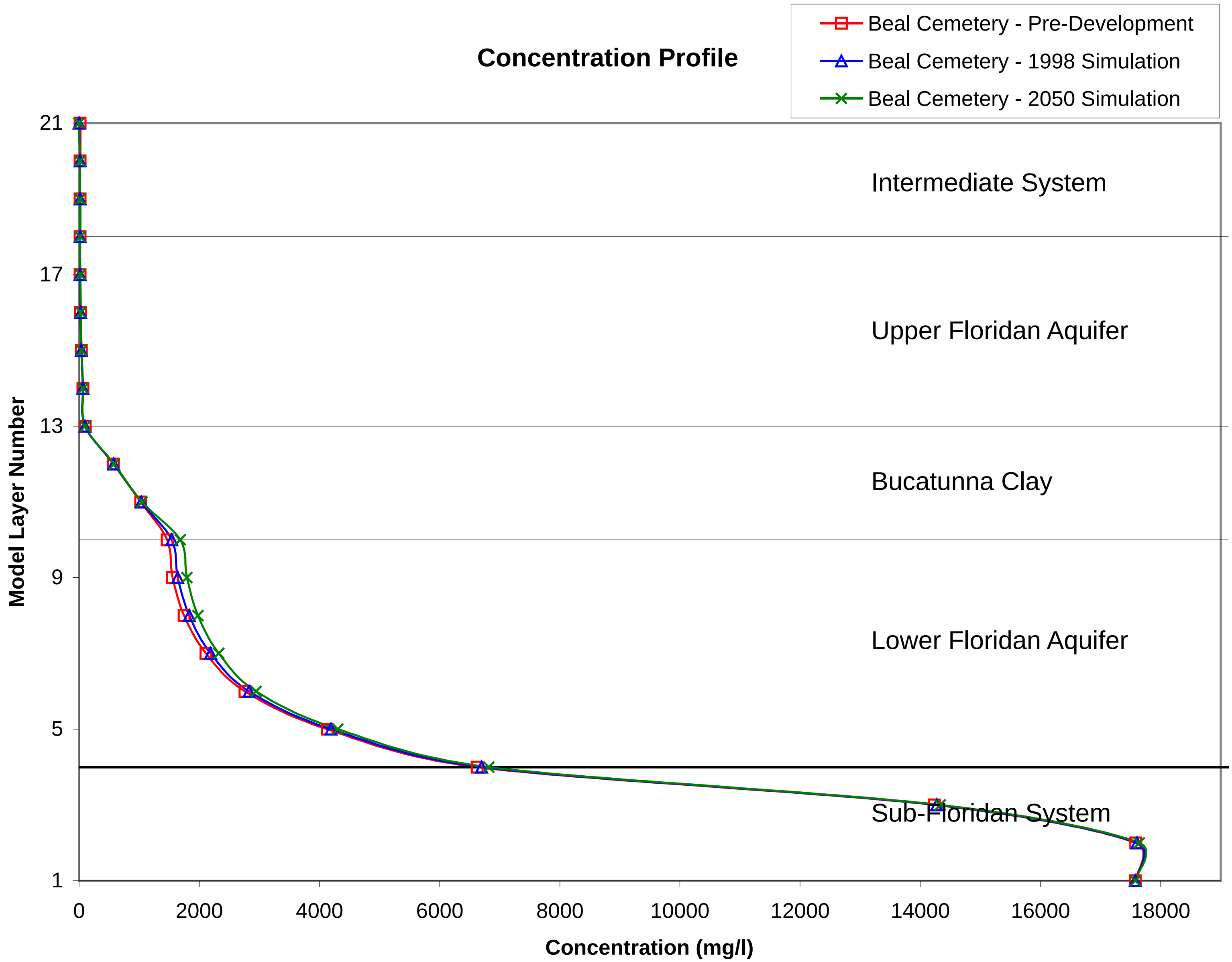
Figure 6.12
Concentration Profile at Navarre Beach for Pre-Development, 1998 and 2050 Simulations



HydroGeoLogic, Inc.—Northwest Florida Water Management District

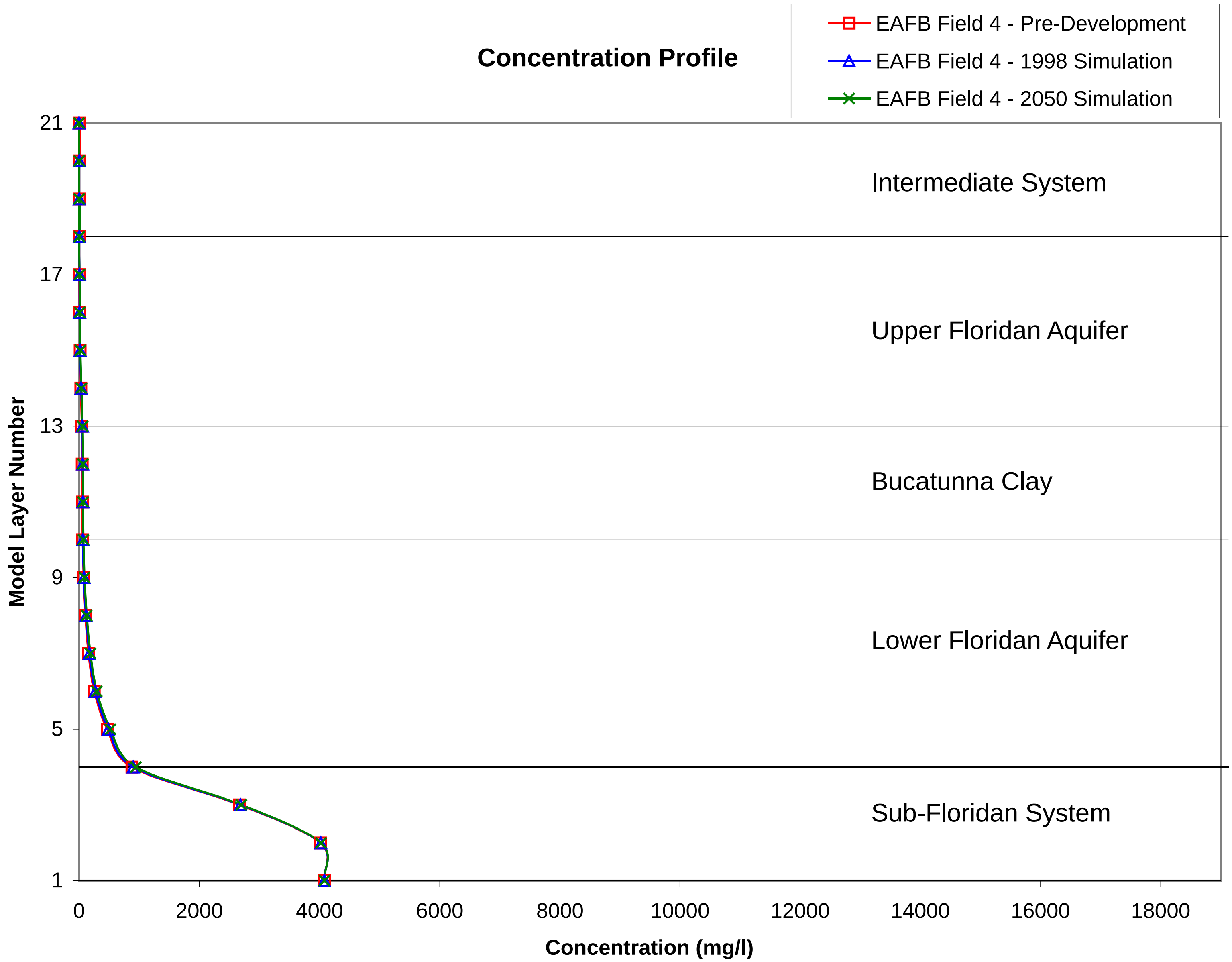
Filename: X:\NWF002\003-07\Lisa_Jackson.cdr
Project: NWF002-004-06
Created by: cfarmer 11/08/04
Revised: 04/13/05 cf
Source: HydroGeoLogic, Inc.

Figure 6.13
Concentration Profile at Lisa Jackson Park
for Pre-Development, 1998 and 2050 Simulations



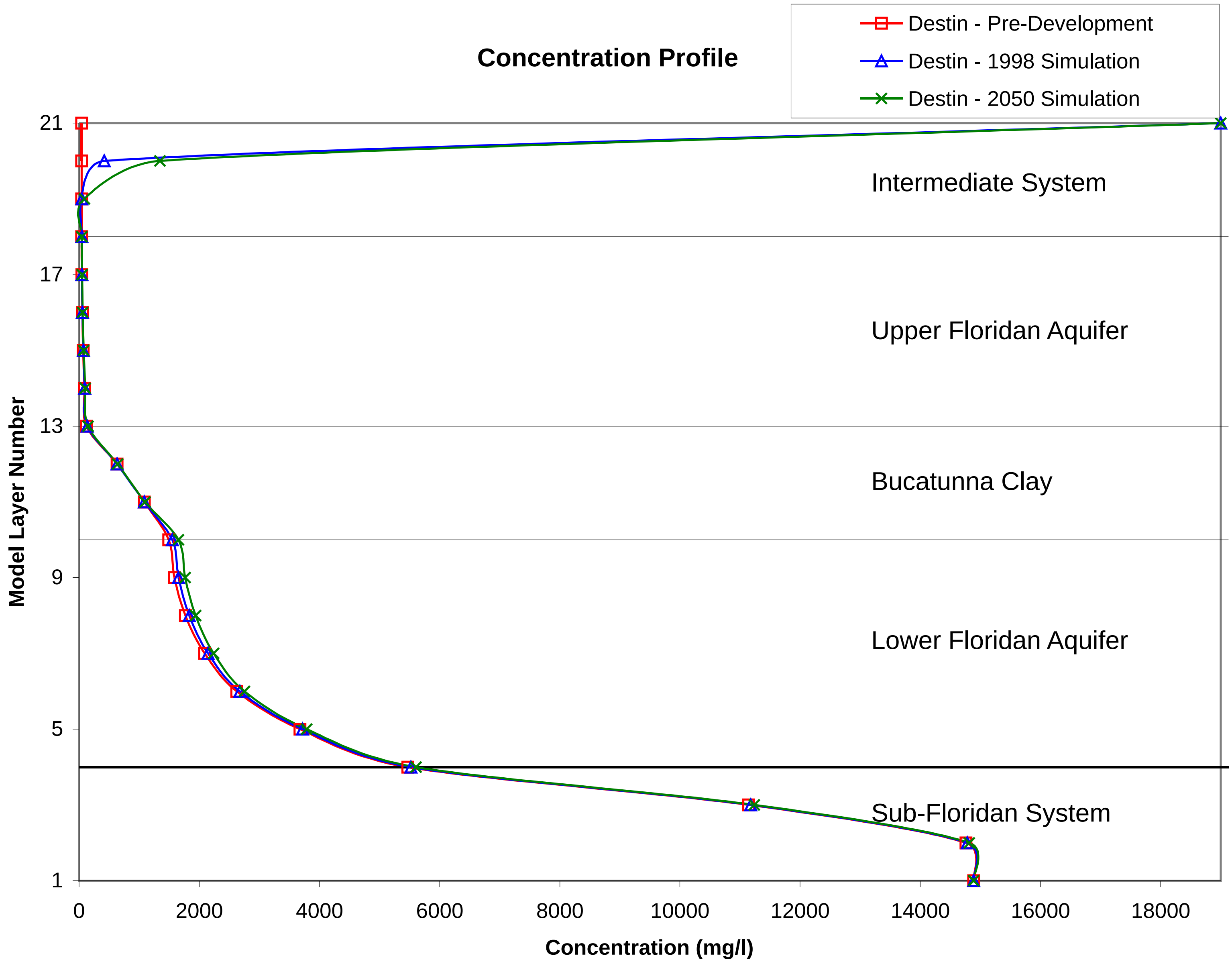
Filename: X:\NWF002\003-07\Beal_Cemetery.cdr
Project: NWF002-004-06
Created by: cfarmer 11/08/04
Revised: 04/13/05 cf
Source: HydroGeoLogic, Inc.

Figure 6.14
Concentration Profile at Beal Cemetery for Pre-Development, 1998 and 2050 Simulations



Filename: X:\NWF002\003-07\EAFB_Field4.cdr
Project: NWF002-004-06
Created by: cfarmer 11/08/04
Revised: 04/13/05 cf
Source: HydroGeoLogic, Inc.

Figure 6.15
Concentration Profile at EAFB Field 4
for Pre-Development, 1998 and 2050 Simulations



HydroGeoLogic, Inc.—Northwest Florida Water Management District

Filename: X:\NWF002\003-07\Destin.cdr
Project: NWF002-004-06
Created by: cfarmer 11/08/04
Revised: 04/13/05 cf
Source: HydroGeoLogic, Inc.

Figure 6.16
Concentration Profile at Destin
for Pre-Development, 1998 and 2050 Simulations

TABLES

Table 2.1
Variation of Chloride Content with Depth for the FREEPORT REMOTE OBS (7233) Well

Freeport Remote Observation Well	
estimated chloride concentration (mg/L)	**point sample interval (ft below land surface)**
0	250
0	350
0	450
0	530
0	575
21	595
500	610
4300	650
5300	700
7100	750
8900	770

Note: Chloride concentrations estimated from fluid resistivity logs.

Table 2.2
Variation of Chloride Content with Depth for the WRP LOWER FLRD TEST (7260) Well

WRP Lower Floridan Monitor Well	
measured chloride concentration (mg/L)	**midpoint of sampled interval (ft below land surface)**
1200	948
1590	980
2240	1020
2930	1060
3860	1075
6370	1110
7280	1150
7790	1185
8600	1220
9580	1320
16900	1402

Note: Chloride concentrations obtained from packer samples.

Table 2.3
Variation of Chloride Content with Depth for the NWFWMD TIGER POINT (7686) Well

NWFWMD Tiger Point Upper Floridan Monitor Well	
measured chloride concentration (mg/L)	**depth of penetration at time of sample collection (ft below land surface)**
340	1200
390	1220
410	1240
420	1260
520	1280
590	1300

Note: Chloride concentrations obtained from drill stem samples.

Table 4.1
Water Balance for Pre-Development Conditions

	Flow In (Mgal/day)	Percent of Total	Flow Out (Mgal/day)	Percent of Total
Northern Boundary	5.58	23.76	0.05	0.23
Southern Boundary	5.70	24.27	6.46	27.51
Eastern Boundary	2.90	12.35	6.42	27.31
Western Boundary	6.50	27.65	6.61	28.14
Top Boundary	1.20	5.09	3.95	16.80
Bottom Boundary	1.61	6.87	0.00	0.00
Total	23.49	100.00	23.49	100.00

Table 4.2
Chloride Balance for Pre-Development Conditions

	Advective Flux				Dispersive Flux			
	Flow In (Kg/day)	Percent of Total	Flow Out (Kg/day)	Percent of Total	Flow In (Kg/day)	Percent of Total	Flow Out (Kg/day)	Percent of Total
Northern Boundary	1641	0.14	288	0.02	547	4.81	396	35.41
Southern Boundary	410151	34.06	454474	37.17	8689	76.50	19	1.72
Eastern Boundary	188832	15.68	319831	26.16	911	8.02	186	16.61
Western Boundary	412767	34.28	416590	34.07	416	3.66	15	1.30
Top Boundary	80026	6.65	31462	2.57	34	0.30	205	18.34
Bottom Boundary	110617	9.19	0	0.00	761	6.70	298	26.61
Total	1204034	100.00	1222644	100.00	11358	100.00	1118	100.00

Table 4.3a
Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958

NWF_ID	Well Name	1942 Pumping (gpd)	1943 Pumping (gpd)	1944 Pumping (gpd)	1945 Pumping (gpd)	1946 Pumping (gpd)	1947 Pumping (gpd)	1948 Pumping (gpd)	1949 Pumping (gpd)	1950 Pumping (gpd)
1369	NAVARRE BEACH #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1444	NAVARRE BEACH #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1481	SWU #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1483	NAVARRE BEACH #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1586	DWU #7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1601	DWU #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1604	US COAST GUARD #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1611	DWU #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1654	DWU #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1661	DWU #9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1664	EAFB A-13 BLDG 9296	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1687	DWU #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1688	ISL-7 (JOHN BEASLEY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1696	ISL-1 (MONITOR)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1697	EAFB A-11 BLDG 9262	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1710	ISL-2 (EAST TANK)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1714	ISL-4 (TREAT PLANT)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1736	EAFB A-6 BLDG 8552	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1742	ISL-6 (EL MATADOR)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1796	DWU #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1838	DWU #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1841	HOLLEY-NAVARRE #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1887	MIDWAY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1901	FWB #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-101666.7
1940	MARY ESTHER #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	MARY ESTHER #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2031	MARY ESTHER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2035	MARY ESTHER #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.3a (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958

NWF_ID	Well Name	1942 Pumping (gpd)	1943 Pumping (gpd)	1944 Pumping (gpd)	1945 Pumping (gpd)	1946 Pumping (gpd)	1947 Pumping (gpd)	1948 Pumping (gpd)	1949 Pumping (gpd)	1950 Pumping (gpd)
2040	OCWS/SEASHORE VIL #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2046	OCWS/SEASHORE VIL #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2048	OCWS/SEASHORE VIL #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2053	HOLLEY-NAVARRE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2073	EAFB HURL #1 #90308	-300000.0	-311000.0	-322000.0	-333000.0	-344000.0	-355000.0	-366000.0	-377000.0	-388000.0
2085	FWB #5	0.0	0.0	0.0	0.0	-70500.0	-91000.0	-111500.0	-132000.0	-101666.7
2093	FWB #2	-50000.0	-67000.0	-83000.0	-100000.0	-70500.0	-91000.0	-111500.0	-132000.0	-101666.7
2099	FWB #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2108	FWB #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2113	EAFB HURL #5 #90355	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2134	EAFB HURL #2 #90601	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2139	FWB #9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2146	FWB #11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2168	EAFB HURL #7 #91136	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2236	OC-9 (NORTHGATE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2318	MIDWAY #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2320	HOLLEY-NAVARRE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2404	OC-1 (OFFICE)	-100000.0	-124000.0	-148000.0	-172000.0	-196000.0	-220000.0	-244000.0	-268000.0	-292000.0
2463	OC-10 (LOWERY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2506	OC-3 (NEWCASTLE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2508	OC-4 (GREEN STREET)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2554	OC-6 (HAWKINS ROAD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2581	OC-5 (SHALIMAR)	-100000.0	-124000.0	-148000.0	-172000.0	-196000.0	-220000.0	-244000.0	-268000.0	-292000.0
2584	OC-7(SHALIMAR ANNEX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2627	HOLLEY-NAVARRE #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2651	MOODY KELLY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2735	EAFB HOUS#13 #2985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2750	EAFB HOUS #12 #2829	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2758	FWB #7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2759	OC-8 (GREEN ACRES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.3a (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958

NWF_ID	Well Name	1942 Pumping (gpd)	1943 Pumping (gpd)	1944 Pumping (gpd)	1945 Pumping (gpd)	1946 Pumping (gpd)	1947 Pumping (gpd)	1948 Pumping (gpd)	1949 Pumping (gpd)	1950 Pumping (gpd)
2762	EAFB HOUS #16 #2755	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2787	EAFB HOUS #11 #10634	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2792	FWB #10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2807	FWB #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2814	BLUEWATER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2815	EAFB HOUS #10 #10941	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2825	EAFB HOUS #8 #2594	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2860	EAFB HOUS #9 #10000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2874	OC-2 (LONGWOOD)	-100000.0	-124000.0	-148000.0	-172000.0	-196000.0	-220000.0	-244000.0	-268000.0	-292000.0
2884	EAFB HOUS #7 #2590	0.0	0.0	0.0	0.0	0.0	-301400.0	-321600.0	-342000.0	-362200.0
2891	BLUEWATER #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2909	SOUTH GOLF COURSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2953	SEMINOLE #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2958	EAFB HOUS #14 #1308	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2971	SEMINOLE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2972	SEMINOLE #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2973	WELL #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2984	EAFB MAIN #5 #616	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2985	EAFB MAIN #4 #303	-250000.0	-275250.0	-300750.0	-326000.0	-351250.0	-301400.0	-321600.0	-342000.0	-362200.0
3004	EAFB HOUS #15 #1320	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3012	EAFB MAIN #3 #31	-250000.0	-275250.0	-300750.0	-326000.0	-351250.0	-301400.0	-321600.0	-342000.0	-362200.0
3015	EAFB MAIN #6 #62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3026	OLD GOLF COURSE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3033	EAFB MAIN #2 #82	-250000.0	-275250.0	-300750.0	-326000.0	-351250.0	-301400.0	-321600.0	-342000.0	-362200.0
3049	SEMINOLE #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3057	SEMINOLE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3063	BLUEWATER #1 (AUX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3071	EAFB MAIN #1 #859	-250000.0	-275250.0	-300750.0	-326000.0	-351250.0	-301400.0	-321600.0	-342000.0	-362200.0
3091	BLUEWATER #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3126	VALPARAISO #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.3a (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958

NWF_ID	Well Name	1942 Pumping (gpd)	1943 Pumping (gpd)	1944 Pumping (gpd)	1945 Pumping (gpd)	1946 Pumping (gpd)	1947 Pumping (gpd)	1948 Pumping (gpd)	1949 Pumping (gpd)	1950 Pumping (gpd)
3231	NICEVILLE #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3240	VALPARAISO #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3256	NICEVILLE #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3258	VALPARAISO #1	0.0	0.0	0.0	-30000.0	-35000.0	-39000.0	-44000.0	-48000.0	-53000.0
3295	VALPARAISO #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3326	NICEVILLE #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3350	NICEVILLE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100000.0
3367	NICEVILLE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3432	NICEVILLE #10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3457	NICEVILLE #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3482	NICEVILLE #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3770	PRIMARY INJECTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5942	OCWS/SEASHORE VIL #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6006	EAFB MAIN #2A BLDG82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6024	VILLA TASSO #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7209	OC-11 (FOREST)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7998	ISL-5 (CAROUSEL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8006	ISL-3 (AMUSEMENT PK)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8209	CEMEX FLD @ DESTIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	-1650000.0	-1851000.0	-2052000.0	-2283000.0	-2513000.0	-2743000.0	-2973000.0	-3203000.0	-3533000.1

Table 4.3a (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958

NWF_ID	Well Name	1951 Pumping (gpd)	1952 Pumping (gpd)	1953 Pumping (gpd)	1954 Pumping (gpd)	1955 Pumping (gpd)	1956 Pumping (gpd)	1957 Pumping (gpd)	1958 Pumping (gpd)
1369	NAVARRE BEACH #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1444	NAVARRE BEACH #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1481	SWU #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1483	NAVARRE BEACH #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1586	DWU #7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1601	DWU #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1604	US COAST GUARD #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1611	DWU #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1654	DWU #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1661	DWU #9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1664	EAFB A-13 BLDG 9296	0.0	0.0	0.0	0.0	0.0	0.0	-33333.3	-36000.0
1687	DWU #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1688	ISL-7 (JOHN BEASLEY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1696	ISL-1 (MONITOR)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1697	EAFB A-11 BLDG 9262	0.0	0.0	0.0	0.0	0.0	0.0	-33333.3	-36000.0
1710	ISL-2 (EAST TANK)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1714	ISL-4 (TREAT PLANT)	0.0	0.0	0.0	0.0	-100000.0	-112500.0	-125000.0	-137500.0
1736	EAFB A-6 BLDG 8552	0.0	0.0	0.0	0.0	0.0	0.0	-33333.3	-36000.0
1742	ISL-6 (EL MATADOR)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1796	DWU #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1838	DWU #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1841	HOLLEY-NAVARRE #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1887	MIDWAY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1901	FWB #1	-115000.0	-128666.7	-142333.3	-156000.0	-169666.7	-183333.3	-186000.0	-234500.0
1940	MARY ESTHER #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	MARY ESTHER #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-150000.0
2031	MARY ESTHER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2035	MARY ESTHER #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.3a (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958

