Jean Hopkins & Associates, Inc.
ENVIRONMENTAL LICENSING SERVICES

Jean Hopkins

5010 HAMPDEN LANE, BETHESDA, MD 20814
(301) 656-4854 • FAX (301) 656-4857

PG&E | BECHTEL
Generating Company

KENT L. FICKETT
Director, Regulatory Affairs

7475 Wisconsin Avenue Bethesda, Maryland 20814-3422
301-718-6860 · FAX 301-718-6910

Volume 1

INDIANTOWN COGENERATION PROJECT

Site Certification Application

Submitted by Indiantown Cogeneration, L. P.

(301) 718-6863

We look forward to working with the Department and other interested agencies in the certification process. If you should need any assistance in this matter, please contact Dr. Mary Coffey of Bechtel Corporation (301) 417-4686; me; or Gary Sams or Doug Roberts of Hopping Boyd Green & Sams, our licensing attorneys.

Sincerely,

Steve

Stephen A. Sorrentino
Project Development Manager

ENSR CONTACT –

Air Emission
Charlie Carlton
STEVE JELINEK
ENSR
(301) 417-4586
35 NAGOG PARK
ACTON, MA 01720

Stephen Sorrentino
(301) 718-6833

SITE CERTIFICATION APPLICATION

FOR

INDIANTOWN COGENERATION PROJECT

Martin Surabian, P.E.
Florida No. 28250

Bechtel Corporation
9801 Washingtonian Boulevard
Gaithersburg, MD 20878-5356

APPLICANT INFORMATION

Applicants Official Name: Indiantown Cogeneration, L. P.

Address: 7475 Wisconsin Avenue, Bethesda MD 20814-3422

Business Entity (corporation, partnership, co-operative): Partnership

Name of Project: Indiantown Cogeneration Project

Name and Title of Chief Executive Officer: Joseph P. Kearney, President and Chief Executive Officer

Name,address,and Phone Number of Official Representative responsible for obtaining certification: Stephen A. Sorrentino, 7475 Wisconsin Avenue Bethesda, MD 20814-4322; (301) 913-5845/Alternate: Mary E. Coffey (301) 417-4686

Site Location (county): Martin County

Site Address: State Road 710; 3 miles northwest of Indiantown, Florida

Nearest Incorporated City: Stuart

Latitude and Longitude: 27° 2' 20"N 80° 30' 45"W

UTM's Northerly 2990.69
Easterly 548.02

Section,Township,Range: Sections 26, 27, 34, 35 Township 39 South, Range 38 East

Name Plate Generating Capacity: 330 MW

ICL Environmental Legal Counsel: Hopping, Boyd Green & Sams, Gary P. Sams, P. O. Box 6526, Tallahassee, Florida 32314 (904) 222-7500

LIST OF ORGANIZATIONS THAT PARTICIPATED

IN THE PREPARATION OF THE SCA

PG&E/Bechtel Generating Company
Bethesda, MD
- o Overall SCA Management and Direction

Bechtel Corporation
Gaithersburg, Maryland
- o Environmental and Engineering Contractor

Arch R. Campbell, Consultant
Pearsall, Texas
- o Subcontractor for Geohydrology

Ardaman & Associates, Inc.
Port St. Lucie, FL
- o Subcontractor for Geohydrologic Field Investigation

CH2M Hill
Gainesville, FL
- o Contractor for Hydrogeology field work and analyses

ENSR Consulting and Engineering
Acton, MA
- o Contractor for BACT analysis

Environmental Consulting & Technology, Inc.
Gainesville, FL
- o Contractor for Ecological, Socioeconomic and Land Use

Gunster, Yoakley & Stewart
Stuart, Florida
- o Attorneys Coordinating with Local Governments

Hessler Associates, Inc.
Cabin John, MD
- o Subcontractor for Noise Analyses

Hopping, Boyd, Green & Sams
Tallahassee, Florida
- o Environmental Attorneys

Kimley-Horn and Associates, Inc.
West Palm Beach, Florida
- o Contractor for Traffic Analyses

Lindahl, Browning, Ferrari & Hellstrom, Inc
Stuart, FL
- o Subcontractor for boundary and bore hole surveys

Moore/Bowers
Tampa, Florida
- o Consultant for land use/socioeconomics

Piper Archaeology
St. Petersburg, Florida
- o Subcontractor for Cultural Resource Surveys

Southern Resources Mapping Corporation
Holly Hill, FL
- o Subcontractor for aerial surveying

PREFACE

Indiantown Cogeneration, Limited Partnership (ICL) is an energy company that intends to construct, own, and operate a new state-of-the-art, clean coal-burning cogeneration facility in the industrial area of Indiantown, Florida. The general partners of ICL are indirect subsidiaries of Pacific Gas & Electric Company (PG&E), one of the largest utilities in the United States, and Bechtel, Inc., one of the largest architect/engineering firms in the world. ICL has access, therefore, to the expertise in both of these firms to ensure that the proposed Indiantown plant is developed in a timely manner and operated reliably.