NWF_ID	Well Name	1951 Pumping (gpd)	1952 Pumping (gpd)	1953 Pumping (gpd)	1954 Pumping (gpd)	1955 Pumping (gpd)	1956 Pumping (gpd)	1957 Pumping (gpd)	1958 Pumping (gpd)
2040	OCWS/SEASHORE VIL #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2046	OCWS/SEASHORE VIL #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2048	OCWS/SEASHORE VIL #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2053	HOLLEY-NAVARRE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2073	EAFB HURL #1 #90308	-399000.0	-411000.0	-422000.0	-216500.0	-222000.0	-227500.0	-233000.0	-238500.0
2085	FWB #5	-115000.0	-128666.7	-142333.3	-156000.0	-169666.7	-183333.3	-186000.0	-234500.0
2093	FWB #2	-115000.0	-128666.7	-142333.3	-156000.0	-169666.7	-183333.3	-186000.0	-234500.0
2099	FWB #3	0.0	0.0	0.0	0.0	0.0	0.0	-186000.0	-234500.0
2108	FWB #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2113	EAFB HURL #5 #90355	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2134	EAFB HURL #2 #90601	0.0	0.0	0.0	-216500.0	-222000.0	-227500.0	-233000.0	-238500.0
2139	FWB #9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2146	FWB #11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2168	EAFB HURL #7 #91136	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2236	OC-9 (NORTHGATE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2318	MIDWAY #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2320	HOLLEY-NAVARRE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2404	OC-1 (OFFICE)	-316000.0	-339666.7	-363666.7	-387666.7	-411666.7	-435666.7	-459666.7	-483666.7
2463	OC-10 (LOWERY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2506	OC-3 (NEWCASTLE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2508	OC-4 (GREEN STREET)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2554	OC-6 (HAWKINS ROAD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2581	OC-5 (SHALIMAR)	-316000.0	-339666.7	-363666.7	-387666.7	-411666.7	-435666.7	-459666.7	-483666.7
2584	OC-7(SHALIMAR ANNEX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2627	HOLLEY-NAVARRE #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2651	MOODY KELLY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2735	EAFB HOUS#13 #2985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2750	EAFB HOUS #12 #2829	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2758	FWB #7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2759	OC-8 (GREEN ACRES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.3a (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958

NWF_ID	Well Name	1951 Pumping (gpd)	1952 Pumping (gpd)	1953 Pumping (gpd)	1954 Pumping (gpd)	1955 Pumping (gpd)	1956 Pumping (gpd)	1957 Pumping (gpd)	1958 Pumping (gpd)
2762	EAFB HOUS #16 #2755	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2787	EAFB HOUS #11 #10634	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2792	FWB #10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2807	FWB #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2814	BLUEWATER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2815	EAFB HOUS #10 #10941	-273142.8	-287714.3	-302142.8	-316571.4	-331142.9	-345571.4	-252000.0	-238363.6
2825	EAFB HOUS #8 #2594	-273142.8	-287714.3	-302142.8	-316571.4	-331142.9	-345571.4	-252000.0	-238363.6
2860	EAFB HOUS #9 #10000	0.0	0.0	0.0	0.0	0.0	0.0	-252000.0	-238363.6
2874	OC-2 (LONGWOOD)	-316000.0	-339666.7	-363666.7	-387666.7	-411666.7	-435666.7	-459666.7	-483666.7
2884	EAFB HOUS #7 #2590	-273142.8	-287714.3	-302142.8	-316571.4	-331142.9	-345571.4	-252000.0	-238363.6
2891	BLUEWATER #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2909	SOUTH GOLF COURSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2953	SEMINOLE #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2958	EAFB HOUS #14 #1308	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2971	SEMINOLE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2972	SEMINOLE #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2973	WELL #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2984	EAFB MAIN #5 #616	0.0	0.0	0.0	0.0	0.0	0.0	-252000.0	-238363.6
2985	EAFB MAIN #4 #303	-273142.8	-287714.3	-302142.8	-316571.4	-331142.9	-345571.4	-252000.0	-238363.6
3004	EAFB HOUS #15 #1320	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-238363.6
3012	EAFB MAIN #3 #31	-273142.8	-287714.3	-302142.8	-316571.4	-331142.9	-345571.4	-252000.0	-238363.6
3015	EAFB MAIN #6 #62	0.0	0.0	0.0	0.0	0.0	0.0	-252000.0	-238363.6
3026	OLD GOLF COURSE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3033	EAFB MAIN #2 #82	-273142.8	-287714.3	-302142.8	-316571.4	-331142.9	-345571.4	-252000.0	-238363.6
3049	SEMINOLE #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3057	SEMINOLE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3063	BLUEWATER #1 (AUX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3071	EAFB MAIN #1 #859	-273142.8	-287714.3	-302142.8	-316571.4	-331142.9	-345571.4	-252000.0	-238363.6
3091	BLUEWATER #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3126	VALPARAISO #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.3a (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1942–1958

NWF_ID	Well Name	1951 Pumping (gpd)	1952 Pumping (gpd)	1953 Pumping (gpd)	1954 Pumping (gpd)	1955 Pumping (gpd)	1956 Pumping (gpd)	1957 Pumping (gpd)	1958 Pumping (gpd)
3231	NICEVILLE #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3240	VALPARAISO #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3256	NICEVILLE #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3258	VALPARAISO #1	-57000.0	-62000.0	-66000.0	-71000.0	-75000.0	-80000.0	-95000.0	-111000.0
3295	VALPARAISO #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3326	NICEVILLE #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3350	NICEVILLE #1	-62500.0	-75000.0	-87500.0	-100000.0	-112500.0	-125000.0	-144500.0	-164000.0
3367	NICEVILLE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3432	NICEVILLE #10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3457	NICEVILLE #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3482	NICEVILLE #4	-62500.0	-75000.0	-87500.0	-100000.0	-112500.0	-125000.0	-144500.0	-164000.0
3770	PRIMARY INJECTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5942	OCWS/SEASHORE VIL #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6006	EAFB MAIN #2A BLDG82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6024	VILLA TASSO #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7209	OC-11 (FOREST)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7998	ISL-5 (CAROUSEL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8006	ISL-3 (AMUSEMENT PK)	0.0	0.0	0.0	0.0	-100000.0	-112500.0	-125000.0	-137500.0
8209	CEMEX FLD @ DESTIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	-3785999.6	-4042000.3	-4295999.6	-4550999.9	-5006000.5	-5285999.8	-5843000.0	-6459999.7

Table 4.3b
Pumping for the Transient Post-Development DSTRAM Simulation 1959–1969

NWF_ID	Well Name	1959 Pumping (gpd)	1960 Pumping (gpd)	1961 Pumping (gpd)	1962 Pumping (gpd)	1963 Pumping (gpd)	1964 Pumping (gpd)	1965 Pumping (gpd)	1966 Pumping (gpd)	1967 Pumping (gpd)	1968 Pumping (gpd)	1969 Pumping (gpd)
1369	NAVARRE BEACH #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1444	NAVARRE BEACH #1	0.0	0.0	-20000.0	-21500.0	-23000.0	-24500.0	-26000.0	-27500.0	-29000.0	-31000.0	-32500.0
1481	SWU #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1483	NAVARRE BEACH #2	0.0	0.0	-20000.0	-21500.0	-23000.0	-24500.0	-26000.0	-27500.0	-29000.0	-31000.0	-32500.0
1586	DWU #7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1601	DWU #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1604	US COAST GUARD #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1611	DWU #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1654	DWU #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1661	DWU #9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1664	EAFB A-13 BLDG 9296	-38333.3	-40666.7	-43333.3	-30000.0	-26666.7	-26666.7	-23333.3	-23333.3	-20000.0	-20000.0	-19333.3
1687	DWU #1	0.0	0.0	0.0	0.0	0.0	-200000.0	-274000.0	-348000.0	-422000.0	-496000.0	-570000.0
1688	ISL-7 (JOHN BEASLEY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1696	ISL-1 (MONITOR)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1697	EAFB A-11 BLDG 9262	-38333.3	-40666.7	-43333.3	-30000.0	-26666.7	-26666.7	-23333.3	-23333.3	-20000.0	-20000.0	-19333.3
1710	ISL-2 (EAST TANK)	0.0	0.0	0.0	-125000.0	-133333.3	-141666.7	-150000.0	-158333.3	-125000.0	-131250.0	-137500.0
1714	ISL-4 (TREAT PLANT)	-150000.0	-162500.0	-175000.0	-125000.0	-133333.3	-141666.7	-150000.0	-158333.3	-125000.0	-131250.0	-137500.0
1736	EAFB A-6 BLDG 8552	-38333.3	-40666.7	-43333.3	-30000.0	-26666.7	-26666.7	-23333.3	-23333.3	-20000.0	-20000.0	-19333.3
1742	ISL-6 (EL MATADOR)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-125000.0	-131250.0	-137500.0
1796	DWU #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1838	DWU #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1841	HOLLEY-NAVARRE #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1887	MIDWAY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1901	FWB #1	-282750.0	-331250.0	-379750.0	-342400.0	-381200.0	-420000.0	-385000.0	-396666.7	-436666.7	-465714.3	-391428.6
1940	MARY ESTHER #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	MARY ESTHER #1	-171000.0	-192000.0	-214000.0	-235000.0	-256000.0	-139000.0	-149500.0	-160000.0	-170000.0	-190000.0	-180000.0
2031	MARY ESTHER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2035	MARY ESTHER #2	0.0	0.0	0.0	0.0	0.0	-139000.0	-149500.0	-160000.0	-170000.0	-190000.0	-180000.0
2040	OCWS/SEASHORE VIL #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2046	OCWS/SEASHORE VIL #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-20000.0	-25000.0
2048	OCWS/SEASHORE VIL #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2053	HOLLEY-NAVARRE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2073	EAFB HURL #1 #90308	-244000.0	-249500.0	-255000.0	-250000.0	-335000.0	-340000.0	-325000.0	-355000.0	-310000.0	-365000.0	-345000.0
2085	FWB #5	-282750.0	-331250.0	-379750.0	-342400.0	-381200.0	-420000.0	-385000.0	-396666.7	-436666.7	-465714.3	-391428.6
2093	FWB #2	-282750.0	-331250.0	-379750.0	-342400.0	-381200.0	-420000.0	-385000.0	-396666.7	-436666.7	-465714.3	-391428.6

Table 4.3b (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1959–1969

NWF_ID	Well Name	1959 Pumping (gpd)	1960 Pumping (gpd)	1961 Pumping (gpd)	1962 Pumping (gpd)	1963 Pumping (gpd)	1964 Pumping (gpd)	1965 Pumping (gpd)	1966 Pumping (gpd)	1967 Pumping (gpd)	1968 Pumping (gpd)	1969 Pumping (gpd)
2099	FWB #3	-282750.0	-331250.0	-379750.0	-342400.0	-381200.0	-420000.0	-385000.0	-396666.7	-436666.7	-465714.3	-391428.6
2108	FWB #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-465714.3	-391428.6
2113	EAFB HURL #5 #90355	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2134	EAFB HURL #2 #90601	-244000.0	-249500.0	-255000.0	-250000.0	-335000.0	-340000.0	-325000.0	-355000.0	-310000.0	-365000.0	-345000.0
2139	FWB #9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2146	FWB #11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2168	EAFB HURL #7 #91136	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2236	OC-9 (NORTHGATE)	0.0	-398750.0	-416750.0	-434750.0	-452750.0	-470750.0	-488750.0	-506750.0	-524750.0	-542750.0	-560750.0
2318	MIDWAY #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2320	HOLLEY-NAVARRE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2404	OC-1 (OFFICE)	-507666.7	-398750.0	-416750.0	-434750.0	-452750.0	-470750.0	-488750.0	-506750.0	-524750.0	-542750.0	-560750.0
2463	OC-10 (LOWERY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2506	OC-3 (NEWCASTLE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2508	OC-4 (GREEN STREET)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2554	OC-6 (HAWKINS ROAD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2581	OC-5 (SHALIMAR)	-507666.7	-398750.0	-416750.0	-434750.0	-452750.0	-470750.0	-488750.0	-506750.0	-524750.0	-542750.0	-560750.0
2584	OC-7(SHALIMAR ANNEX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2627	HOLLEY-NAVARRE #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2651	MOODY KELLY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2735	EAFB HOUS#13 #2985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-265384.6	-246428.6
2750	EAFB HOUS #12 #2829	0.0	0.0	0.0	0.0	0.0	0.0	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
2758	FWB #7	0.0	0.0	0.0	0.0	0.0	0.0	-385000.0	-396666.7	-436666.7	-465714.3	-391428.6
2759	OC-8 (GREEN ACRES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2762	EAFB HOUS #16 #2755	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2787	EAFB HOUS #11 #10634	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2792	FWB #10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2807	FWB #6	0.0	0.0	0.0	-342400.0	-381200.0	-420000.0	-385000.0	-396666.7	-436666.7	-465714.3	-391428.6
2814	BLUEWATER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2815	EAFB HOUS #10 #10941	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
2825	EAFB HOUS #8 #2594	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
2860	EAFB HOUS #9 #10000	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
2874	OC-2 (LONGWOOD)	-507666.7	-398750.0	-416750.0	-434750.0	-452750.0	-470750.0	-488750.0	-506750.0	-524750.0	-542750.0	-560750.0
2884	EAFB HOUS #7 #2590	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
2891	BLUEWATER #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2909	SOUTH GOLF COURSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2953	SEMINOLE #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2958	EAFB HOUS #14 #1308	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-246428.6
2971	SEMINOLE #1	0.0	-15000.0	-16000.0	-17500.0	-18500.0	-19500.0	-21000.0	-22000.0	-23000.0	-24500.0	-25500.0

Table 4.3b (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1959–1969

NWF_ID	Well Name	1959 Pumping (gpd)	1960 Pumping (gpd)	1961 Pumping (gpd)	1962 Pumping (gpd)	1963 Pumping (gpd)	1964 Pumping (gpd)	1965 Pumping (gpd)	1966 Pumping (gpd)	1967 Pumping (gpd)	1968 Pumping (gpd)	1969 Pumping (gpd)
2972	SEMINOLE #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2973	WELL #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2984	EAFB MAIN #5 #616	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
2985	EAFB MAIN #4 #303	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
3004	EAFB HOUS #15 #1320	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
3012	EAFB MAIN #3 #31	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
3015	EAFB MAIN #6 #62	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
3026	OLD GOLF COURSE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3033	EAFB MAIN #2 #82	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
3049	SEMINOLE #2	0.0	-15000.0	-16000.0	-17500.0	-18500.0	-19500.0	-21000.0	-22000.0	-23000.0	-24500.0	-25500.0
3057	SEMINOLE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3063	BLUEWATER #1 (AUX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3071	EAFB MAIN #1 #859	-247545.5	-256818.2	-266000.0	-275181.8	-284454.5	-293636.4	-256666.7	-291666.7	-317500.0	-265384.6	-246428.6
3091	BLUEWATER #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3126	VALPARAISO #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3231	NICEVILLE #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3240	VALPARAISO #2	-63000.0	-70500.0	-78500.0	-86000.0	-62333.3	-67666.7	-72666.7	-77666.7	-83000.0	-88000.0	-93000.0
3256	NICEVILLE #2	0.0	0.0	0.0	0.0	0.0	0.0	-200000.0	-206666.7	-213333.3	-220000.0	-226666.7
3258	VALPARAISO #1	-63000.0	-70500.0	-78500.0	-86000.0	-62333.3	-67666.7	-72666.7	-77666.7	-83000.0	-88000.0	-93000.0
3295	VALPARAISO #3	0.0	0.0	0.0	0.0	-62333.3	-67666.7	-72666.7	-77666.7	-83000.0	-88000.0	-93000.0
3326	NICEVILLE #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3350	NICEVILLE #1	-183500.0	-203000.0	-222000.0	-241500.0	-261000.0	-280500.0	-200000.0	-206666.7	-213333.3	-220000.0	-226666.7
3367	NICEVILLE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3432	NICEVILLE #10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3457	NICEVILLE #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3482	NICEVILLE #4	-183500.0	-203000.0	-222000.0	-241500.0	-261000.0	-280500.0	-200000.0	-206666.7	-213333.3	-220000.0	-226666.7
3770	PRIMARY INJECTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5942	OCWS/SEASHORE VIL #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6006	EAFB MAIN #2A BLDG82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6024	VILLA TASSO #2	0.0	-10000.0	-11000.0	-12000.0	-12000.0	-13000.0	-14000.0	-15000.0	-16000.0	-16000.0	-17000.0
7209	OC-11 (FOREST)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7998	ISL-5 (CAROUSEL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8006	ISL-3 (AMUSEMENT PK)	-150000.0	-162500.0	-175000.0	-125000.0	-133333.3	-141666.7	-150000.0	-158333.3	-125000.0	-131250.0	-137500.0
8209	CEMEX FLD @ DESTIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	-6944000.5	-7470000.3	-7999999.9	-8422999.8	-9055999.4	-9741000.7	-10014000.4	-10797000.6	-11480000.1	-12142999.9	-11778000.6

Table 4.3c
Pumping for the Transient Post-Development DSTRAM Simulation 1970–1982

NWF_ID	Well Name	1970 Pumping (gpd)	1971 Pumping (gpd)	1972 Pumping (gpd)	1973 Pumping (gpd)	1974 Pumping (gpd)	1975 Pumping (gpd)	1976 Pumping (gpd)
1369	NAVARRE BEACH #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1444	NAVARRE BEACH #1	-34000.0	-35500.0	-37000.0	-38500.0	-40000.0	-45000.0	-60000.0
1481	SWU #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1483	NAVARRE BEACH #2	-34000.0	-35500.0	-37000.0	-38500.0	-40000.0	-45000.0	-60000.0
1586	DWU #7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1601	DWU #2	0.0	-359000.0	-396000.0	-433000.0	-313333.3	-290000.0	-350000.0
1604	US COAST GUARD #1	0.0	0.0	0.0	0.0	0.0	0.0	-5000.0
1611	DWU #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1654	DWU #3	0.0	0.0	0.0	0.0	-313333.3	-290000.0	-350000.0
1661	DWU #9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1664	EAFB A-13 BLDG 9296	-18666.7	-18333.3	-17666.7	-17000.0	-16333.3	-15666.7	-15333.3
1687	DWU #1	-644000.0	-359000.0	-396000.0	-433000.0	-313333.3	-290000.0	-350000.0
1688	ISL-7 (JOHN BEASLEY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1696	ISL-1 (MONITOR)	0.0	0.0	0.0	0.0	-112500.0	-116666.7	-120833.3
1697	EAFB A-11 BLDG 9262	-18666.7	-18333.3	-17666.7	-17000.0	-16333.3	-15666.7	-15333.3
1710	ISL-2 (EAST TANK)	-143750.0	-150000.0	-156250.0	-130000.0	-112500.0	-116666.7	-120833.3
1714	ISL-4 (TREAT PLANT)	-143750.0	-150000.0	-156250.0	-130000.0	-112500.0	-116666.7	-120833.3
1736	EAFB A-6 BLDG 8552	-18666.7	-18333.3	-17666.7	-17000.0	-16333.3	-15666.7	-15333.3
1742	ISL-6 (EL MATADOR)	-143750.0	-150000.0	-156250.0	-130000.0	-112500.0	-116666.7	-120833.3
1796	DWU #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1838	DWU #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1841	HOLLEY-NAVARRE #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1887	MIDWAY #1	0.0	0.0	-100000.0	-111000.0	-122000.0	-133000.0	-141000.0
1901	FWB #1	-343750.0	-366250.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
1940	MARY ESTHER #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	MARY ESTHER #1	-196000.0	-175000.0	-182000.0	-150000.0	-168000.0	-168000.0	-225000.0
2031	MARY ESTHER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2035	MARY ESTHER #2	-196000.0	-175000.0	-182000.0	-150000.0	-168000.0	-168000.0	-225000.0

Table 4.3c (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1970–1982

NWF_ID	Well Name	1970 Pumping (gpd)	1971 Pumping (gpd)	1972 Pumping (gpd)	1973 Pumping (gpd)	1974 Pumping (gpd)	1975 Pumping (gpd)	1976 Pumping (gpd)
2040	OCWS/SEASHORE VIL #2	0.0	0.0	0.0	0.0	-130000.0	-132500.0	-135000.0
2046	OCWS/SEASHORE VIL #1	-30000.0	-60000.0	-90000.0	-120000.0	-130000.0	-132500.0	-135000.0
2048	OCWS/SEASHORE VIL #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2053	HOLLEY-NAVARRE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2073	EAFB HURL #1 #90308	-370000.0	-243333.3	-243333.3	-206666.7	-196666.7	-236666.7	-283333.3
2085	FWB #5	-343750.0	-366250.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
2093	FWB #2	-343750.0	-366250.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
2099	FWB #3	-343750.0	-366250.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
2108	FWB #8	-343750.0	-366250.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
2113	EAFB HURL #5 #90355	0.0	-243333.3	-243333.3	-206666.7	-196666.7	-236666.7	-283333.3
2134	EAFB HURL #2 #90601	-370000.0	-243333.3	-243333.3	-206666.7	-196666.7	-236666.7	-283333.3
2139	FWB #9	-343750.0	-366250.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
2146	FWB #11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2168	EAFB HURL #7 #91136	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2236	OC-9 (NORTHGATE)	-462800.0	-477200.0	-409666.7	-421666.7	-433666.7	-445666.7	-457666.7
2318	MIDWAY #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2320	HOLLEY-NAVARRE #1	-60000.0	-90000.0	-90000.0	-160000.0	-100000.0	-120000.0	-160000.0
2404	OC-1 (OFFICE)	-462800.0	-477200.0	-409666.7	-421666.7	-433666.7	-445666.7	-457666.7
2463	OC-10 (LOWERY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2506	OC-3 (NEWCASTLE)	-462800.0	-477200.0	-409666.7	-421666.7	-433666.7	-445666.7	-457666.7
2508	OC-4 (GREEN STREET)	0.0	0.0	-409666.7	-421666.7	-433666.7	-445666.7	-457666.7
2554	OC-6 (HAWKINS ROAD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2581	OC-5 (SHALIMAR)	-462800.0	-477200.0	-409666.7	-421666.7	-433666.7	-445666.7	-457666.7
2584	OC-7(SHALIMAR ANNEX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2627	HOLLEY-NAVARRE #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2651	MOODY KELLY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2735	EAFB HOUS#13 #2985	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2750	EAFB HOUS #12 #2829	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2758	FWB #7	-343750.0	-366250.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
2759	OC-8 (GREEN ACRES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.3c (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1970–1982

NWF_ID	Well Name	1970 Pumping (gpd)	1971 Pumping (gpd)	1972 Pumping (gpd)	1973 Pumping (gpd)	1974 Pumping (gpd)	1975 Pumping (gpd)	1976 Pumping (gpd)
2762	EAFB HOUS #16 #2755	0.0	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2787	EAFB HOUS #11 #10634	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2792	FWB #10	0.0	0.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
2807	FWB #6	-343750.0	-366250.0	-341888.9	-331666.7	-343333.3	-321111.1	-340000.0
2814	BLUEWATER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2815	EAFB HOUS #10 #10941	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2825	EAFB HOUS #8 #2594	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2860	EAFB HOUS #9 #10000	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2874	OC-2 (LONGWOOD)	-462800.0	-477200.0	-409666.7	-421666.7	-433666.7	-445666.7	-457666.7
2884	EAFB HOUS #7 #2590	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2891	BLUEWATER #2	0.0	0.0	0.0	0.0	0.0	0.0	-200000.0
2909	SOUTH GOLF COURSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2953	SEMINOLE #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2958	EAFB HOUS #14 #1308	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2971	SEMINOLE #1	-27000.0	-28000.0	-29000.0	-30500.0	-31500.0	-32500.0	-34000.0
2972	SEMINOLE #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2973	WELL #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2984	EAFB MAIN #5 #616	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
2985	EAFB MAIN #4 #303	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
3004	EAFB HOUS #15 #1320	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
3012	EAFB MAIN #3 #31	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
3015	EAFB MAIN #6 #62	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
3026	OLD GOLF COURSE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3033	EAFB MAIN #2 #82	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
3049	SEMINOLE #2	-27000.0	-28000.0	-29000.0	-30500.0	-31500.0	-32500.0	-34000.0
3057	SEMINOLE #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3063	BLUEWATER #1 (AUX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3071	EAFB MAIN #1 #859	-251428.6	-250000.0	-322666.7	-305333.3	-286666.7	-295333.3	-266666.7
3091	BLUEWATER #3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3126	VALPARAISO #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.3c (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1970–1982