The ICL cogeneration plant will produce steam to support the operations of the Caulkins Citrus Processing Plant. The plant will also produce approximately 330 MW of electricity for sale to Florida Power & Light (FPL). This additional capacity will help FPL support Florida's increasing need for reliable and economical sources of electricity. The plant also should enhance economic development in the Indiantown area.

ICL is seeking approval for the Indiantown Cogeneration Project under the Florida Electrical Power Plant Siting Act, Chapter 403, Part II, Florida Statutes (PPSA). The PPSA provides a centralized review process for new electrical generating facilities in Florida, involving a balancing of "the increasing demand for electrical power plants with the broad interests of the public," including human health, the environment, and state waters and wildlife. Under the PPSA, the Florida Public Service Commission (PSC) is the sole forum for the determination of "need" for a proposed facility. The Florida Department of Environmental Regulation (FDER) acts as the coordinator for the remainder of the certification process, with input from various state, regional, and local agencies and ultimate disposition by the Governor and Cabinet sitting as the Siting Board.

ICL submitted jointly with FPL a "Petition to Determine Need for Electrical Power Plant" to the PSC on August 20, 1990. The Petition, along with supporting documentation, addresses the manner in which the Indiantown Cogeneration Project will meet the need for electric system reliability and integrity; meet the need for adequate electricity at reasonable cost; and be the most cost-effective alternative available. A summary of the Need Petition is presented in Section 1.0 of this Site Certification Application (SCA).

This SCA is being filed with the FDER pursuant to Chapter 17-17, Florida Administrative Code. It addresses the environmental and socioeconomic aspects of the ICL Project by presenting information on the existing natural and human environments, on the generating and associated facilities proposed to be constructed and operated, and on the impacts of those facilities on those environments.

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INDIANTOWN COGENERATION PROJECT

Site Certification Application

Submitted by
Indiantown Cogeneration, L.P.

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LIST OF ACRONYMS AND ABBREVIATIONS

ac	acre
ac-ft	acre-feet
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
AQCR	Air Quality Control Region
ASR	Aquifer Storage and Retrieval
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BACT	Best Available Control Technology
bls	Below land surface
BMP	Best Management Practice
BOCC	Board of County Commissioners
Btu/lb	British thermal units per pound
CEMS	Continuous Emissions Monitoring System
CFR	Code of Federal Regulations
CFRPC	Central Florida Regional Planning Council
cfs	cubic feet per second
CGMP	Comprehensive Growth Management Plan
cm/sec	Centimeters per second
CO	Carbon monoxide
COA	Council on Aging
COC	Cycles of Concentration
CR	County Road
dB	decibels
dBA	decibels, A-weighted
dbh	diameter-at-breast-height
DCA	Department of Community Affairs
DER	Department of Environmental Regulations (FDER)
El	Elevation, relative to ground level
EMS	Emergency Medical Services
FAAQS	Florida Ambient Air Quality Standards
EPA	Environmental Protection Agency
FAC	Florida Administrative Code
FCREPA	Florida Committee on Rare and Endangered Plants and Animals
FDACS	Florida Department of Agriculture and Consumer Services
FDOT	Florida Department of Transportation
FEC	Florida East Coast Railway
FEMA	Federal Emergency Management Agency
FGC	Flue Gas Cleaning
FGFWFC	Florida Game and Fresh Water Fish Commission
FHSRC	Florida High-Speed Rail Corporation
fps	feet per second
FPL	Florida Power and Light
FRP	Fiberglass reinforced plastic
FSC	Florida Steel Corporation

ft	feet
FY	Fiscal Year
GEP	Good Engineering Practice (stack height)
gpd/ft	gallons per day per foot
gph	gallons per hour
gpm	gallons per minute
HDPE	High density polyethylene
ISC	Industrial Source Complex Model
ISO	International Standards Organization
ICL	Indiantown Cogeneration, Limited Partnership
K'/b'	Leakance
kV	kilovolts
lb/acre-mo	pounds per acre-month
lb/hr	pounds per hour
lb/MMBtu	pounds per million Btu
LCD	Local Climatological Data
Ldn	Day/night weighted average noise level
LOS	Level of Service
mEq	milliequivalents
MDF	Maximum Daily Flow
MGD	Million Gallons per Day
mg/l	milligrams/liter
mi	mile
mi^2	square mile
mph	miles per hour
MSL	Mean Sea Level
MW	Megawatt
MPO	Metropolitan Planning Organization
ug/m3	micrograms per cubic meter
umhos	micromhos
NAAQS	National Ambient Air Quality Standards
NAS	National Audubon Society
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
O_3	Ozone
PC	Pulverized Coal
PM-10	Particulate with diameter of 10μ or less
ppm	parts per million
PSD	Prevention of Significant Deterioration
PUD(i)	Planned Unit Development-Industrial
PSC	Public Service Commission
PVC	Polyvinyl chloride
ROW	Right-of-way