NWF_ID	Well Name	1970 Pumping (gpd)	1971 Pumping (gpd)	1972 Pumping (gpd)	1973 Pumping (gpd)	1974 Pumping (gpd)	1975 Pumping (gpd)	1976 Pumping (gpd)
3231	NICEVILLE #8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3240	VALPARAISO #2	-98333.3	-103333.3	-123333.3	-100000.0	-133333.3	-130000.0	-150000.0
3256	NICEVILLE #2	-233333.3	-246666.7	-326666.7	-305000.0	-227000.0	-207250.0	-268750.0
3258	VALPARAISO #1	-98333.3	-103333.3	-123333.3	-100000.0	-133333.3	-130000.0	-150000.0
3295	VALPARAISO #3	-98333.3	-103333.3	-123333.3	-100000.0	-133333.3	-130000.0	-150000.0
3326	NICEVILLE #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3350	NICEVILLE #1	-233333.3	-246666.7	-326666.7	-305000.0	-227000.0	-207250.0	-268750.0
3367	NICEVILLE #3	0.0	0.0	0.0	-305000.0	-227000.0	-207250.0	-268750.0
3432	NICEVILLE #10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3457	NICEVILLE #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3482	NICEVILLE #4	-233333.3	-246666.7	-326666.7	-305000.0	-227000.0	-207250.0	-268750.0
3770	PRIMARY INJECTION	0.0	0.0	0.0	0.0	0.0	446367.1	812054.8
5942	OCWS/SEASHORE VIL #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6006	EAFB MAIN #2A BLDG82	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6024	VILLA TASSO #2	-18000.0	-19000.0	-20000.0	-20000.0	-21000.0	-11000.0	-11000.0
7209	OC-11 (FOREST)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7998	ISL-5 (CAROUSEL)	0.0	0.0	0.0	-130000.0	-112500.0	-116666.7	-120833.3
8006	ISL-3 (AMUSEMENT PK)	-143750.0	-150000.0	-156250.0	-130000.0	-112500.0	-116666.7	-120833.3
8209	CEMEX FLD @ DESTIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	-12216000.3	-12864999.8	-14721000.8	-14651000.1	-14536000.2	-14113632.9	-14614945.5

Table 4.3c (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1970–1982

NWF_ID	Well Name	1977 Pumping (gpd)	1978 Pumping (gpd)	1979 Pumping (gpd)	1980 Pumping (gpd)	1981 Pumping (gpd)	1982 Pumping (gpd)
1369	NAVARRE BEACH #3	0.0	0.0	0.0	0.0	0.0	0.0
1444	NAVARRE BEACH #1	-70000.0	-80000.0	-75000.0	-80000.0	-100000.0	-115000.0
1481	SWU #6	0.0	0.0	0.0	0.0	0.0	0.0
1483	NAVARRE BEACH #2	-70000.0	-80000.0	-75000.0	-80000.0	-100000.0	-115000.0
1586	DWU #7	0.0	0.0	0.0	0.0	0.0	0.0
1601	DWU #2	-400000.0	-453333.3	-462000.0	-353000.0	-393000.0	-433250.0
1604	US COAST GUARD #1	-5000.0	-5000.0	-6000.0	-6000.0	-6000.0	-6000.0
1611	DWU #8	0.0	0.0	0.0	0.0	0.0	0.0
1654	DWU #3	-400000.0	-453333.3	-462000.0	-353000.0	-393000.0	-433250.0
1661	DWU #9	0.0	0.0	0.0	0.0	0.0	0.0
1664	EAFB A-13 BLDG 9296	-14666.7	-14000.0	-13333.3	-12666.7	-12333.3	-11666.7
1687	DWU #1	-400000.0	-453333.3	-462000.0	-353000.0	-393000.0	-433250.0
1688	ISL-7 (JOHN BEASLEY)	0.0	0.0	0.0	0.0	0.0	0.0
1696	ISL-1 (MONITOR)	-125000.0	-129166.7	-133333.3	-125000.0	-116500.0	0.0
1697	EAFB A-11 BLDG 9262	-14666.7	-14000.0	-13333.3	-12666.7	-12333.3	-11666.7
1710	ISL-2 (EAST TANK)	-125000.0	-129166.7	-133333.3	-125000.0	-116500.0	-52104.1
1714	ISL-4 (TREAT PLANT)	-125000.0	-129166.7	-133333.3	-125000.0	-116500.0	-134106.8
1736	EAFB A-6 BLDG 8552	-14666.7	-14000.0	-13333.3	-12666.7	-12333.3	-11666.7
1742	ISL-6 (EL MATADOR)	-125000.0	-129166.7	-133333.3	-125000.0	-116500.0	-168180.8
1796	DWU #5	0.0	0.0	0.0	0.0	0.0	0.0
1838	DWU #4	0.0	0.0	0.0	-353000.0	-393000.0	-433250.0
1841	HOLLEY-NAVARRE #4	0.0	0.0	0.0	0.0	0.0	0.0
1887	MIDWAY #1	-150000.0	-150000.0	-221000.0	-292000.0	-475500.0	-1108128.8
1901	FWB #1	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	0.0
1940	MARY ESTHER #3	0.0	0.0	0.0	0.0	0.0	0.0
2023	MARY ESTHER #1	-255000.0	-259000.0	-263000.0	-267000.0	-278000.0	-289000.0
2031	MARY ESTHER #4	0.0	0.0	0.0	0.0	0.0	0.0
2035	MARY ESTHER #2	-255000.0	-259000.0	-263000.0	-267000.0	-278000.0	-289000.0
2040	OCWS/SEASHORE VIL #2	-145000.0	-125000.0	-149500.0	-173500.0	-181500.0	-189000.0
2046	OCWS/SEASHORE VIL #1	-145000.0	-125000.0	-149500.0	-173500.0	-181500.0	-189000.0
2048	OCWS/SEASHORE VIL #3	0.0	0.0	0.0	0.0	0.0	0.0
2053	HOLLEY-NAVARRE #3	0.0	0.0	0.0	0.0	0.0	0.0
2073	EAFB HURL #1 #90308	-336666.7	-266666.7	-277000.0	-256666.7	-261000.0	-265333.3
2085	FWB #5	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	-362333.3

Table 4.3c (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1970–1982

NWF_ID	Well Name	1977 Pumping (gpd)	1978 Pumping (gpd)	1979 Pumping (gpd)	1980 Pumping (gpd)	1981 Pumping (gpd)	1982 Pumping (gpd)
2093	FWB #2	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	-362333.3
2099	FWB #3	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	-362333.3
2108	FWB #8	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	-362333.3
2113	EAFB HURL #5 #90355	-336666.7	-266666.7	-277000.0	-256666.7	-261000.0	-265333.3
2134	EAFB HURL #2 #90601	-336666.7	-266666.7	-277000.0	-256666.7	-261000.0	-265333.3
2139	FWB #9	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	-362333.3
2146	FWB #11	0.0	0.0	0.0	0.0	0.0	-362333.3
2168	EAFB HURL #7 #91136	0.0	0.0	0.0	0.0	0.0	0.0
2236	OC-9 (NORTHGATE)	-469666.7	-481666.7	-423142.8	-445142.8	-467285.7	-428125.0
2318	MIDWAY #2	0.0	0.0	0.0	0.0	-475500.0	0.0
2320	HOLLEY-NAVARRE #1	-170000.0	-170000.0	-200000.0	-200000.0	-131500.0	-163500.0
2404	OC-1 (OFFICE)	-469666.7	-481666.7	-423142.8	-445142.8	-467285.7	-428125.0
2463	OC-10 (LOWERY)	0.0	0.0	0.0	0.0	0.0	0.0
2506	OC-3 (NEWCASTLE)	-469666.7	-481666.7	-423142.8	-445142.8	-467285.7	-428125.0
2508	OC-4 (GREEN STREET)	-469666.7	-481666.7	-423142.8	-445142.8	-467285.7	-428125.0
2554	OC-6 (HAWKINS ROAD)	0.0	0.0	-423142.8	-445142.8	-467285.7	-428125.0
2581	OC-5 (SHALIMAR)	-469666.7	-481666.7	-423142.8	-445142.8	-467285.7	-428125.0
2584	OC-7(SHALIMAR ANNEX)	0.0	0.0	0.0	0.0	0.0	-428125.0
2627	HOLLEY-NAVARRE #2	0.0	0.0	0.0	0.0	-131500.0	-163500.0
2651	MOODY KELLY #1	0.0	0.0	0.0	0.0	0.0	0.0
2735	EAFB HOUS#13 #2985	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2750	EAFB HOUS #12 #2829	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2758	FWB #7	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	-362333.3
2759	OC-8 (GREEN ACRES)	0.0	0.0	0.0	0.0	0.0	0.0
2762	EAFB HOUS #16 #2755	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2787	EAFB HOUS #11 #10634	0.0	0.0	0.0	0.0	0.0	0.0
2792	FWB #10	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	-362333.3
2807	FWB #6	-353333.3	-347777.8	-371555.6	-349333.3	-355888.9	-362333.3
2814	BLUEWATER #4	0.0	0.0	0.0	0.0	0.0	0.0
2815	EAFB HOUS #10 #10941	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2825	EAFB HOUS #8 #2594	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2860	EAFB HOUS #9 #10000	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2874	OC-2 (LONGWOOD)	-469666.7	-481666.7	-423142.8	-445142.8	-467285.7	-428125.0
2884	EAFB HOUS #7 #2590	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2891	BLUEWATER #2	-248000.0	-148500.0	-172500.0	-197000.0	-221000.0	-245500.0
2909	SOUTH GOLF COURSE	0.0	0.0	0.0	0.0	0.0	0.0
2953	SEMINOLE #5	0.0	0.0	0.0	-19750.0	-21000.0	-22250.0

Table 4.3c (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1970–1982

NWF_ID	Well Name	1977 Pumping (gpd)	1978 Pumping (gpd)	1979 Pumping (gpd)	1980 Pumping (gpd)	1981 Pumping (gpd)	1982 Pumping (gpd)
2958	EAFB HOUS #14 #1308	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2971	SEMINOLE #1	-35000.0	-35000.0	-37500.0	-19750.0	-21000.0	-22250.0
2972	SEMINOLE #6	0.0	0.0	0.0	-19750.0	-21000.0	-22250.0
2973	WELL #6	0.0	0.0	0.0	0.0	0.0	0.0
2984	EAFB MAIN #5 #616	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
2985	EAFB MAIN #4 #303	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
3004	EAFB HOUS #15 #1320	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
3012	EAFB MAIN #3 #31	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
3015	EAFB MAIN #6 #62	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
3026	OLD GOLF COURSE #1	0.0	0.0	0.0	-20000.0	-22000.0	-25000.0
3033	EAFB MAIN #2 #82	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
3049	SEMINOLE #2	-35000.0	-35000.0	-37500.0	-19750.0	-21000.0	-22250.0
3057	SEMINOLE #3	0.0	0.0	0.0	0.0	0.0	0.0
3063	BLUEWATER #1 (AUX)	0.0	-148500.0	-172500.0	-197000.0	-221000.0	-245500.0
3071	EAFB MAIN #1 #859	-250000.0	-209333.3	-227666.7	-246000.0	-261733.3	-277466.7
3091	BLUEWATER #3	0.0	0.0	0.0	0.0	0.0	0.0
3126	VALPARAISO #4	0.0	0.0	0.0	0.0	0.0	0.0
3231	NICEVILLE #8	0.0	0.0	0.0	0.0	0.0	0.0
3240	VALPARAISO #2	-199333.3	-183333.3	-169000.0	-170333.3	-170000.0	-169333.3
3256	NICEVILLE #2	-229800.0	-264200.0	-281800.0	-207333.3	-225000.0	-242666.7
3258	VALPARAISO #1	-199333.3	-183333.3	-169000.0	-170333.3	-170000.0	-169333.3
3295	VALPARAISO #3	-199333.3	-183333.3	-169000.0	-170333.3	-170000.0	-169333.3
3326	NICEVILLE #6	0.0	0.0	0.0	-207333.3	-225000.0	-242666.7
3350	NICEVILLE #1	-229800.0	-264200.0	-281800.0	-207333.3	-225000.0	-242666.7
3367	NICEVILLE #3	-229800.0	-264200.0	-281800.0	-207333.3	-225000.0	-242666.7
3432	NICEVILLE #10	0.0	0.0	0.0	0.0	0.0	0.0
3457	NICEVILLE #5	-229800.0	-264200.0	-281800.0	-207333.3	-225000.0	-242666.7
3482	NICEVILLE #4	-229800.0	-264200.0	-281800.0	-207333.3	-225000.0	-242666.7
3770	PRIMARY INJECTION	754884.9	826789.1	838978.1	854920.6	812043.8	820753.4
5942	OCWS/SEASHORE VIL #4	0.0	0.0	0.0	0.0	0.0	0.0
6006	EAFB MAIN #2A BLDG82	0.0	0.0	0.0	0.0	0.0	0.0
6024	VILLA TASSO #2	-11000.0	-11000.0	-11000.0	-11000.0	-13500.0	-16000.0
7209	OC-11 (FOREST)	0.0	0.0	0.0	0.0	0.0	0.0
7998	ISL-5 (CAROUSEL)	-125000.0	-129166.7	-133333.3	-125000.0	-116500.0	0.0
8006	ISL-3 (AMUSEMENT PK)	-125000.0	-129166.7	-133333.3	-125000.0	-116500.0	-294139.7
8209	CEMEX FLD @ DESTIN	0.0	0.0	0.0	0.0	0.0	-10000.0
	Total	-15338115.1	-14812210.9	-15688022.1	-15863078.6	-17439455.6	-18461907.1

Table 4.3d
Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998

NWF_ID	Well Name	1983 Pumping (gpd)	1984 Pumping (gpd)	1985 Pumping (gpd)	1986 Pumping (gpd)	1987 Pumping (gpd)	1988 Pumping (gpd)	1989 Pumping (gpd)	1990 Pumping (gpd)
1369	NAVARRE BEACH #3	0.0	-96666.7	-116666.7	-334208.2	-191063.0	-57920.5	-217413.7	-229197.3
1444	NAVARRE BEACH #1	-63252.1	-96666.7	-116666.7	-10000.0	-10000.0	-10027.4	-10000.0	-8326.0
1481	SWU #6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1483	NAVARRE BEACH #2	-192967.1	-96666.7	-116666.7	-42211.0	-92405.5	-259827.4	-104890.4	-106339.7
1586	DWU #7	0.0	0.0	0.0	-389166.7	-336000.0	-344000.0	-295625.0	-321000.0
1601	DWU #2	-473250.0	-410800.0	-442800.0	-389166.7	-336000.0	-344000.0	-295625.0	-321000.0
1604	US COAST GUARD #1	-7000.0	-7000.0	-7000.0	-7000.0	-7000.0	-7000.0	-7000.0	-7000.0
1611	DWU #8	0.0	0.0	0.0	0.0	-336000.0	-344000.0	-295625.0	-321000.0
1654	DWU #3	-473250.0	-410800.0	-442800.0	-389166.7	-336000.0	-344000.0	-295625.0	-321000.0
1661	DWU #9	0.0	0.0	0.0	0.0	0.0	0.0	-295625.0	-321000.0
1664	EAFB A-13 BLDG 9296	-11000.0	-10333.3	-9666.7	-9333.3	-8666.7	-8000.0	-7333.3	-6666.7
1687	DWU #1	-473250.0	-410800.0	-442800.0	-389166.7	-336000.0	-344000.0	-295625.0	-321000.0
1688	ISL-7 (JOHN BEASLEY)	0.0	0.0	0.0	0.0	-167975.3	-210917.8	-92200.0	-16805.5
1696	ISL-1 (MONITOR)	0.0	0.0	0.0	0.0	0.0	0.0	-92200.0	0.0
1697	EAFB A-11 BLDG 9262	-11000.0	-10333.3	-9666.7	-9333.3	-8666.7	-8000.0	-7333.3	-6666.7
1710	ISL-2 (EAST TANK)	-42904.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1714	ISL-4 (TREAT PLANT)	-108106.9	-123531.5	0.0	0.0	0.0	0.0	0.0	0.0
1736	EAFB A-6 BLDG 8552	-11000.0	-10333.3	-9666.7	-9333.3	-8666.7	-8000.0	-7333.3	-6666.7
1742	ISL-6 (EL MATADOR)	-220660.3	-255060.3	-276613.7	-240515.1	-217219.2	-207408.2	-92200.0	-119304.1
1796	DWU #5	0.0	-410800.0	-442800.0	-389166.7	-336000.0	-344000.0	-295625.0	-321000.0
1838	DWU #4	-473250.0	-410800.0	-442800.0	-389166.7	-336000.0	-344000.0	-295625.0	-321000.0
1841	HOLLEY-NAVARRE #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1887	MIDWAY #1	-198917.8	-467643.8	-504027.4	-664893.1	-594638.4	-576506.9	-646556.2	-610498.6
1901	FWB #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1940	MARY ESTHER #3	0.0	0.0	-215000.0	-245000.0	-234666.7	-227333.3	-235000.0	-233333.3
2023	MARY ESTHER #1	-300500.0	-311500.0	-215000.0	-245000.0	-234666.7	-227333.3	-235000.0	-233333.3
2031	MARY ESTHER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2035	MARY ESTHER #2	-300500.0	-311500.0	-215000.0	-245000.0	-234666.7	-227333.3	-235000.0	-233333.3
2040	OCWS/SEASHORE VIL #2	-131333.3	-136333.3	-141666.7	-149000.0	-165333.3	-175666.7	-167666.7	-187333.3

Table 4.3d (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998

NWF_ID	Well Name	1983 Pumping (gpd)	1984 Pumping (gpd)	1985 Pumping (gpd)	1986 Pumping (gpd)	1987 Pumping (gpd)	1988 Pumping (gpd)	1989 Pumping (gpd)	1990 Pumping (gpd)
2046	OCWS/SEASHORE VIL #1	-131333.3	-136333.3	-141666.7	-149000.0	-165333.3	-175666.7	-167666.7	-187333.3
2048	OCWS/SEASHORE VIL #3	-131333.3	-136333.3	-141666.7	-149000.0	-165333.3	-175666.7	-167666.7	-187333.3
2053	HOLLEY-NAVARRE #3	0.0	0.0	0.0	-296666.7	-386666.7	-310000.0	-280000.0	-336666.7
2073	EAFB HURL #1 #90308	-270000.0	-274333.3	-278666.7	-269666.7	-195500.0	-188750.0	-182000.0	-175250.0
2085	FWB #5	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-163884.9	-174093.2	-73087.7
2093	FWB #2	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-75874.0	-63454.8	-40284.9
2099	FWB #3	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-308526.0	-81961.6	-72684.9
2108	FWB #8	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-38706.8	0.0	-52000.0
2113	EAFB HURL #5 #90355	-270000.0	-274333.3	-278666.7	-269666.7	-195500.0	-188750.0	-182000.0	-175250.0
2134	EAFB HURL #2 #90601	-270000.0	-274333.3	-278666.7	-269666.7	-195500.0	-188750.0	-182000.0	-175250.0
2139	FWB #9	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-175947.9	-946134.3	-909205.5
2146	FWB #11	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-712553.4	-563904.1	-576274.0
2168	EAFB HURL #7 #91136	0.0	0.0	0.0	0.0	-195500.0	-188750.0	-182000.0	-175250.0
2236	OC-9 (NORTHGATE)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-270794.5
2318	MIDWAY #2	-1040717.8	-940290.4	-1059405.5	-1009284.9	-895589.1	-929438.4	-859578.1	-754813.7
2320	HOLLEY-NAVARRE #1	-195000.0	-245000.0	-303000.0	-296666.7	-386666.7	-310000.0	-280000.0	-336666.7
2404	OC-1 (OFFICE)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-765572.6
2463	OC-10 (LOWERY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2506	OC-3 (NEWCASTLE)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-210621.9
2508	OC-4 (GREEN STREET)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-663189.1
2554	OC-6 (HAWKINS ROAD)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-597816.4
2581	OC-5 (SHALIMAR)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-482452.1
2584	OC-7(SHALIMAR ANNEX)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-640312.3
2627	HOLLEY-NAVARRE #2	-195000.0	-245000.0	-303000.0	-296666.7	-386666.7	-310000.0	-280000.0	-336666.7
2651	MOODY KELLY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2735	EAFB HOUS#13 #2985	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2750	EAFB HOUS #12 #2829	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2758	FWB #7	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-833438.4	-667169.9	-1071328.8

Table 4.3d (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998

NWF_ID	Well Name	1983 Pumping (gpd)	1984 Pumping (gpd)	1985 Pumping (gpd)	1986 Pumping (gpd)	1987 Pumping (gpd)	1988 Pumping (gpd)	1989 Pumping (gpd)	1990 Pumping (gpd)
2759	OC-8 (GREEN ACRES)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-661863.0
2762	EAFB HOUS #16 #2755	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2787	EAFB HOUS #11 #10634	0.0	0.0	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2792	FWB #10	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-743605.5	-290835.6	-412520.6
2807	FWB #6	-368888.9	-391111.1	-431111.1	-439888.9	-426888.9	-814035.6	-960290.4	-645690.4
2814	BLUEWATER #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2815	EAFB HOUS #10 #10941	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2825	EAFB HOUS #8 #2594	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2860	EAFB HOUS #9 #10000	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2874	OC-2 (LONGWOOD)	-397666.7	-414888.9	-432000.0	-449222.3	-466333.3	-488111.1	-507666.7	-452939.7
2884	EAFB HOUS #7 #2590	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2891	BLUEWATER #2	-179666.7	-195666.7	-212000.0	-228000.0	-244333.3	-260333.3	-276666.7	-129369.9
2909	SOUTH GOLF COURSE	0.0	0.0	0.0	-11333.3	-12333.3	-13000.0	-13666.7	-14666.7
2953	SEMINOLE #5	-23250.0	-24500.0	-25750.0	-20000.0	-22200.0	-21200.0	-20000.0	-21200.0
2958	EAFB HOUS #14 #1308	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2971	SEMINOLE #1	-23250.0	-24500.0	-25750.0	-20000.0	-22200.0	-21200.0	-20000.0	-21200.0
2972	SEMINOLE #6	-23250.0	-24500.0	-25750.0	-20000.0	-22200.0	-21200.0	-20000.0	-21200.0
2973	WELL #6	0.0	0.0	0.0	-11333.3	-12333.3	-13000.0	-13666.7	-14666.7
2984	EAFB MAIN #5 #616	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
2985	EAFB MAIN #4 #303	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
3004	EAFB HOUS #15 #1320	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
3012	EAFB MAIN #3 #31	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
3015	EAFB MAIN #6 #62	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0
3026	OLD GOLF COURSE #1	-27000.0	-29000.0	-32000.0	-11333.3	-12333.3	-13000.0	-13666.7	-14666.7
3033	EAFB MAIN #2 #82	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	0.0	0.0
3049	SEMINOLE #2	-23250.0	-24500.0	-25750.0	-20000.0	-22200.0	-21200.0	-20000.0	-21200.0
3057	SEMINOLE #3	0.0	0.0	0.0	-20000.0	-22200.0	-21200.0	-20000.0	-21200.0
3063	BLUEWATER #1 (AUX)	-179666.7	-195666.7	-212000.0	-228000.0	-244333.3	-260333.3	-276666.7	0.0
3071	EAFB MAIN #1 #859	-293200.0	-308933.3	-304375.0	-306875.0	-309375.0	-311875.0	-314375.0	-316875.0

Table 4.3d (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998

NWF_ID	Well Name	1983 Pumping (gpd)	1984 Pumping (gpd)	1985 Pumping (gpd)	1986 Pumping (gpd)	1987 Pumping (gpd)	1988 Pumping (gpd)	1989 Pumping (gpd)	1990 Pumping (gpd)
3091	BLUEWATER #3	-179666.7	-195666.7	-212000.0	-228000.0	-244333.3	-260333.3	-276666.7	-748613.7
3126	VALPARAISO #4	0.0	0.0	0.0	0.0	-113750.0	-150000.0	-23619.2	-79389.0
3231	NICEVILLE #8	0.0	0.0	-253285.7	-297428.6	-312000.0	-309142.9	-124909.6	-171104.1
3240	VALPARAISO #2	-216046.6	-183000.0	-196666.7	-170000.0	-113750.0	-150000.0	-243320.5	-235268.5
3256	NICEVILLE #2	-260166.7	-277833.3	-253285.7	-297428.6	-312000.0	-309142.9	-421498.6	-360295.9
3258	VALPARAISO #1	-80501.4	-183000.0	-196666.7	-170000.0	-113750.0	-150000.0	-94600.0	-75780.8
3295	VALPARAISO #3	-209972.6	-183000.0	-196666.7	-170000.0	-113750.0	-150000.0	-206131.5	-216205.5
3326	NICEVILLE #6	-260166.7	-277833.3	-253285.7	-297428.6	-312000.0	-309142.9	-157537.0	-211200.0
3350	NICEVILLE #1	-260166.7	-277833.3	-253285.7	-297428.6	-312000.0	-309142.9	-381315.1	-377660.3
3367	NICEVILLE #3	-260166.7	-277833.3	-253285.7	-297428.6	-312000.0	-309142.9	-390854.8	-377021.9
3432	NICEVILLE #10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-333619.2
3457	NICEVILLE #5	-260166.7	-277833.3	-253285.7	-297428.6	-312000.0	-309142.9	-684652.1	-640189.1
3482	NICEVILLE #4	-260166.7	-277833.3	-253285.7	-297428.6	-312000.0	-309142.9	-43698.6	-42517.8
3770	PRIMARY INJECTION	756298.6	747263.0	756057.6	710093.1	681334.3	705279.4	791868.5	961739.8
5942	OCWS/SEASHORE VIL #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6006	EAFB MAIN #2A BLDG82	0.0	0.0	0.0	0.0	0.0	0.0	-314375.0	-316875.0
6024	VILLA TASSO #2	-18000.0	-20500.0	-23000.0	-24000.0	-25000.0	-26000.0	-27000.0	-28000.0
7209	OC-11 (FOREST)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7998	ISL-5 (CAROUSEL)	0.0	0.0	0.0	0.0	0.0	0.0	-92200.0	0.0
8006	ISL-3 (AMUSEMENT PK)	-353156.2	-447493.2	-460052.1	-427169.9	-358813.7	-273756.2	-92200.0	-93145.2
8209	CEMEX FLD @ DESTIN	-10000.0	-10000.0	-11000.0	-11000.0	-11000.0	-11000.0	-12000.0	-12000.0
	Total	-19643904.9	-21062255.4	-22462041.4	-23626190.3	-23918369.7	-24130096.0	-23806551.3	-24401564.5

Table 4.3d (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998

NWF_ID	Well Name	1991 Pumping (gpd)	1992 Pumping (gpd)	1993 Pumping (gpd)	1994 Pumping (gpd)	1995 Pumping (gpd)	1996 Pumping (gpd)	1997 Pumping (gpd)	1998 Pumping (gpd)
1369	NAVARRE BEACH #3	-215547.9	-239054.8	-260917.8	-220315.1	-190400.0	-160394.5	-137339.7	-153663.0
1444	NAVARRE BEACH #1	-8901.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1481	SWU #6	0.0	-369106.8	-371687.7	-555810.9	-495027.4	-406364.4	-352575.3	-502158.9
1483	NAVARRE BEACH #2	-174797.3	-165312.3	-132098.6	-108353.4	-87011.0	-39457.5	-142227.4	-121934.3
1586	DWU #7	-316125.0	-317125.0	-381571.4	-505923.3	-570567.1	-549797.3	-394326.0	-574189.1
1601	DWU #2	-316125.0	-317125.0	-381571.4	-789210.9	-839295.9	-820989.1	-869800.0	-769600.0
1604	US COAST GUARD #1	-9693.2	-12000.0	-14000.0	-15000.0	-16578.1	-15306.8	-31827.4	-20191.8
1611	DWU #8	-316125.0	-317125.0	-381571.4	-712.3	-13.7	-106715.1	-368027.4	-313487.7
1654	DWU #3	-316125.0	-317125.0	-381571.4	-607816.4	-572093.1	-691953.4	-610265.8	-685054.8
1661	DWU #9	-316125.0	-317125.0	-381571.4	-13241.1	-61019.2	-154923.3	-171095.9	-351474.0
1664	EAFB A-13 BLDG 9296	-6333.3	-5666.7	-5000.0	-4333.3	-3666.7	-3333.3	-2666.7	-2000.0
1687	DWU #1	-316125.0	-317125.0	0.0	0.0	0.0	0.0	0.0	0.0
1688	ISL-7 (JOHN BEASLEY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1696	ISL-1 (MONITOR)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1697	EAFB A-11 BLDG 9262	-6333.3	-5666.7	-5000.0	-4333.3	-3666.7	-3333.3	-2666.7	-2000.0
1710	ISL-2 (EAST TANK)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1714	ISL-4 (TREAT PLANT)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1736	EAFB A-6 BLDG 8552	-6333.3	-5666.7	-5000.0	-4333.3	-3666.7	-3333.3	-2666.7	-2000.0
1742	ISL-6 (EL MATADOR)	-114591.8	-86679.5	-2690.4	0.0	0.0	0.0	0.0	0.0
1796	DWU #5	-316125.0	-317125.0	-381571.4	-379750.7	-251191.8	-132353.4	-341304.1	-139526.0
1838	DWU #4	-316125.0	-317125.0	-381571.4	-457424.7	-526876.7	-463405.5	-166000.0	-291342.5
1841	HOLLEY-NAVARRE #4	0.0	-262250.0	0.0	-262320.6	-647279.4	-674937.0	-686882.2	-752446.6
1887	MIDWAY #1	-675000.0	-668000.0	-660500.0	-508391.8	-667665.8	-602002.8	-622619.2	-761328.8
1901	FWB #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1940	MARY ESTHER #3	-254378.1	-256372.6	-192775.3	-126821.9	-189126.0	-168632.9	-165112.3	-164690.4
2023	MARY ESTHER #1	-194805.5	-169347.9	-200463.0	-102095.9	-7698.6	-35049.3	-140813.7	-35643.8
2031	MARY ESTHER #4	0.0	0.0	0.0	-198008.2	-319274.0	-355389.0	-325758.9	-264435.6
2035	MARY ESTHER #2	-251011.0	-277898.6	-383937.0	-368419.2	-268093.2	-204298.6	-74139.7	-246353.4
2040	OCWS/SEASHORE VIL #2	-163333.3	-198666.7	-179000.0	-190666.7	-296931.5	-321164.4	-193306.8	-228772.6

Table 4.3d (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998

NWF_ID	Well Name	1991 Pumping (gpd)	1992 Pumping (gpd)	1993 Pumping (gpd)	1994 Pumping (gpd)	1995 Pumping (gpd)	1996 Pumping (gpd)	1997 Pumping (gpd)	1998 Pumping (gpd)
2046	OCWS/SEASHORE VIL #1	-163333.3	-198666.7	-179000.0	-190666.7	0.0	0.0	0.0	0.0
2048	OCWS/SEASHORE VIL #3	-163333.3	-198666.7	-179000.0	-190666.7	-292657.5	-292589.0	-204101.4	-138438.4
2053	HOLLEY-NAVARRE #3	-681019.2	-262250.0	-779654.8	-689369.9	-631167.1	-737038.4	-722372.6	-731134.3
2073	EAFB HURL #1 #90308	-168500.0	-161750.0	-155000.0	-148250.0	0.0	0.0	-180750.0	-118298.6
2085	FWB #5	-4400.0	-20109.6	-65695.9	-12232.9	-201884.9	-66512.3	-93808.2	-43682.2
2093	FWB #2	-235.6	-51852.1	-203556.2	-229715.1	-318016.4	-345745.2	-295567.1	-24071.2
2099	FWB #3	-125934.3	0.0	0.0	0.0	-13569.9	-70980.8	-109074.0	-152005.5
2108	FWB #8	-66150.7	-291504.1	-207871.2	-311660.3	-455871.2	-286386.3	-113863.0	-178821.9
2113	EAFB HURL #5 #90355	-168500.0	-161750.0	-155000.0	-148250.0	-212098.6	-164608.2	-180750.0	-188600.0
2134	EAFB HURL #2 #90601	-168500.0	-161750.0	-155000.0	-148250.0	-246687.7	-294717.8	-180750.0	-215002.7
2139	FWB #9	-558501.4	-50137.0	-216032.9	-95671.2	-286342.5	-432049.3	-127471.2	-248419.2
2146	FWB #11	-568287.7	-757090.4	-673465.8	-693106.9	-703213.7	-413589.0	-826654.8	-918780.8
2168	EAFB HURL #7 #91136	-168500.0	-161750.0	-155000.0	-148250.0	-107221.9	-213457.5	-180750.0	-251326.0
2236	OC-9 (NORTHGATE)	-313863.0	-325893.2	-359123.3	-489742.5	-378369.9	-391016.4	-223756.2	-361701.4
2318	MIDWAY #2	-675000.0	-668000.0	-660500.0	-797126.0	-763465.8	-845942.4	-716495.9	-818923.3
2320	HOLLEY-NAVARRE #1	-164095.9	-262250.0	-253945.2	-220526.0	-109912.3	-71589.0	-48139.7	-40745.2
2404	OC-1 (OFFICE)	-725279.4	-556265.8	-330986.3	-350750.7	-299742.5	-383737.0	-272920.6	-39219.2
2463	OC-10 (LOWERY)	0.0	-70230.1	-488679.4	-580306.9	-486928.8	-548791.8	-584660.3	-599257.6
2506	OC-3 (NEWCASTLE)	-331528.8	-172783.6	-281191.8	-328761.7	-184775.3	-221115.1	-275301.4	-275484.9
2508	OC-4 (GREEN STREET)	-522983.6	-577452.1	-776465.8	-320731.5	-674356.2	-688093.1	-564180.8	-499698.6
2554	OC-6 (HAWKINS ROAD)	-328109.6	-532498.6	-599112.3	-644279.4	-636016.4	-737816.4	-897019.2	-770610.9
2581	OC-5 (SHALIMAR)	-676474.0	-794843.8	-739243.8	-518356.2	-532838.4	-265235.6	-476208.2	-361975.3
2584	OC-7(SHALIMAR ANNEX)	-749115.1	-635583.6	-662783.6	-664953.4	-643304.1	-627997.3	-407909.6	-540493.1
2627	HOLLEY-NAVARRE #2	-103649.3	-262250.0	-144676.7	-133597.3	-126449.3	-126687.7	-220816.4	-298575.3
2651	MOODY KELLY #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2735	EAFB HOUS#13 #2985	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-109893.1
2750	EAFB HOUS #12 #2829	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-92687.7
2758	FWB #7	-716202.8	-868452.1	-901076.7	-825030.1	-844295.9	-614183.6	-746254.8	-109841.1

Table 4.3d (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998

NWF_ID	Well Name	1991 Pumping (gpd)	1992 Pumping (gpd)	1993 Pumping (gpd)	1994 Pumping (gpd)	1995 Pumping (gpd)	1996 Pumping (gpd)	1997 Pumping (gpd)	1998 Pumping (gpd)
2759	OC-8 (GREEN ACRES)	-344150.7	-625564.4	-714279.4	-714041.1	-730506.9	-738293.1	-927731.5	-855260.3
2762	EAFB HOUS #16 #2755	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-249112.3
2787	EAFB HOUS #11 #10634	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-375186.3
2792	FWB #10	-720643.8	-576967.1	-512008.2	-449002.8	0.0	-468838.3	-662197.3	-862991.8
2807	FWB #6	-723671.3	-958676.7	-760498.6	-733490.4	-466391.8	-651978.1	-218293.2	-713197.3
2814	BLUEWATER #4	0.0	0.0	-82.2	-404742.5	-370134.3	-409471.2	-524019.2	-402432.9
2815	EAFB HOUS #10 #10941	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-198331.5
2825	EAFB HOUS #8 #2594	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-155106.8
2860	EAFB HOUS #9 #10000	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-440676.7
2874	OC-2 (LONGWOOD)	-553884.9	-680030.1	-447920.6	-389939.7	-633326.0	-518011.0	-477937.0	-496131.5
2884	EAFB HOUS #7 #2590	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-218756.2
2891	BLUEWATER #2	-172758.9	-475500.0	-266663.0	-104169.9	-236427.4	-127742.5	-217646.6	-215890.4
2909	SOUTH GOLF COURSE	-24463.0	-21542.5	-34528.8	-104052.0	-53476.7	-24446.6	-18315.1	-31720.5
2953	SEMINOLE #5	-17600.0	-19000.0	-20564.4	-19200.0	-34515.1	-31575.3	-26364.4	-19695.9
2958	EAFB HOUS #14 #1308	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-73805.5
2971	SEMINOLE #1	-17600.0	-19000.0	-11597.3	-19200.0	-13123.3	-10221.9	-13011.0	-19695.9
2972	SEMINOLE #6	-17600.0	-19000.0	-18367.1	-19200.0	-11720.5	-14684.9	-15342.5	-19695.9
2973	WELL #6	-22843.8	-17758.9	-10526.0	-1517.8	-1331.5	-939.7	-1131.5	0.0
2984	EAFB MAIN #5 #616	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-35386.3
2985	EAFB MAIN #4 #303	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-77775.3
3004	EAFB HOUS #15 #1320	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-83304.1
3012	EAFB MAIN #3 #31	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-261865.8
3015	EAFB MAIN #6 #62	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-52682.2
3026	OLD GOLF COURSE #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3033	EAFB MAIN #2 #82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3049	SEMINOLE #2	-17600.0	-19000.0	-24016.4	-19200.0	-28857.5	-23849.3	-23542.5	-19695.9
3057	SEMINOLE #3	-17600.0	-19000.0	-27589.0	-19200.0	-22860.3	-25778.1	-24934.2	-19695.9
3063	BLUEWATER #1 (AUX)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3071	EAFB MAIN #1 #859	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-316676.7

Table 4.3d (continued)
Pumping for the Transient Post-Development DSTRAM Simulation 1983–1998

NWF_ID	Well Name	1991 Pumping (gpd)	1992 Pumping (gpd)	1993 Pumping (gpd)	1994 Pumping (gpd)	1995 Pumping (gpd)	1996 Pumping (gpd)	1997 Pumping (gpd)	1998 Pumping (gpd)
3091	BLUEWATER #3	-667465.8	-475500.0	-750772.6	-484463.0	-420569.9	-489076.7	-318561.7	-431320.6
3126	VALPARAISO #4	-103934.3	-121983.6	-113178.1	-181854.8	-177241.1	-215049.3	-241504.1	-255347.9
3231	NICEVILLE #8	-125169.9	-179279.5	-196558.9	-215786.3	-353411.0	-373863.0	-275361.7	-269504.1
3240	VALPARAISO #2	-186534.3	-221767.1	-166274.0	-160052.1	-146731.5	-125474.0	-108898.6	-124074.0
3256	NICEVILLE #2	-290816.4	-201287.7	-380167.1	-354298.6	-407424.7	-349493.2	-247419.2	-550137.0
3258	VALPARAISO #1	-92824.7	-169476.7	-140169.9	-120786.3	-124709.6	-101654.8	-96383.6	-139411.0
3295	VALPARAISO #3	-173838.4	-69800.0	-196539.7	-145893.2	-162098.6	-175013.7	-178945.2	-139824.7
3326	NICEVILLE #6	-154665.8	-195405.5	-211668.5	-199232.9	-278679.4	-562912.3	-545024.7	-356600.0
3350	NICEVILLE #1	-358202.8	-343063.0	-337906.8	-315035.6	-365328.8	-352071.2	-388909.6	-414934.3
3367	NICEVILLE #3	-350726.0	-342895.9	-337208.2	-318789.0	-356523.3	-346501.4	-369265.8	-318397.3
3432	NICEVILLE #10	-461874.0	-456945.2	-475953.4	-437964.4	-494797.3	-489213.7	-553983.6	-274852.1
3457	NICEVILLE #5	-333824.7	-611063.0	-545989.1	-541194.5	-519035.6	-521134.3	-597616.4	-604084.9
3482	NICEVILLE #4	-56589.0	-43306.8	-51605.5	-42706.8	-37457.5	-26558.9	-30241.1	-33112.3
3770	PRIMARY INJECTION	946315.1	910101.4	947134.3	1059969.9	836145.2	828884.9	1160668.5	843424.7
5942	OCWS/SEASHORE VIL #4	0.0	0.0	0.0	0.0	0.0	0.0	-249178.1	-367391.8
6006	EAFB MAIN #2A BLDG82	-300875.0	-284875.0	-268875.0	-252875.0	-236875.0	-223125.0	-209437.5	-414591.8
6024	VILLA TASSO #2	-21500.0	-22000.0	-25000.0	-27500.0	-29500.0	-29500.0	-26695.9	-34320.5
7209	OC-11 (FOREST)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-151912.3
7998	ISL-5 (CAROUSEL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8006	ISL-3 (AMUSEMENT PK)	-137778.1	-114800.0	0.0	-48101.4	0.0	-219.2	-95.9	0.0
8209	CEMEX FLD @ DESTIN	-12000.0	-12000.0	-12000.0	-13000.0	-13000.0	-12857.5	-13928.8	-16819.2
	Total	-22967401.9	-24141981.1	-24550629.8	-23893179.6	-24609363.3	-24710551.7	-24033808.8	-24777961.8

Table 4.4
Water Balance for Post-Development (1998) Conditions

	Flow In (Mgal/day)	Percent of Total	Flow Out (Mgal/Day)	Percent of Total
Northern Boundary	10.31	23.59	0.53	1.21
Southern Boundary	6.78	15.51	5.61	12.72
Eastern Boundary	5.99	13.70	5.52	12.51
Western Boundary	8.51	19.46	6.34	14.38
Top Boundary	6.63	15.17	0.05	0.11
Bottom Boundary	4.65	10.64	0.44	0.99
Pumping	0.84	1.93	25.62	58.08
Total	43.72	100.00	44.12	100.00

Table 4.5
Net Fluid Flux for Pre-Development and 1998 Conditions

	Pre-Development	Post Development (1998)	Change in Boundary Flow (1998) – (Pre-Dev)	
	Net Flow In (out) (Mgal/day)	Net Flow In (out) (Mgal/day)	(Mgal/day)	Percent of Total
Northern Boundary	5.53	9.78	4.25	17.4
Southern Boundary	(0.76)	1.17	1.93	7.9
Eastern Boundary	(3.51)	0.47	3.98	16.3
Western Boundary	(0.12)	2.17	2.28	9.4
Top Boundary	(2.75)	6.59	9.34	38.3
Bottom Boundary	1.61	4.21	2.60	10.7
Wells	0	(24.78)	(24.78)	(100.0)

Table 4.6
Chloride Balance for Post-Development (1998) Conditions

	Advective Flux				Dispersive Flux			
	Flow In (Kg/day)	Percent of Total	Flow Out (Kg/day)	Percent of Total	Flow In (Kg/day)	Percent of Total	Flow Out (Kg/day)	Percent of Total
Northern Boundary	1317	0.07	2671	0.22	2386	8.31	3698	3.78
Southern Boundary	487719	26.71	403682	33.37	5893	20.54	5	0.00
Eastern Boundary	187128	10.25	351854	29.08	16647	58.03	1665	1.70
Western Boundary	469082	25.69	411648	34.03	2474	8.62	196	0.20
Top Boundary	399735	21.89	3367	0.28	314	1.10	92005	94.09
Bottom Boundary	280945	15.39	31379	2.59	976	3.40	216	0.22
Pumping	0	0.00	5151	0.43	0	0.00	0	0.00
Total	1825925	100.000	1209751	100.000	28690	100.000	97785	100.000

Table 5.1
Model Parameter Changes Applied to the Sensitivity Simulations and the Resulting Statistics

Sensitivity Run Number	Tested Parameter	Perturbation applied	Total mass (equilibrated predevelopment simulation) (Relative Units)	Total mass (1998 simulation) (Relative Units)	Mean head error, 1998 (ft)	RMS head error, 1998 (ft)	Mean chloride error, 1998 (mg/L)	RMS chloride error, 1998 (mg/L)
0	Base Case	0	7.272E+12	7.84E+12	-23.7	29.2	58.2	387.7
1a	Porosity (for all elements)	Value = 0.15	4.315E+12	4.70E+12	-23.7	29.2	77.9	382.4
2a	Kx and Ky (aquifers only - slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 0.5	7.847E+12	8.59E+12	9.7	15.5	-257.0	672.9
2b	Kx and Ky (aquifers only – slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 1.5	6.708E+12	7.30E+12	-35.9	43.6	174.3	448.3
3a	Kz (Intermediate System only)	Factor by 0.1	6.833E+12	7.40E+12	-18.0	23.5	94.2	401.8
3b	Kz (Intermediate System only)	Factor by 10.0	8.111E+12	9.02E+12	-39.1	46.0	-86.3	642.1
4a	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 0.1	6.852E+12	7.64E+12	-23.3	28.6	65.6	388.2
4b	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 10.0	7.361E+12	7.97E+12	-24.9	31.4	37.4	398.5
5a	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 0.1	5.126E+12	5.83E+12	-20.7	27.0	276.6	643.6
5b	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 10.0	8.428E+12	9.09E+12	-34.9	40.4	-814.8	1664.2
6a	Specified Head (sub-Floridan System)	hd - 10 ft	5.275E+12	6.05E+12	-23.2	28.9	263.5	610.0
6b	Specified Head (sub-Floridan System)	hd + 10 ft	8.228E+12	8.91E+12	-24.2	29.6	-379.3	882.9
7a	Molecular diffusion (all layers)	Value = 0.0	7.173E+12	7.79E+12	-23.7	29.2	134.8	404.1
8a	Grid (elements x, y - ft)	Factor by 0.5	6.879E+12	7.57E+12	-23.4	28.5	52.8	390.7
9a	Dispersivity (Horizontal longitudinal and transverse: applied to refined grid used in Case 8a)	Factor by 0.5	6.910E+12	7.58E+12	-23.4	28.5	41.9	389.3
10	Southern boundary (move landward)	Decrease to 16 miles	6.187E+12	7.03E+12	-24.4	30.1	129.7	418.9

Table 5.2
1998 Head Observations, Upper Floridan Aquifer

WELL NAME	NWFID	OBSERVATION TYPE	NODE # (slice 1)	NODE #	HEAD-MSL (ft)	SLICE #
DWU #5	1796	ufld-head	5682	163362	-75.19	16
EAFB FLD-4 #2 #4204	3209	ufld-head	9313	166993	-50.32	16
EAFB METTS TOWER	3642	ufld-head	10002	167682	-11.59	16
EAFB POSTIL POINT	2994	ufld-head	9042	166722	-77.83	16
MARY ESTHER #2	2035	ufld-head	6084	163764	-154.12	16
NAVARRE BEACH MO#1	1472	ufld-head	4869	162549	-70.94	16
OKALOOSA SCHOOL BRD	1894	ufld-head	5805	163485	-94.26	16
WAYSIDE PARK	1675	ufld-head	5371	163051	-82.78	16
WRIGHT ELEMENTARY	2394	ufld-head	7113	164793	-113.00	16
WRIGHT UPPER FLRD	2822	ufld-head	8133	165813	-102.30	16

Table 5.3
1998 Head Observations, Lower Floridan Aquifer

WELL NAME	NWFID	OBSERVATION TYPE	NODE # (slice 1)	NODE #	HEAD-MSL (ft)	SLICE #
BEAL CEM. LOWER FLRD	2173	lfld-head	6529	90625	-23.02	9
EAFB FLD 4 LOW FLRD	3210	lfld-head	9313	93409	-49.67	9
NORTH MONITOR WELL	3926	lfld-head	10228	94324	180.00	9
YELLOW R. LOWER FLRD	3555	lfld-head	9822	93918	51.59	9

Table 5.4
Post-Development Chloride Observations, Upper Floridan Aquifer

WELL NAME	NWFID	OBSERVATION TYPE	NODE # (slice 1)	NODE #	CHLORIDE (mg/L)	SLICE #
CW-3 PASCHEL	2048	ufld-cl	6205	163885	106	16
DWU #4	1838	ufld-cl	5684	163364	39	16
EAFB A-11 BLDG 9262	1697	ufld-cl	5341	173533	130	17
EAFB A-13 BLDG 9296	1664	ufld-cl	5333	163013	120	16
EAFB A-15 BLDG 12503	1645	ufld-cl	5173	152341	280	15
EAFB A-3 BLDG 8351	1628	ufld-cl	5233	173425	66	17
EAFB A-6 BLDG 8552	1736	ufld-cl	5504	152672	56	15
EAFB NCO #71	6016	ufld-cl	5095	162775	80	16
FWB #2	2093	ufld-cl	6388	164068	53	16
H-N #2	2627	ufld-cl	7494	165174	27	16
H-N #4	1841	ufld-cl	5582	163262	140	16
J.S. COBB	1751	ufld-cl	5416	142072	315	14
MARY ESTHER #3	1940	ufld-cl	6079	163759	78	16
MIDWAY #1	1887	ufld-cl	5741	163421	91	16
NAVARRE BEACH #3	1369	ufld-cl	4569	151737	169	15
NWFWMD LIZA JACKSON	7523	ufld-cl	5798	142454	170	14
NWFWMD TIGER POINT	7686	ufld-cl	4976	141632	520	14
OCWS ISL-3 AMUSE. PK	8006	ufld-cl	5516	152684	75	15
OCWS-2 (LONGWOOD)	2874	ufld-cl	8438	166118	5	16
OCWS-6 (HAWKINS RD)	2554	ufld-cl	7402	175594	43	17

Table 5.5
Post-Development Chloride Observations, Lower Floridan Aquifer

WELL NAME	NWFID	OBSERVATION TYPE	NODE # (slice 1)	NODE #	CHLORIDE (mg/L)	SLICE #
BEAL CEM. LOWER FLRD	2173	lfld-cl	6529	80113	1600	8
EAFB FLD 4 LWR FLRD	3210	lfld-cl	9313	51361	410	5
WRP LOWER FLRD	7174	lfld-cl	5684	79268	1700	8
YELLOW RIVER LOWER FLRD	3555	lfld-cl	9821	72893	3300	7

Table 5.6
Nodes Representing Upper Floridan Aquifer Approximately 3 Miles Offshore

AREA	TYPE	REFERENCE #	NODE #	SLICE #
Offshore	ufld-node	2650	160349	16
Offshore	ufld-node	3106	160807	16
Offshore	ufld-node	3172	160873	16
Offshore	ufld-node	3414	161117	16
Offshore	ufld-node	3579	161283	16

Table 5.7
Nodes Representing the Lower Floridan Aquifer near the Bucatunna Clay Pinchout

AREA	TYPE	REFERENCE #	NODE #	SLICE #
Bucatunna Clay. pinchout	lfld-node	6220	90504	9
Bucatunna Clay. pinchout	lfld-node	6501	90787	9
Bucatunna Clay. pinchout	lfld-node	6927	91071	9
Bucatunna Clay. pinchout	lfld-node	7498	91646	9
Bucatunna Clay. pinchout	lfld-node	8215	92368	9

Table 5.8
Elements Representing Intermediate System,
Near Shore Gulf of Mexico and Choctawhatchee Bay

AREA	TYPE	REFERENCE #	ELEMENT #	LAYER #
bay and near shore gulf	is-element	4767	190077	19
bay and near shore gulf	is-element	4894	190204	19
bay and near shore gulf	is-element	5774	191084	19
bay and near shore gulf	is-element	6506	191816	19
bay and near shore gulf	is-element	7235	192545	19

Table 5.9
Elements Representing the Upper Floridan Aquifer
Approximately 3 Miles Offshore

AREA	TYPE	REFERENCE #	ELEMENT #	LAYER #
Offshore	ufld-element	2650	157075	16
Offshore	ufld-element	3106	157531	16
Offshore	ufld-element	3172	157597	16
Offshore	ufld-element	3414	157839	16
Offshore	ufld-element	3579	158004	16

Table 5.10
Elements Representing the Lower Floridan Aquifer
Near the Bucatunna Clay Pinchout

AREA	TYPE	REFERENCE #	ELEMENT #	LAYER #
Bucatunna Clay. pinchout	lfld-element	6220	78285	8
Bucatunna Clay. pinchout	lfld-element	6501	78566	8
Bucatunna Clay. pinchout	lfld-element	6927	78992	8
Bucatunna Clay. pinchout	lfld-element	7498	79563	8
Bucatunna Clay. pinchout	lfld-element	8215	80280	8

Table 5.11
Summary of 1998 Model Sensitivity Results for Up Gradient Salt Water Interface Areas

(Locations provided in Figure 5.15)

Sens Run No.	Tested Parameter	Perturbation applied	Upper Floridan Aquifer (approx. 3 miles offshore)			Lower Floridan Aquifer (near Bucatunna Clay pinchout)			Intermediate System (bay and near shore Gulf of Mexico)
			Mean head (ft msl)	Mean chloride (mg/L)	Mean horizontal seepage velocity (ft/year)	Mean head (ft msl)	Mean chloride (mg/L)	Mean horizontal seepage velocity (ft/year)	Mean vertical seepage velocity (ft/year) (negative velocity is downward movement)
Base	Base Case	0	-31.8	177.7	7.98	-15.8	1135.0	28.93	-0.07
1a	Porosity (for all elements)	Value = 0.15	-31.9	123.6	13.30	-15.8	1227.3	48.20	-0.11
2a	Kx and Ky (aquifers only - slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 0.5	-56.7	471.3	7.50	-34.5	2244.8	23.55	-0.11
2b	Kx and Ky (aquifers only – slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 1.5	-22.1	97.0	8.46	-9.0	706.0	33.87	-0.05
3a	Kz (Intermediate System only)	Factor by 0.1	-43.9	193.5	6.66	-18.7	880.2	30.55	-0.01
3b	Kz (Intermediate System only)	Factor by 10.0	-11.3	3881.6	8.12	-6.2	1779.3	23.77	-0.29
4a	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 0.1	-32.6	168.0	8.05	-13.5	1127.1	28.22	-0.07
4b	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 10.0	-27.5	257.3	7.90	-21.6	978.3	27.78	-0.06
5a	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 0.1	-33.2	57.3	8.06	-24.8	170.7	23.59	-0.07
5b	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 10.0	-27.6	567.1	7.30	16.2	5352.2	40.60	-0.06
6a	Specified Head (sub-Floridan System)	hd - 10 ft	-32.3	65.0	7.93	-17.0	282.8	28.22	-0.07
6b	Specified Head (sub-Floridan System)	hd + 10 ft	-31.6	399.2	8.00	-14.6	3010.0	29.67	-0.07
7a	Molecular diffusion (all layers)	Value = 0.0	-32.0	18.6	7.94	-15.8	1272.1	28.92	-0.07
8a	Grid (elements x, y - ft)	Factor by 0.5	-32.0	180.0	7.78	-15.6	1151.5	28.49	-0.07
9a	Dispersivity (Horizontal longitudinal and transverse: applied to refined grid used in Case 8a)	Factor by 0.5	-32.0	185.9	7.78	-15.6	1194.7	28.49	-0.07
10	Southern boundary (move landward)	Decrease to 16 miles	-28.0	134.1	8.99	-15.6	749.8	28.64	-0.07

Table 5.12
Sensitivity of Upper Floridan Aquifer Groundwater Seepage Velocity in Offshore Areas

Horizontal groundwater seepage velocity and bearing for t = 1998 for listed elements

Sens Run No.	Tested Parameter	Perturbation applied	Element 157075		Element 157531		Element 157597		Element 157839		Element 158004		Average Velocity[2] (ft/yr)	ASTM Sensitivity Type
			Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]		
	Base case	0	9.30	69.27	5.82	103.37	9.25	80.54	6.15	86.77	9.40	96.78	7.98	
1a	Porosity (for all elements)	Value = 0.15	15.48	69.22	9.69	103.36	15.41	80.57	10.23	86.77	15.67	96.80	13.30	IV
2a	Kx and Ky (aquifers only - slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 0.5	8.41	71.61	5.90	108.71	7.71	83.95	6.12	94.70	9.37	102.50	7.50	I
2b	Kx and Ky (auifers only - slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 1.5	10.24	68.27	5.98	99.58	10.28	76.24	6.34	81.34	9.47	92.08	8.46	II
3a	Kz (Intermediate System only)	Factor by 0.1	9.14	63.81	4.59	91.82	6.89	86.26	5.20	68.91	7.47	86.44	6.66	I
3b	Kz (Intermediate System only)	Factor by 10.0	9.14	77.61	7.40	115.18	7.13	77.31	7.24	106.56	9.71	108.81	8.12	II
4a	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 0.1	9.30	69.17	5.83	103.31	9.40	80.89	6.20	86.80	9.52	96.79	8.05	I
4b	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 10.0	9.54	69.26	5.86	102.34	8.94	78.68	6.06	84.73	9.08	95.26	7.90	I
5a	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 0.1	9.34	68.66	5.79	102.65	9.40	81.17	6.21	86.13	9.56	96.59	8.06	II
5b	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 10.0	8.88	70.55	5.60	105.69	8.04	78.27	5.58	89.04	8.40	98.25	7.30	II
6a	Specified Head (sub-Floridan System)	hd - 10 ft	9.27	68.99	5.77	103.12	9.14	80.68	6.11	86.50	9.36	96.75	7.93	II
6b	Specified Head (sub-Floridan System)	hd + 10 ft	9.31	69.44	5.85	103.54	9.26	80.41	6.16	86.94	9.41	96.80	8.00	II

Table 5.12 (continued)
Sensitivity of Upper Floridan Aquifer Groundwater Seepage Velocity in Offshore Areas

Horizontal groundwater seepage velocity and bearing for t = 1998 for listed elements

Sens Run No.	Tested Parameter	Perturbation applied	Element 157075		Element 157531		Element 157597		Element 157839		Element 158004		Average Velocity[2] (ft/yr)	ASTM Sensitivity Type
			Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]		
7a	Molecular diffusion (all layers)	Value = 0.0	9.24	68.99	5.76	103.31	9.23	80.64	6.10	86.78	9.38	96.89	7.94	II
8a	Grid (elements x, y - ft)	Factor by 0.5	8.78	67.72	5.70	103.94	9.04	81.59	6.09	87.42	9.30	96.84	7.78	I
9a	Dispersivity (Horizontal longitudinal and transverse: applied to refined grid used in Case 8a)	Factor by 0.5	8.77	67.71	5.70	103.94	9.04	81.60	6.09	87.43	9.30	96.86	7.78	I
10	Southern boundary (move landward)	Decrease to 16 miles	11.76	72.68	7.01	101.70	9.54	79.22	6.87	84.38	9.77	94.37	8.99	I

[1] Bearing is given in degrees measured counter-clockwise relative to the positive x-direction.
[2] Average velocity is the average of the specified elements.

Table 5.13
Sensitivity of Lower Floridan Aquifer Groundwater Seepage Velocity near the Bucatunna Clay Pinchout

Horizontal groundwater seepage velocity and bearing for t = 1998 for listed elements

Sens Run No.	Tested Parameter	Perturbation applied	Element 78285		Element 78566		Element 78992		Element 79563		Element 80280		Average Velocity[2] (ft/yr)	ASTM Sensitivity Type
			Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]		
	Base case	0	22.97	72.39	25.07	61.94	28.01	50.85	33.04	38.34	35.57	25.29	28.93	
1a	Porosity (for all elements)	Value = 0.15	38.27	72.39	41.76	61.94	46.67	50.84	55.05	38.33	59.26	25.28	48.20	IV
2a	Kx and Ky (aquifers only - slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 0.5	19.80	84.41	21.07	71.10	22.93	56.87	26.48	41.06	27.47	25.40	23.55	I
2b	Kx and Ky (auifers only - slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 1.5	26.23	62.90	28.88	55.12	32.51	46.58	38.88	36.29	42.85	25.00	33.87	II
3a	Kz (Intermediate System only)	Factor by 0.1	24.70	74.37	26.66	62.93	29.57	51.11	34.68	38.12	37.16	24.69	30.55	I
3b	Kz (Intermediate System only)	Factor by 10.0	17.78	63.02	20.03	57.03	22.99	49.07	27.72	38.52	30.31	27.04	23.77	II
4a	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 0.1	22.43	70.13	24.49	60.42	27.29	50.12	32.11	38.82	34.77	26.35	28.22	I
4b	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 10.0	22.08	77.74	23.93	65.26	26.48	51.06	31.88	35.24	34.55	20.62	27.78	I
5a	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 0.1	18.60	79.25	19.84	63.58	22.31	48.13	26.99	32.16	30.18	16.41	23.59	II
5b	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 10.0	33.61	60.83	36.05	59.25	39.68	54.55	45.82	46.85	47.86	38.36	40.60	III
6a	Specified Head (sub-Floridan System)	hd - 10 ft	22.47	73.23	24.43	62.23	27.27	50.69	32.18	37.76	34.72	24.32	28.22	II
6b	Specified Head (sub-Floridan System)	hd + 10 ft	23.48	71.51	25.71	61.60	28.78	50.94	33.94	38.84	36.47	26.22	29.67	II

Table 5.13 (continued)
Sensitivity of Lower Floridan Aquifer Groundwater Seepage Velocity near the Bucatunna Clay Pinchout

Horizontal groundwater seepage velocity and bearing for t = 1998 for listed elements

Sens Run No.	Tested Parameter	Perturbation applied	Element 78285		Element 78566		Element 78992		Element 79563		Element 80280		Average Velocity[2] (ft/yr)	ASTM Sensitivity Type
			Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]	Velocity (ft/yr)	Bearing[1]		
7a	Molecular diffusion (all layers)	Value = 0.0	22.96	72.41	25.05	61.95	27.99	50.85	33.03	38.32	35.56	25.26	28.92	II
8a	Grid (elements x, y - ft)	Factor by 0.5	22.73	71.90	24.77	61.19	27.62	49.78	32.45	37.66	34.89	25.14	28.49	I
9a	Dispersivity (Horizontal longitudinal and transverse: applied to refined grid used in Case 8a)	Factor by 0.5	22.72	71.89	24.77	61.18	27.61	49.77	32.45	37.66	34.88	25.14	28.49	I
10	Southern boundary (move landward)	Decrease to 16 miles	23.23	72.82	25.05	62.58	27.70	51.34	32.43	38.49	34.81	25.07	28.64	I

[1] Bearing is given in degrees measured counter-clockwise relative to the positive x-direction.
[2] Average velocity is the average of the specified elements.

Table 5.14
Sensitivity of Intermediate System Groundwater Seepage Velocity For the Bay and Near Shore Gulf of Mexico Areas

Vertical groundwater seepage velocity for t = 1998 for listed elements

Sensitivity Run Number	Tested Parameter	Perturbation applied	Vertical velocity for element number (ft/yr)[1]					Average Velocity[2] (ft/yr)	ASTM Sensitivity Type
			190077	190204	191084	191816	192545		
0	Base case	0	-0.16	-0.08	-0.06	-0.03	-0.01	-0.07	
1a	Porosity (for all elements)	Value = 0.15	-0.27	-0.14	-0.10	-0.04	-0.02	-0.11	IV
2a	Kx and Ky (aquifers only - slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 0.5	-0.24	-0.14	-0.10	-0.04	-0.02	-0.11	IV
2b	Kx and Ky (auifers only - slices 10, 11 and 12 where Kx and Ky >= 1.0 ft/d)	Factor by 1.5	-0.13	-0.06	-0.05	-0.02	-0.01	-0.05	II
3a	Kz (Intermediate System only)	Factor by 0.1	-0.02	-0.01	-0.01	0.00	0.00	-0.01	IV
3b	Kz (Intermediate System only)	Factor by 10.0	-0.53	-0.37	-0.32	-0.14	-0.07	-0.29	III
4a	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 0.1	-0.16	-0.09	-0.06	-0.03	-0.01	-0.07	I
4b	Kz (Bucatunna Clay only - slices 10, 11 and 12 where Kx and Ky < 1.0)	Factor by 10.0	-0.15	-0.08	-0.06	-0.02	-0.01	-0.06	I
5a	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 0.1	-0.17	-0.09	-0.06	-0.03	-0.01	-0.07	II
5b	Kz (sub-Floridan System - slices 1, 2 and 3)	Factor by 10.0	-0.14	-0.07	-0.05	-0.02	-0.01	-0.06	II
6a	Specified Head (sub-Floridan System)	hd - 10 ft	-0.16	-0.08	-0.06	-0.03	-0.01	-0.07	II
6b	Specified Head (sub-Floridan System)	hd + 10 ft	-0.16	-0.08	-0.06	-0.03	-0.01	-0.07	II
7a	Molecular diffusion (all layers)	Value = 0.0	-0.16	-0.08	-0.06	-0.03	-0.01	-0.07	II
8a	Grid (elements x, y - ft)	Factor by 0.5	-0.16	-0.08	-0.06	-0.03	-0.01	-0.07	I
9a	Dispersivity (Horizontal longitudinal and transverse: applied to refined grid used in Case 8a)	Factor by 0.5	-0.16	-0.08	-0.06	-0.03	-0.01	-0.07	I
10	Southern boundary (move landward)	Decrease to 16 miles	-0.16	-0.08	-0.06	-0.03	-0.01	-0.07	I

[1] Negative velocity is downward movement.
[2] Average velocity is the average of the specified elements.

Table 6.1
Water Balance for Predictive Simulation at 2050 Conditions

	Flow In (Mgal/day)	Percent of Total	Flow Out (Mgal/day)	Percent of Total
Northern Boundary	10.32	24.64	0.52	1.23
Southern Boundary	4.86	11.61	3.66	8.70
Eastern Boundary	5.91	14.12	5.44	12.92
Western Boundary	8.55	20.41	6.37	15.14
Top Boundary	6.71	16.02	0.04	0.10
Bottom Boundary	4.69	11.19	0.43	1.02
Pumping	0.84	2.01	25.62	60.88
Total	41.88	100.00	42.08	100.00

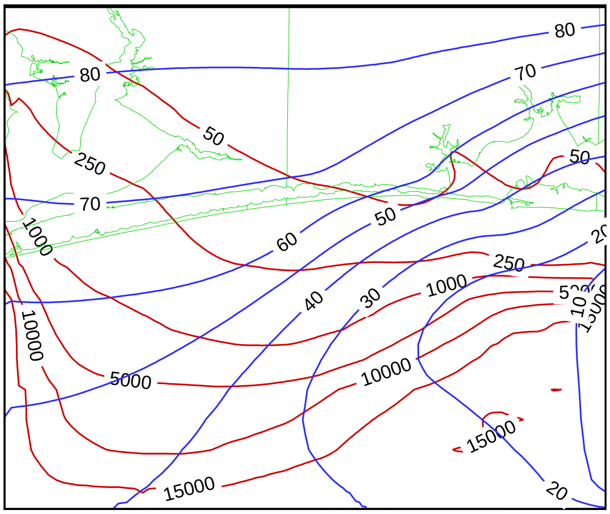
Table 6.2
Chloride Balance for Predictive Simulation at 2050 Conditions

	Advective Flux				Dispersive Flux			
	Flow In (Kg/day)	Percent of Total	Flow Out (Kg/day)	Percent of Total	Flow In (Kg/day)	Percent of Total	Flow Out (Kg/day)	Percent of Total
Northern Boundary	1286	0.08	2493	0.23	1143	18.06	2469	2.68
Southern Boundary	349618	20.61	262972	24.65	2389	37.75	3	0.00
Eastern Boundary	187171	11.03	349486	32.75	773	12.21	1094	1.19
Western Boundary	470511	27.74	412666	38.67	1432	22.63	112	0.12
Top Boundary	404471	23.84	3076	0.29	125	1.97	88364	95.80
Bottom Boundary	283299	16.70	30700	2.88	467	7.37	200	0.22
Pumping	0	0.00	5635	0.53	0	0.00	0	0.00
Total	1696355	100.000	1067028	100.000	6329	100.000	92242	100.000

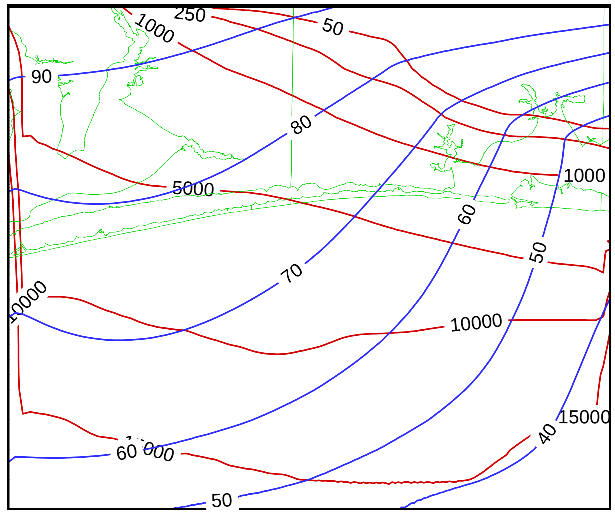
APPENDIX A

EQUIVALENT FRESHWATER HEAD AND CHLORIDE CONCENTRATION PLOTS

SIMULATED PREDEVELOPMENT CONDITIONS : calibrated model

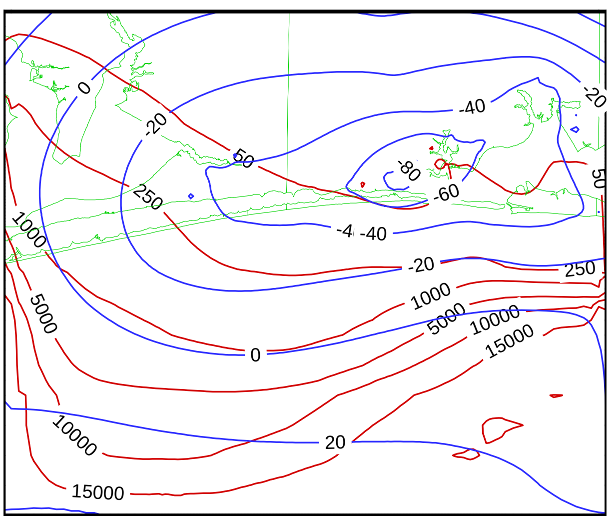


UPPER FLORIDAN AQUIFER

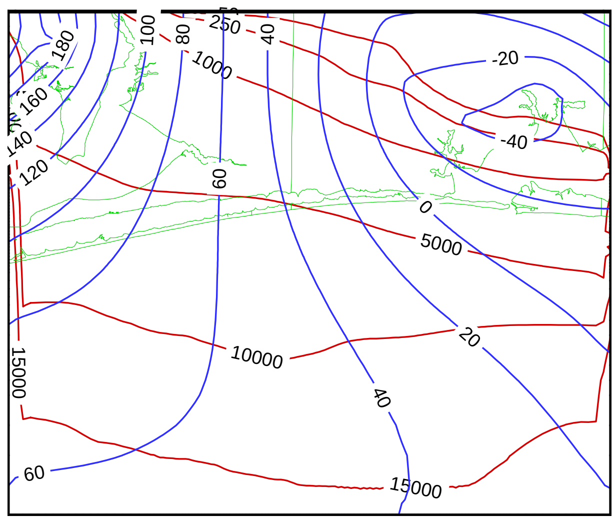


LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : calibrated model



UPPER FLORIDAN AQUIFER



LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

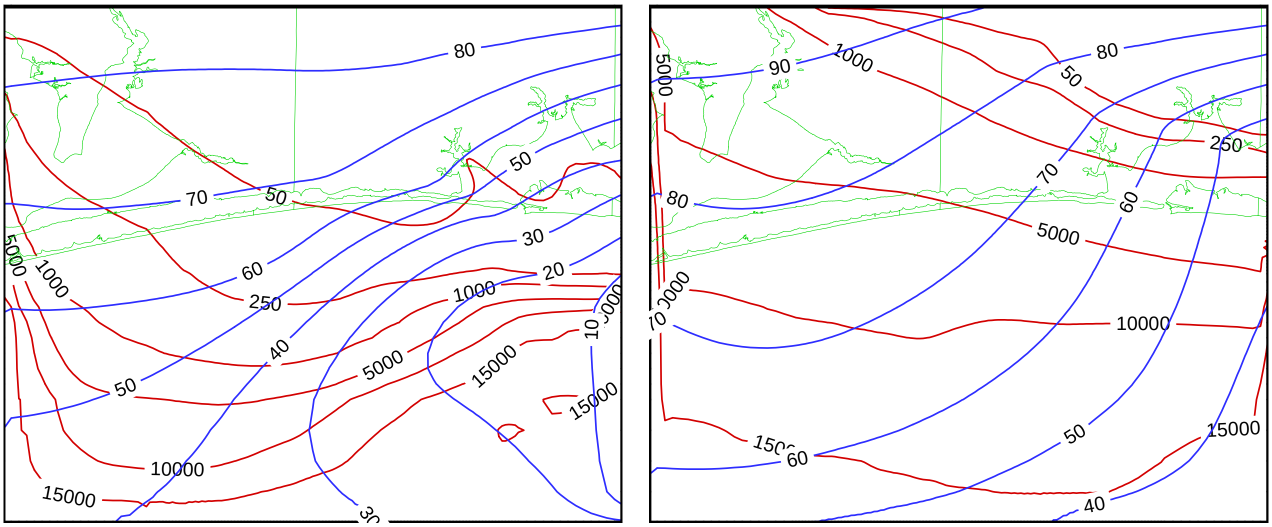
Blue contours: Water level elevation (ft msl)

Figure A.1

Western Domain Salt Water Intrusion Model Simulation: base case calibrated model

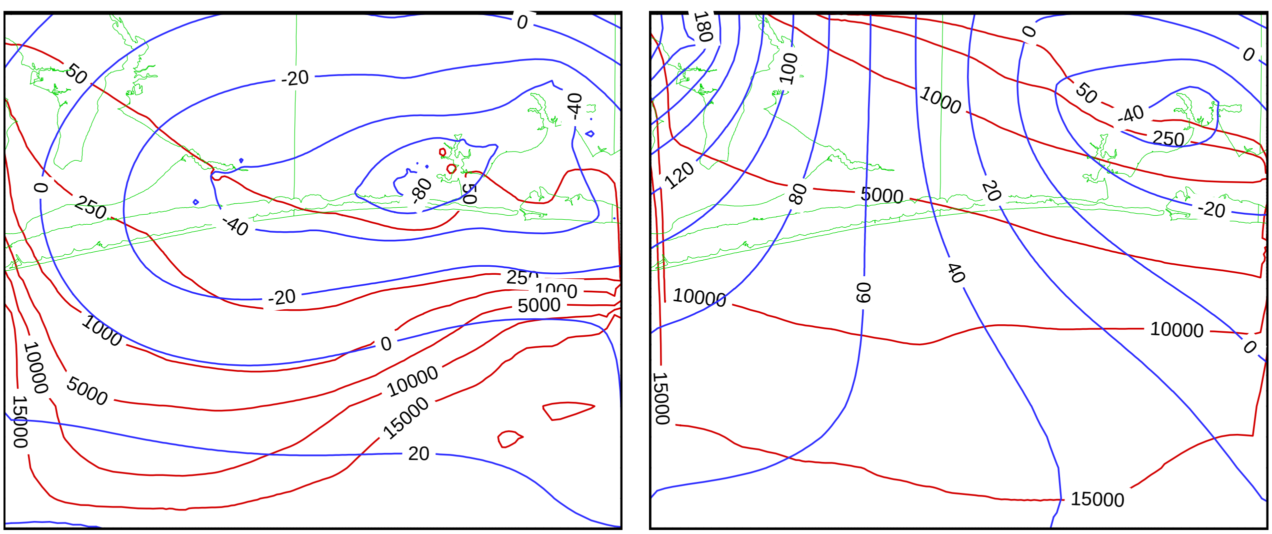
Simulation by HGL - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : porosity = 0.15



UPPER FLORIDAN AQUIFER   LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : porosity = 0.15



UPPER FLORIDAN AQUIFER   LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

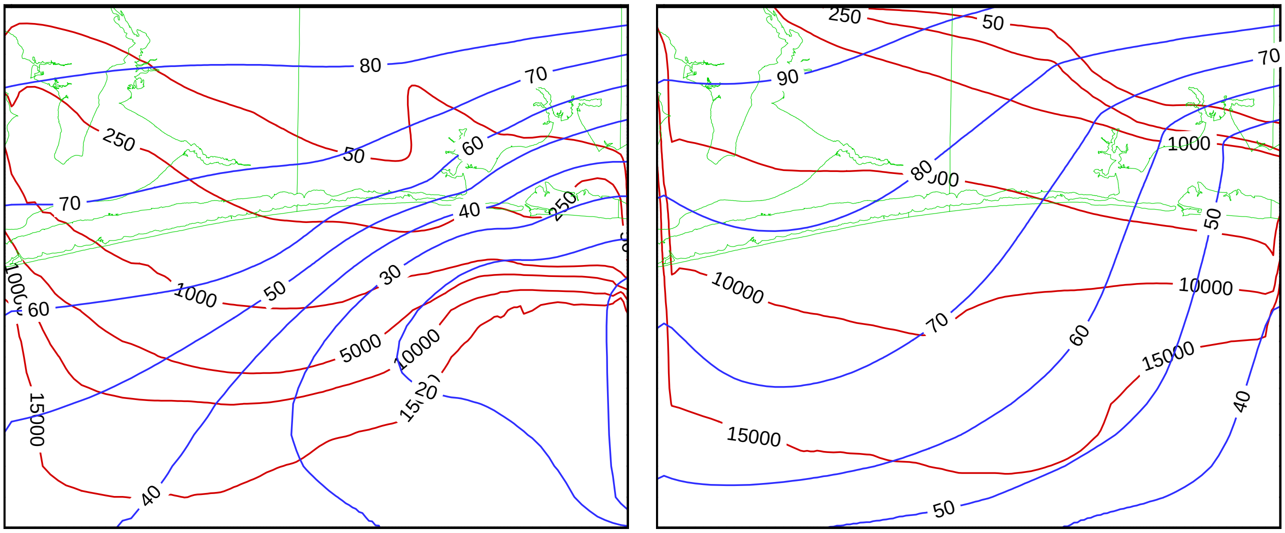
Blue contours: Water level elevation (ft msl)

Figure A.2

Western Domain Salt Water Intrusion Model Simulation: porosity = 0.15

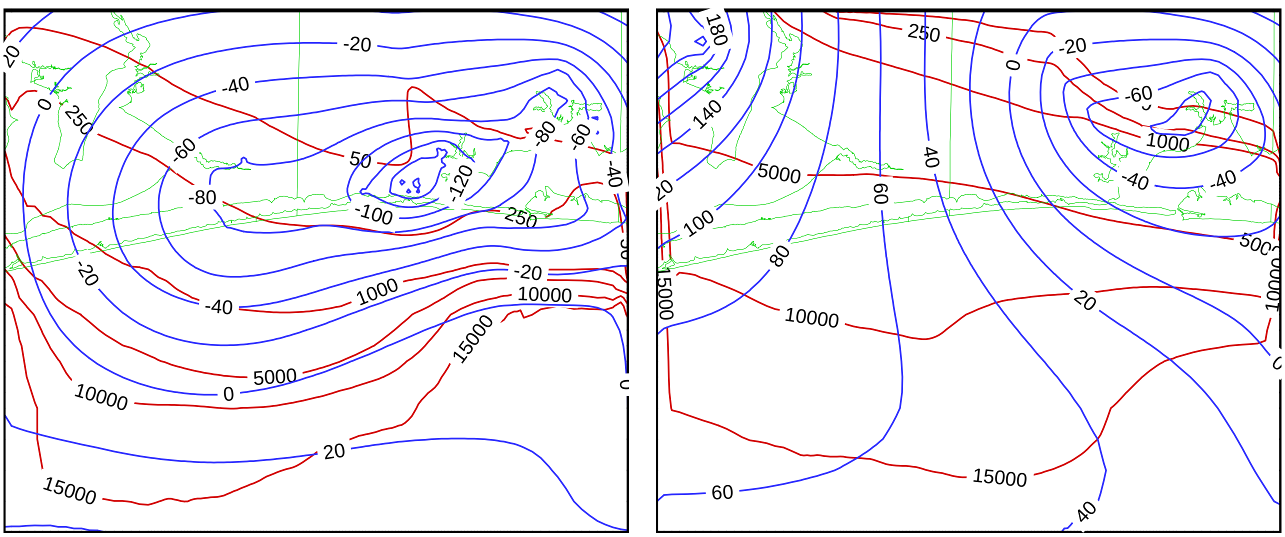
Simulation by HGL (s1a) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Kx,Ky(Fld)*0.5



UPPER FLORIDAN AQUIFER | LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Kx,Ky(Fld)*0.5



UPPER FLORIDAN AQUIFER | LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

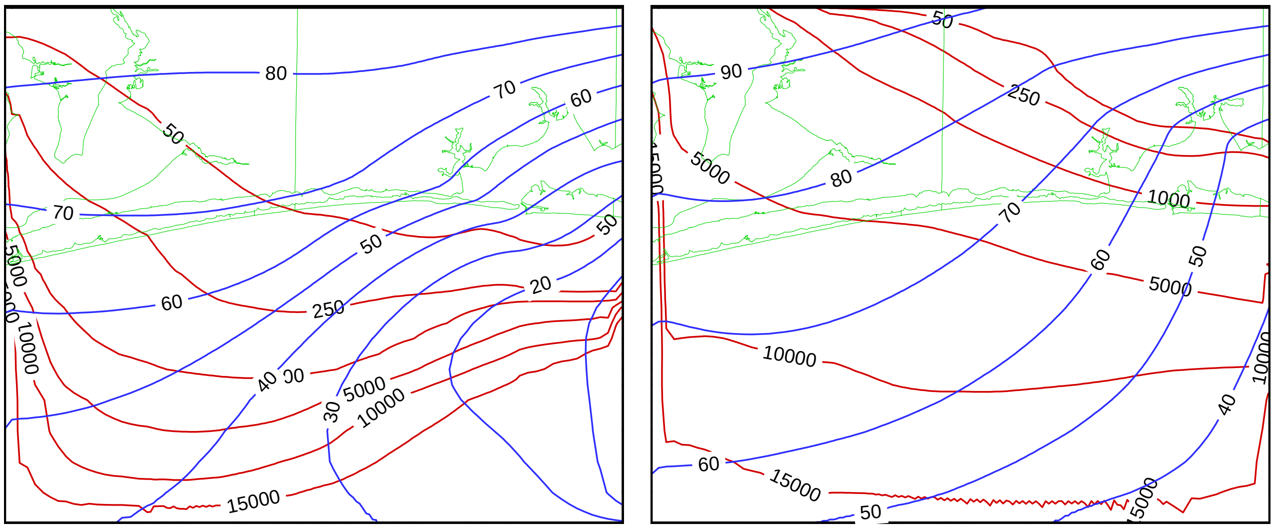
Blue contours: Water level elevation (ft msl)

Figure A.3

Western Domain Salt Water Intrusion Model Simulation: Kx,Ky(Fld)*0.5

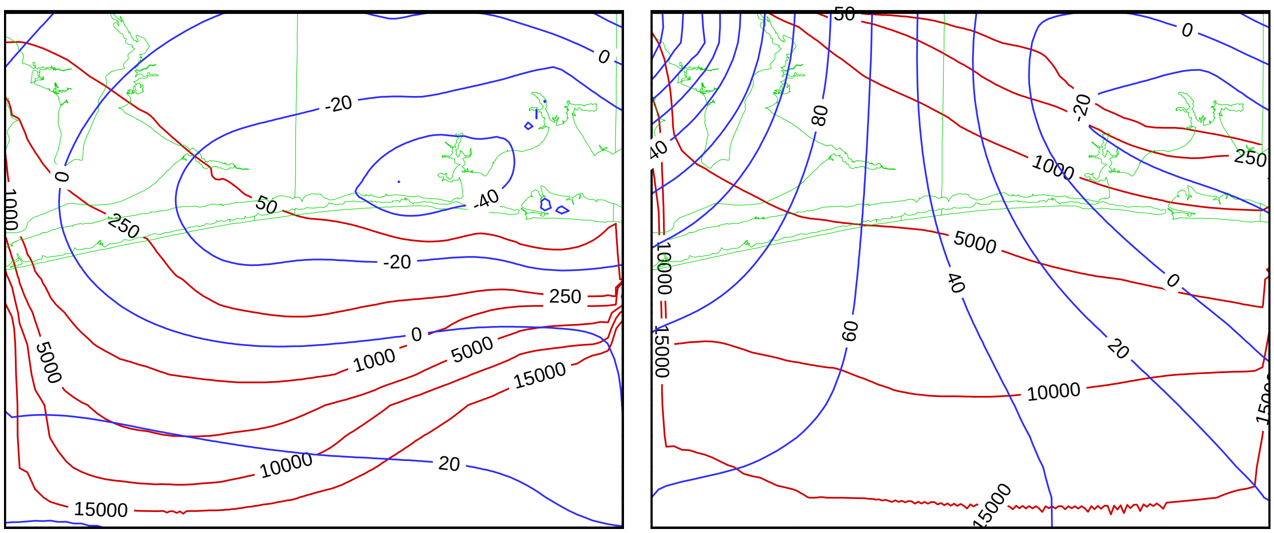
Simulation by HGL (s2a) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Kx,Ky(Fld)*1.5



UPPER FLORIDAN AQUIFER　　　　LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Kx,Ky(Fld)*1.5



UPPER FLORIDAN AQUIFER　　　　LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

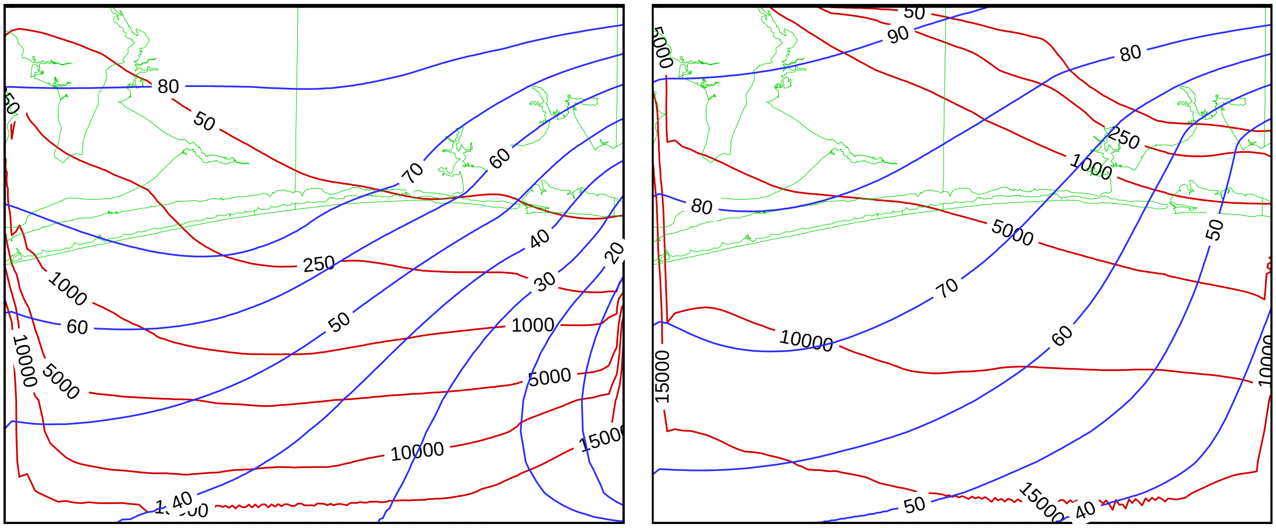
Blue contours: Water level elevation (ft msl)

Figure A.4

Western Domain Salt Water Intrusion Model Simulation: Kx,Ky(Fld)*1.5

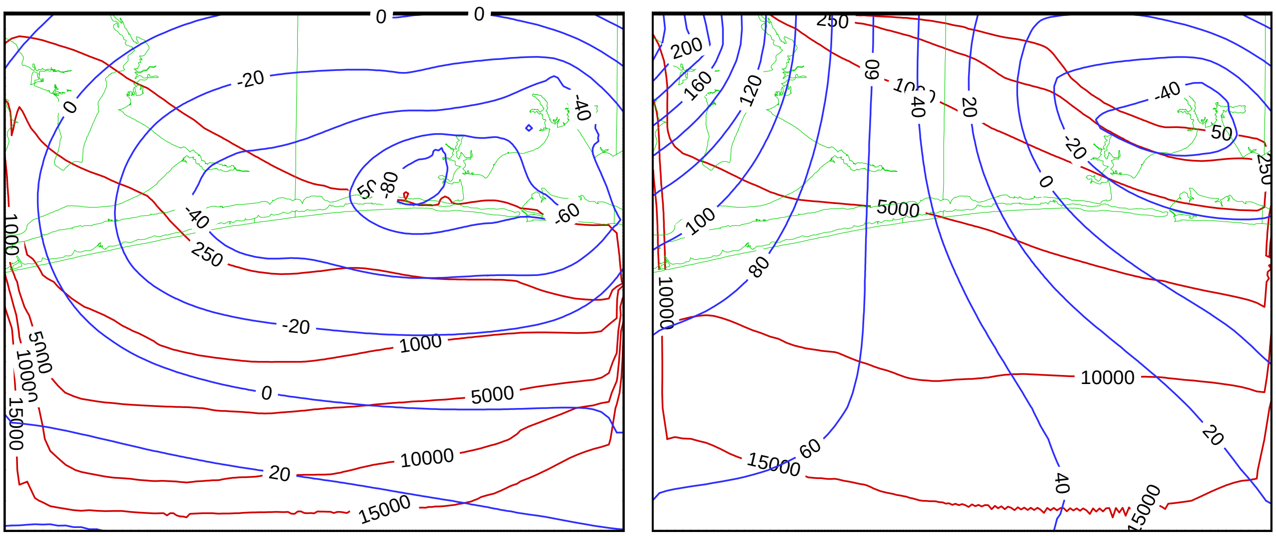
Simulation by HGL (s2b) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Kz(IS)*0.1



UPPER FLORIDAN AQUIFER | LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Kz(IS)*0.1



UPPER FLORIDAN AQUIFER | LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

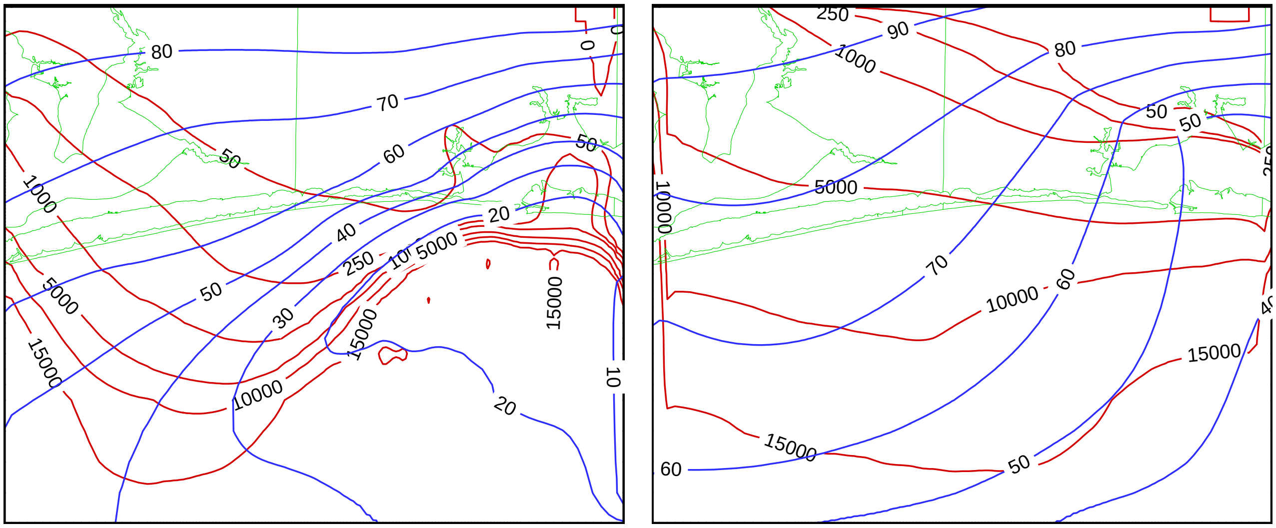
Blue contours: Water level elevation (ft msl)

Figure A.5

Western Domain Salt Water Intrusion Model Simulation: Kz(IS)*0.1

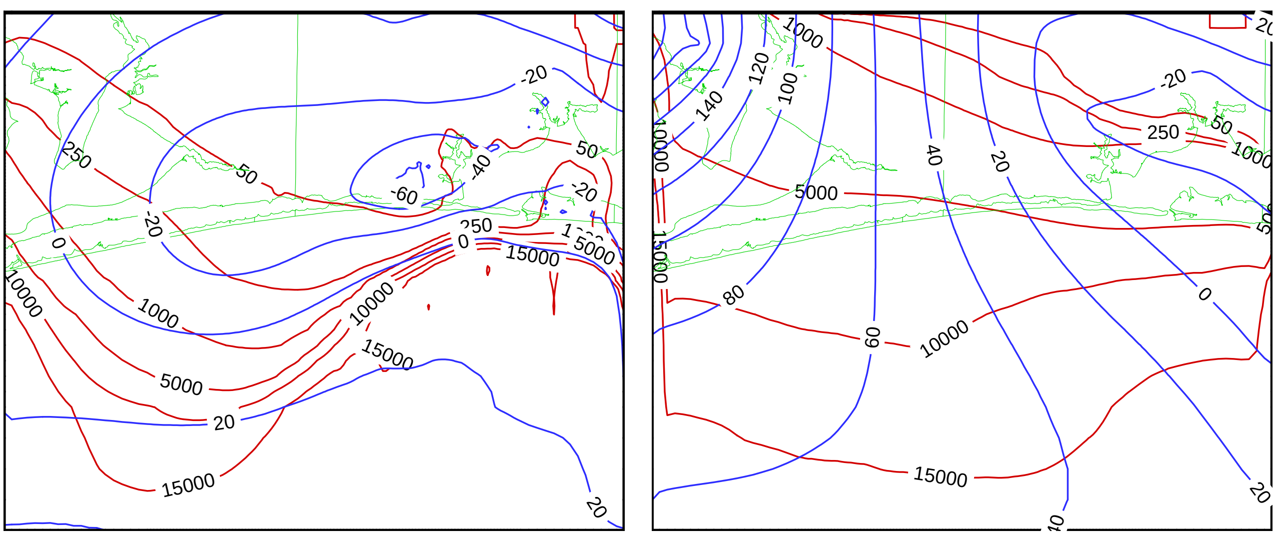
Simulation by HGL (s3a) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Kz(IS)*10



UPPER FLORIDAN AQUIFER | LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Kz(IS)*10



UPPER FLORIDAN AQUIFER | LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

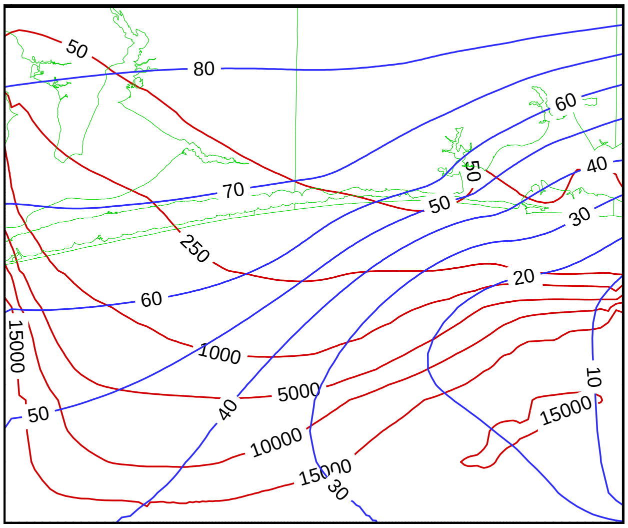
Blue contours: Water level elevation (ft msl)

Figure A.6

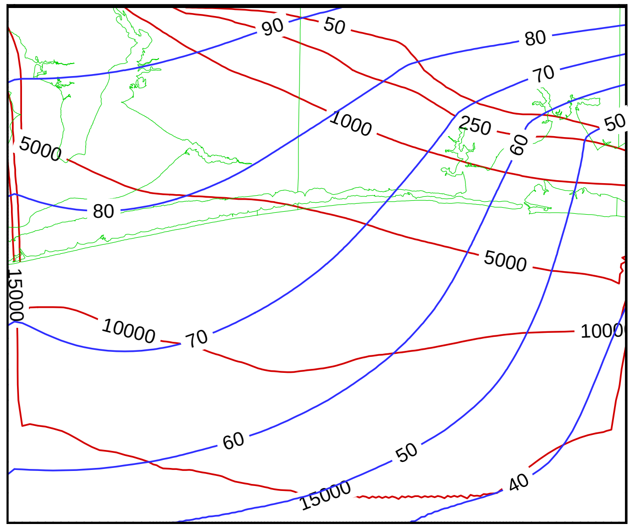
Western Domain Salt Water Intrusion Model Simulation: Kz(IS)*10

Simulation by HGL (s3b) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Kz(Buc)*0.1

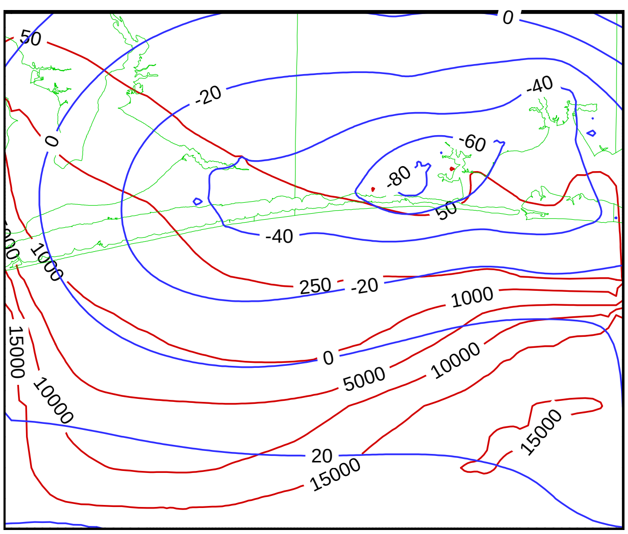


UPPER FLORIDAN AQUIFER

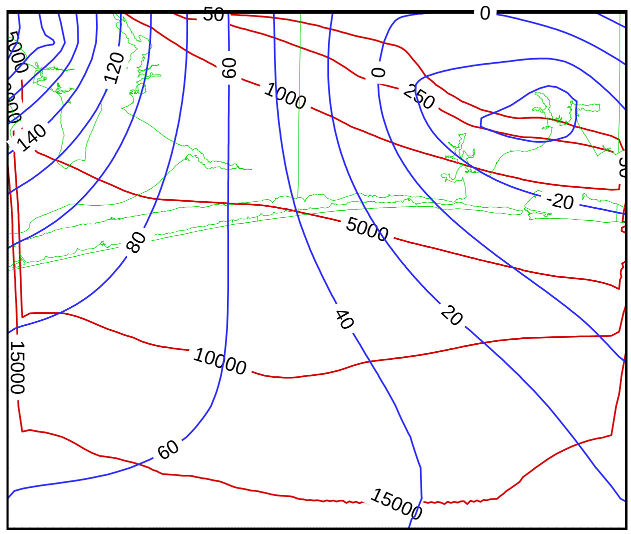


LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Kz(Buc)*0.1



UPPER FLORIDAN AQUIFER



LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

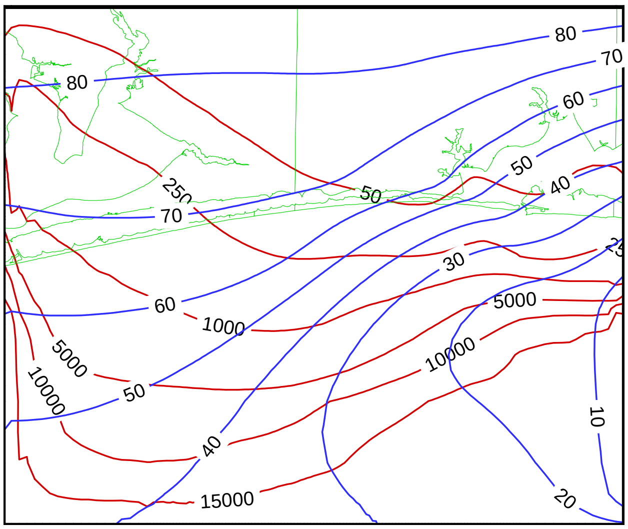
Blue contours: Water level elevation (ft msl)

Figure A.7

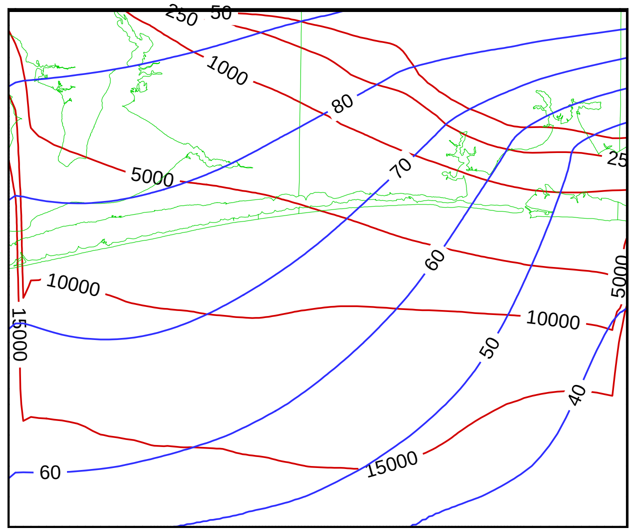
Western Domain Salt Water Intrusion Model Simulation: Kz(Buc)*0.1

Simulation by HGL (s4a) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Kz(Buc)*10

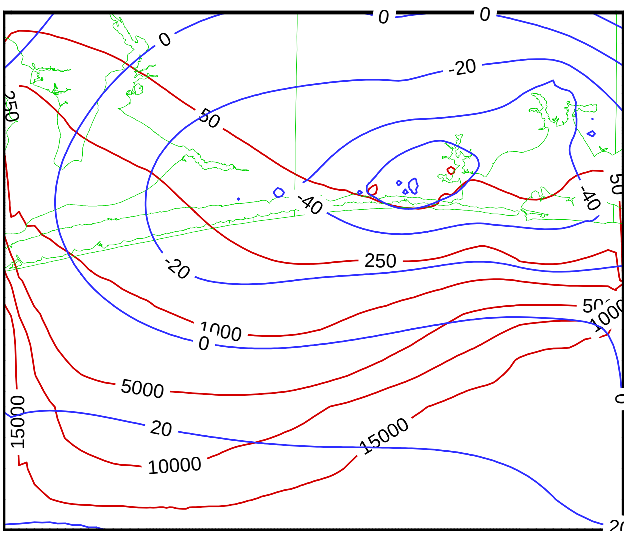


UPPER FLORIDAN AQUIFER

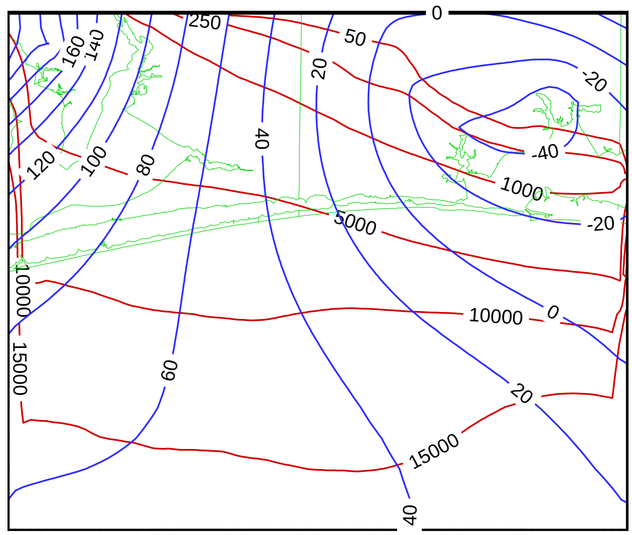


LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Kz(Buc)*10



UPPER FLORIDAN AQUIFER



LOWER FLORIDAN AQUIFER

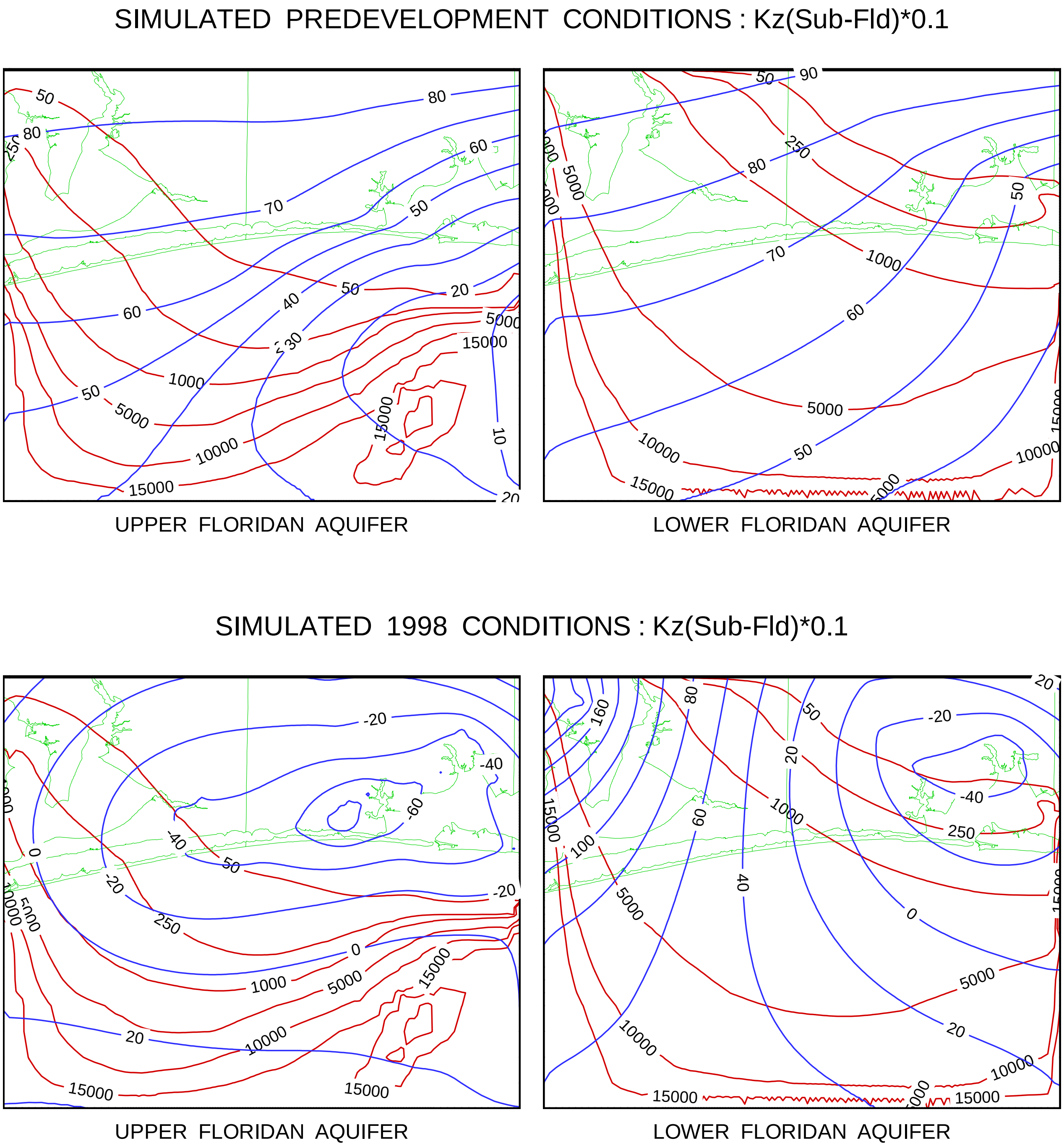
Red contours: Chloride concentration (mg/l)

Blue contours: Water level elevation (ft msl)

Figure A.8

Western Domain Salt Water Intrusion Model Simulation: Kz(Buc)*10

Simulation by HGL (s4b) - - Plot by NWFWMD - - 01 Apr 2004



Red contours: Chloride concentration (mg/l)

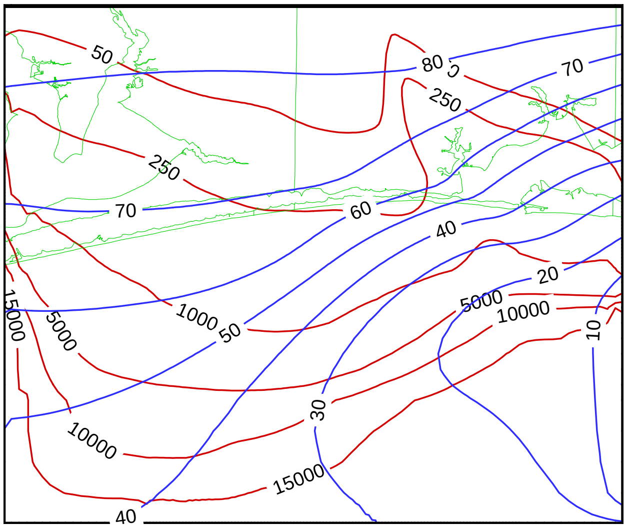
Blue contours: Water level elevation (ft msl)

Figure A.9

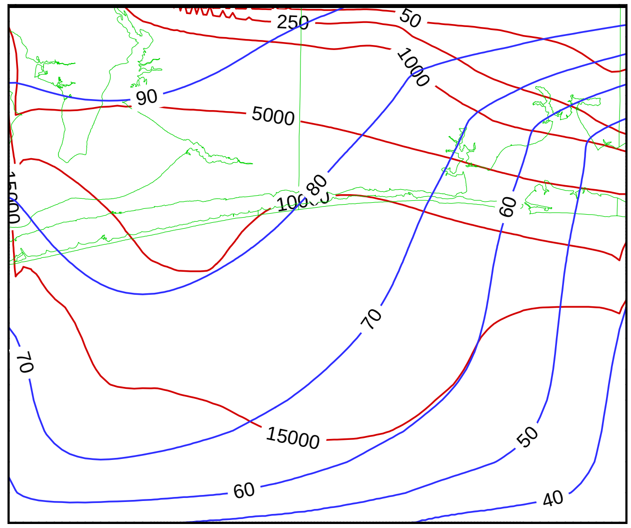
Western Domain Salt Water Intrusion Model Simulation: Kz(Sub-Fld)*0.1

Simulation by HGL (s5a) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Kz(Sub-Fld)*10

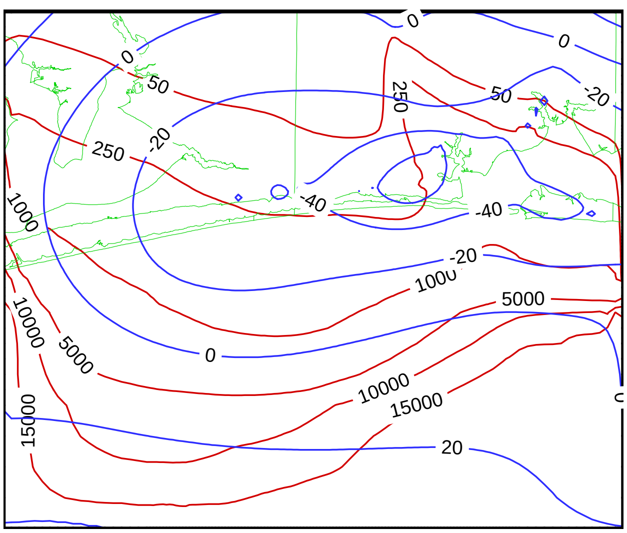


UPPER FLORIDAN AQUIFER

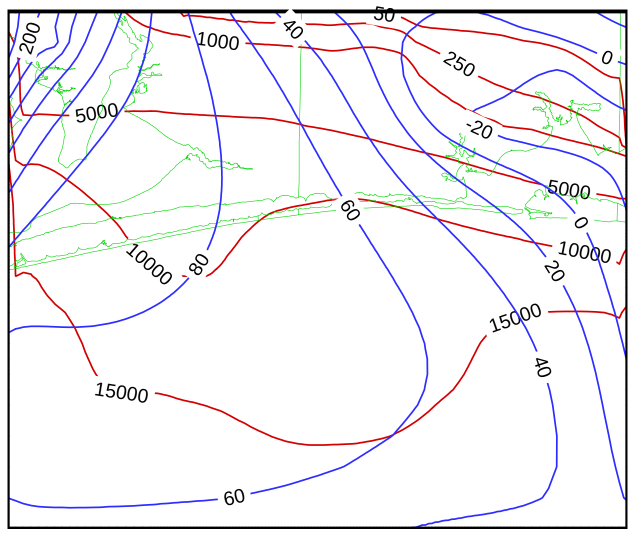


LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Kz(Sub-Fld)*10



UPPER FLORIDAN AQUIFER



LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

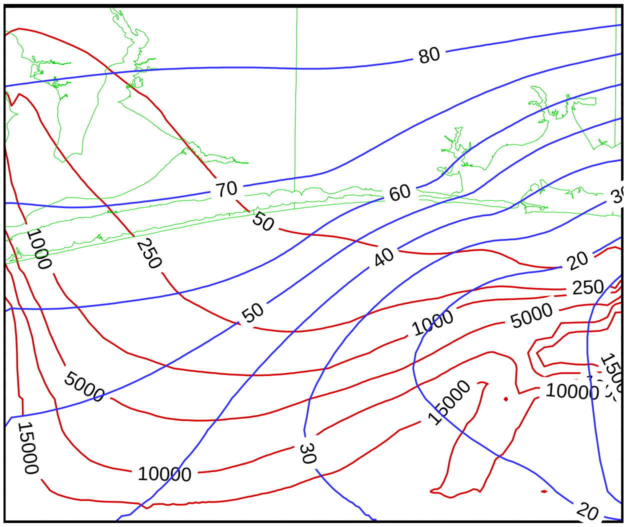
Blue contours: Water level elevation (ft msl)

Figure A.10

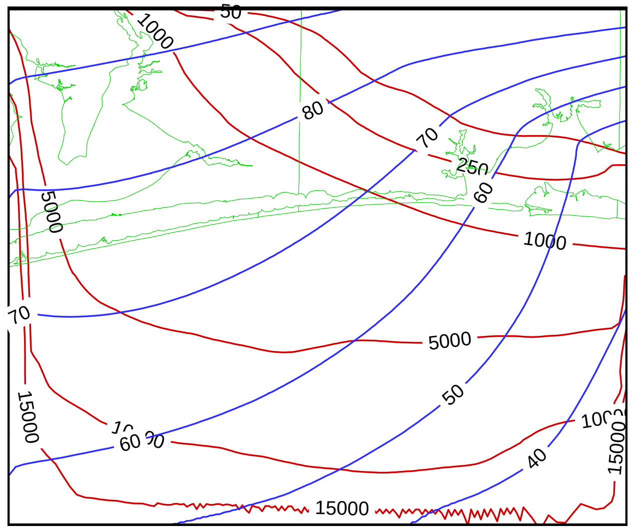
Western Domain Salt Water Intrusion Model Simulation: Kz(Sub-Fld)*10

Simulation by HGL (s5b) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Hd(Sub-Fld)-10

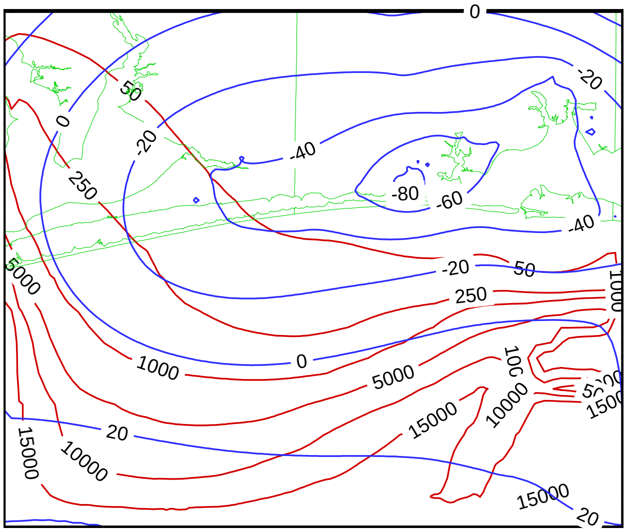


UPPER FLORIDAN AQUIFER

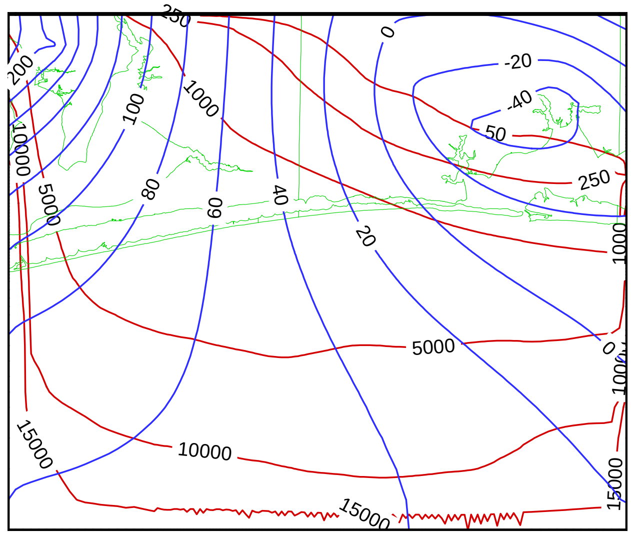


LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Hd(Sub-Fld)-10



UPPER FLORIDAN AQUIFER



LOWER FLORIDAN AQUIFER

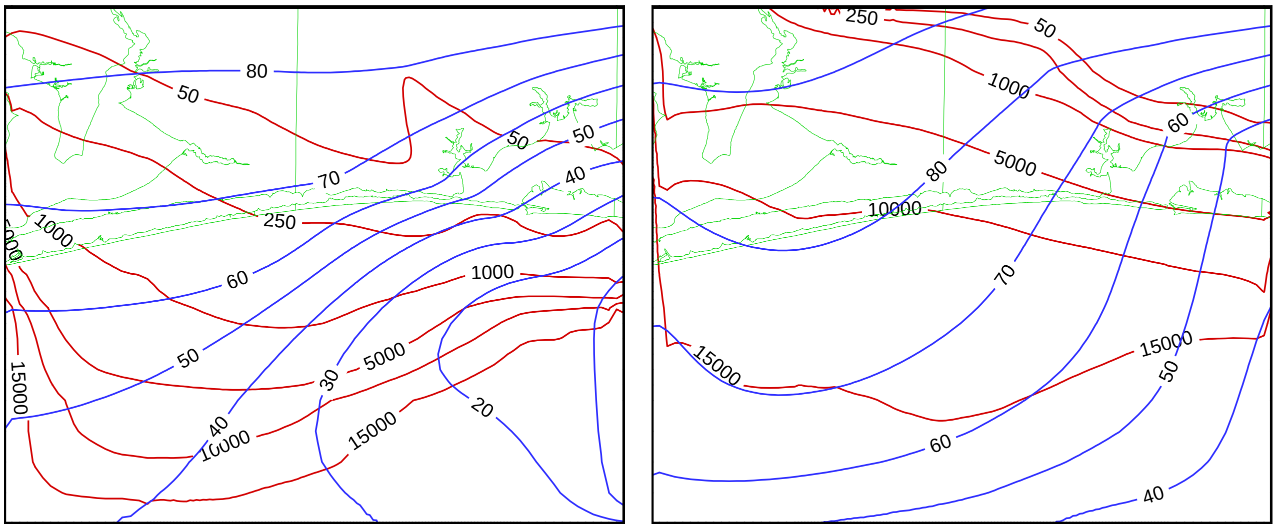
Red contours: Chloride concentration (mg/l)
Blue contours: Water level elevation (ft msl)

Figure A.11

Western Domain Salt Water Intrusion Model Simulation: Hd(Sub-Fld)-10

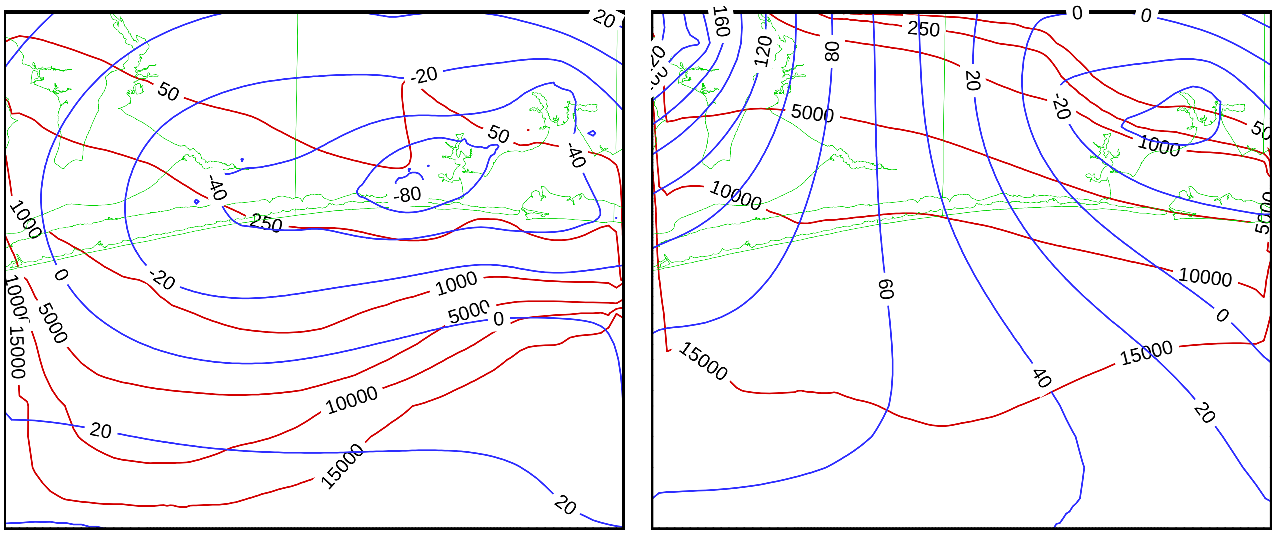
Simulation by HGL (s6a) - - Plot by NWFWMD - - 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : Hd(Sub-Fld)+10



UPPER FLORIDAN AQUIFER   LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Hd(Sub-Fld)+10



UPPER FLORIDAN AQUIFER   LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

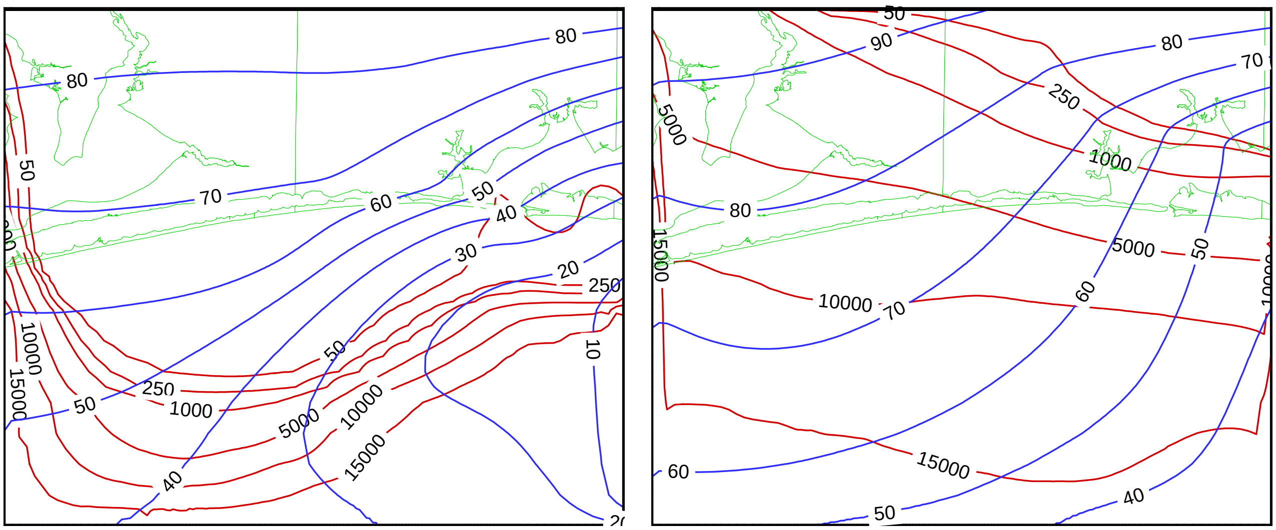
Blue contours: Water level elevation (ft msl)

Figure A.12

Western Domain Salt Water Intrusion Model Simulation: Hd(Sub-Fld)+10

Simulation by HGL (s6b) - - Plot by NWFWMD - - 01 Apr 2004

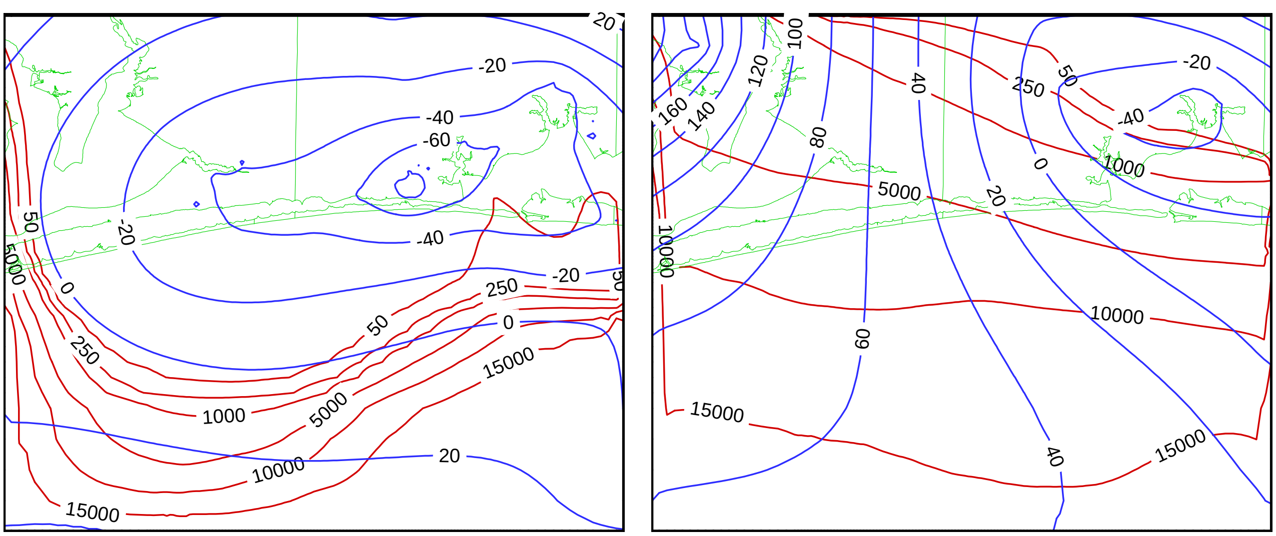
SIMULATED PREDEVELOPMENT CONDITIONS : Diffusion = 0.0



UPPER FLORIDAN AQUIFER

LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : Diffusion = 0.0



UPPER FLORIDAN AQUIFER

LOWER FLORIDAN AQUIFER

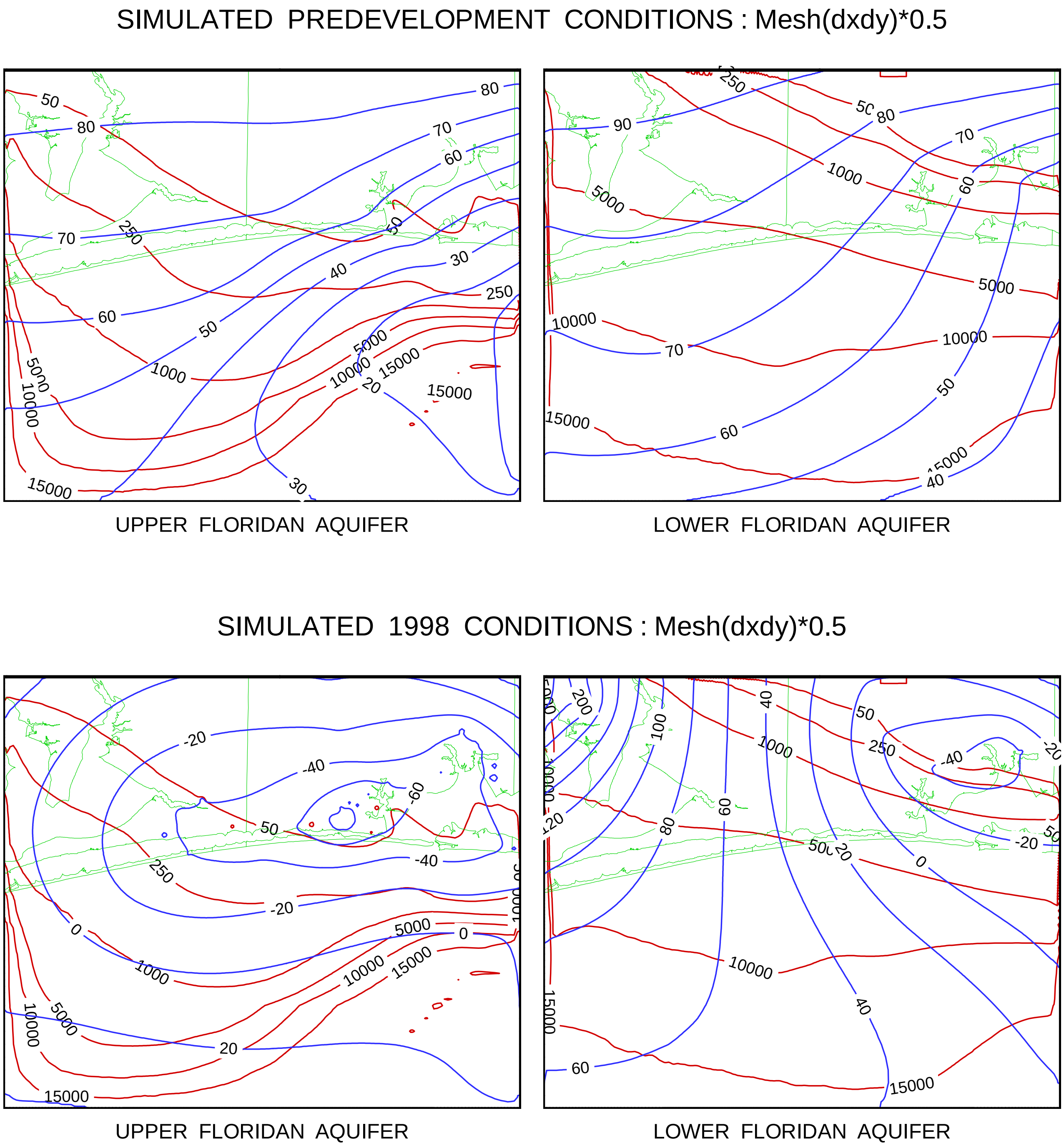
Red contours: Chloride concentration (mg/l)

Blue contours: Water level elevation (ft msl)

Figure A.13

Western Domain Salt Water Intrusion Model Simulation: Diffusion = 0.0

Simulation by HGL (s7a) - - Plot by NWFWMD - - 01 Apr 2004



Red contours: Chloride concentration (mg/l)

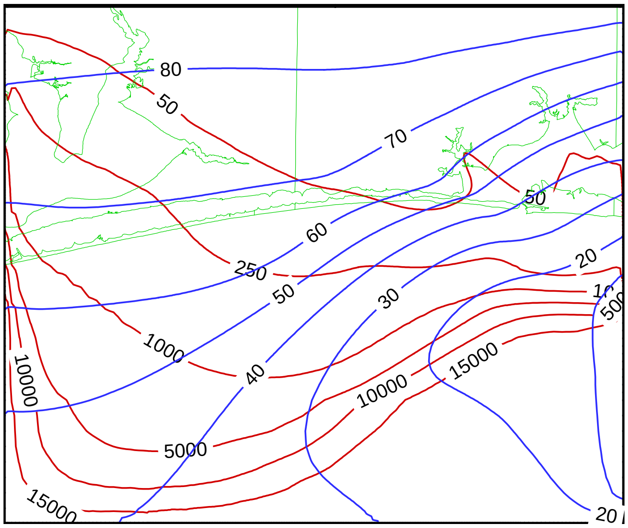
Blue contours: Water level elevation (ft msl)

Figure A.14

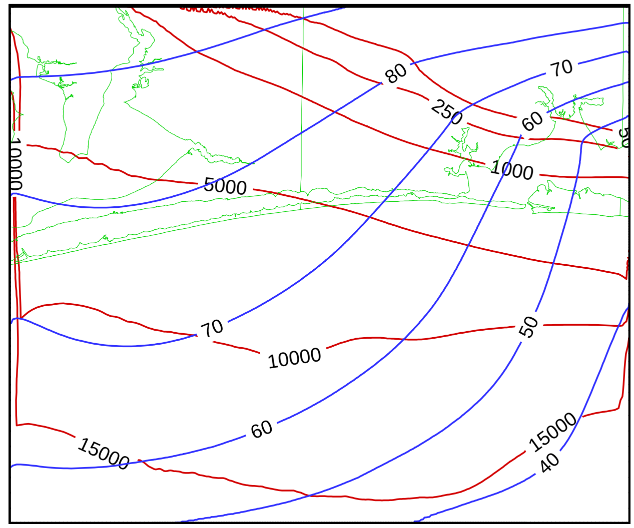
Western Domain Salt Water Intrusion Model Simulation: Mesh(dxdy)*0.5

Simulation by HGL (s8a) -- Plot by NWFWMD -- 01 Apr 2004

SIMULATED PREDEVELOPMENT CONDITIONS : (Mesh & Dispersivity)*0.5

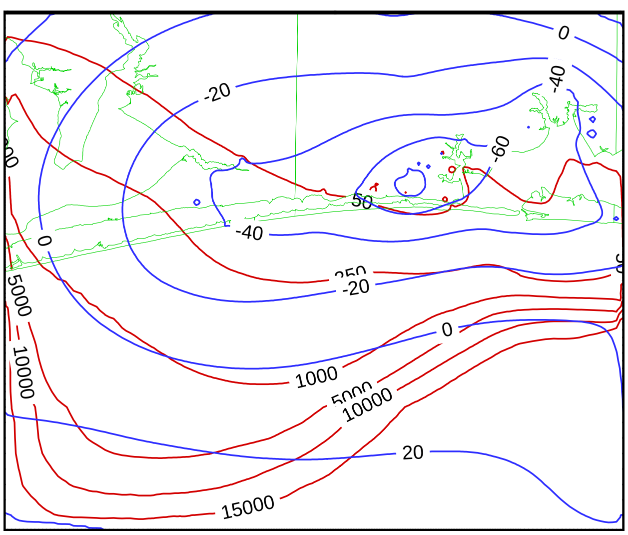


UPPER FLORIDAN AQUIFER

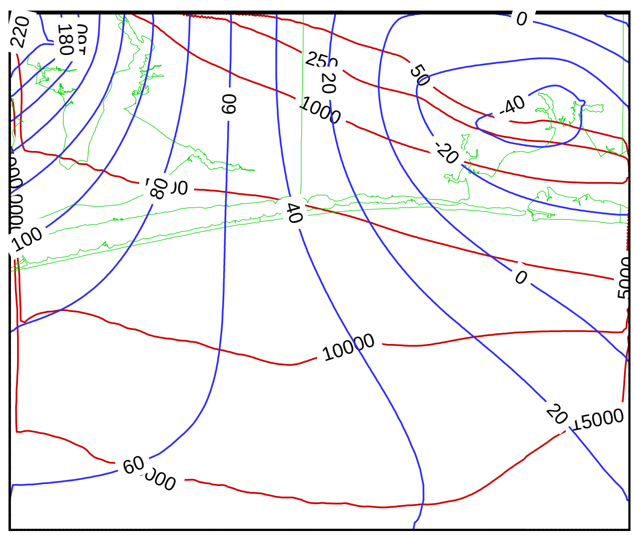


LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : (Mesh & Dispersivity)*0.5



UPPER FLORIDAN AQUIFER



LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

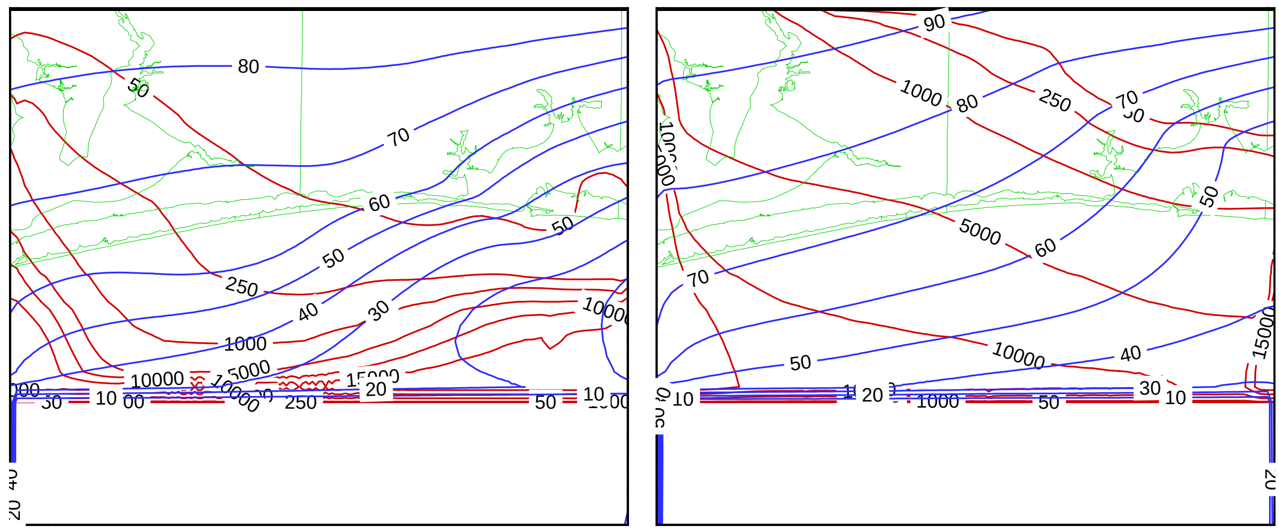
Blue contours: Water level elevation (ft msl)

Figure A.15

Western Domain Salt Water Intrusion Model Simulation: (Mesh & Dispersivity)*0.5

Simulation by HGL (s9a) - - Plot by NWFWMD - - 01 Apr 2004

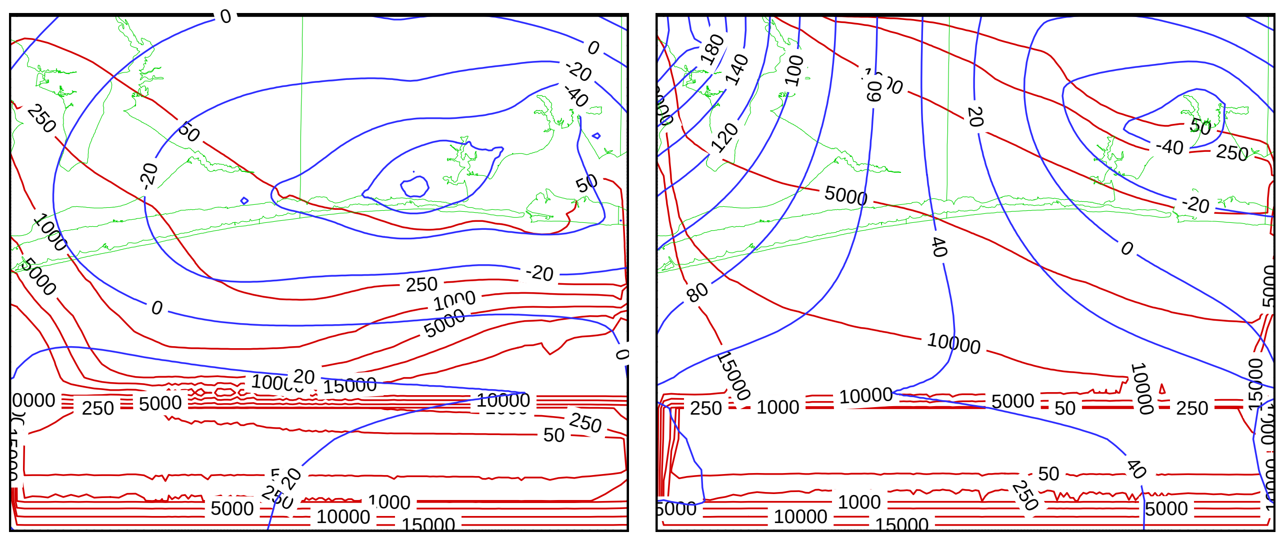
SIMULATED PREDEVELOPMENT CONDITIONS : south bndy moved landward



UPPER FLORIDAN AQUIFER

LOWER FLORIDAN AQUIFER

SIMULATED 1998 CONDITIONS : south bndy moved landward



UPPER FLORIDAN AQUIFER

LOWER FLORIDAN AQUIFER

Red contours: Chloride concentration (mg/l)

Blue contours: Water level elevation (ft msl)

Figure A.16

Western Domain Salt Water Intrusion Model Simulation: south bndy moved landward

Simulation by HGL (s10) -- Plot by NWFWMD -- 01 Apr 2004