SACTI	Seasonal/Annual Cooling Tower Plume Impact Model
SDA	Spray dryer absorber
SFWMD	South Florida Water Management District
SR	State Road
S	Storativity
SCA	Site Certification Application
SCR	Selective Catalytic Reduction
SCS	Soil Conservation Service
SHPO	State Historic Preservation Office
SNCR	Selective Non-catalytic Reduction
SO_2	Sulfur Dioxide
SWIM	Surface Water Improvement Management (Act)
T	Transmissivity
TC/NS	Taylor Creek/Nubbin Slough
TCRPC	Treasure Coast Regional Planning Council
TDS	Total Dissolved Solids
tph	tons per hour
TSP	Total Suspended Particulate
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USDW	Underground Source of Drinking Water
VOC	Volatile Organic Compound

1.0 THE NEED FOR POWER AND THE PROPOSED FACILITIES

A Joint Petition to Determine Need for Electrical Power Plant was submitted to the Florida Public Service Commission (PSC) by Indiantown Cogeneration, L. P. (ICL) and Florida Power and Light (FPL) on August 21, 1990. This submittal to the PSC discussed the DER's requirement for information on (1) internal benefits to the cogeneration owners, (2) benefits to the county, region, and state; and (3) an assessment of the impact of the proposed facility on the reliability, generation planning, unit dispatching, and generation costs of the power purchasing utility, as coordinated with the affected utilities. What follows is a brief summary of the need determination document submitted to the PSC.

ICL proposes to construct a cogeneration project near Indiantown, Florida (the "Indiantown Cogeneration Project"). This project is a pulverized coal fired steam unit that will produce approximately 330 MW of electricity for sale to FPL and approximately 225,000 lb/hour of process steam for sale to the Caulkins Indiantown Citrus Company ("Caulkins"). The project is projected to start commercial operation between September 1, 1995 and December 1, 1995.

The document submitted to the PSC demonstrates the need for the new electrical generating capacity to be provided by the Indiantown Cogeneration Project, consistent with the requirements of the Florida Electrical Power Plant Siting Act, Section 403.519, Florida Statutes, and Section 25-22.081 of the Florida Administrative Code.

Under the policy expressed by the PSC in Order No. 22341 in Docket No. 890004-EU (the 1989 annual planning hearing order), the document submitted to the PSC also addresses the need for the Indiantown Cogeneration Project's electrical generating capacity from the viewpoint of FPL, the purchasing utility.

Where possible, the document submitted to the PSC relies on information concerning FPL's need that has previously been furnished to the Commission in the need determination dockets for FPL's Lauderdale Repowering Project and its Martin Units 3 and 4. In doing this, "FPL's Petition to Determine Need for Electrical Power Plant 1993-1996 (Revised November 1989)" [hereafter referred to as "FPL's 1989 Need Study"] was included as an attachment and was cross-referenced throughout.

FPL's 1989 Need Study shows that FPL has a need by 1996 for the 330 MW represented by the ICL Indiantown Cogeneration Project, in addition to capacity and/or demand reductions available to FPL from other sources. The information in the document submitted to the PSC reconfirms FPL's need for capacity and shows that the Indiantown Cogeneration Project is a cost-effective and reliable method of satisfying the need.

The PSC hearing on the Joint Need for Power submittal by ICL and FPL was held on December 5, 1990.

2.0 SITE AND VICINITY CHARACTERISTICS

2.1 SITE AND ASSOCIATED FACILITIES DELINEATION

The Indiantown Cogeneration, L. P. (ICL) project will be constructed in southwestern Martin County, Florida.

The site and its access facilities occupy Sections 26, 27, 34, and 35, Township 39 South, Range 38 East, Martin County, Florida. Figure 2.1.0-1, entitled Site Vicinity Plan, illustrates the general location of the ICL project site. The site, which occupies approximately 232 acres, is located 9 miles east of Lake Okeechobee and about 3 miles northwest of the unincorporated town of Indiantown. To the north of the site are the Caulkins Citrus Processing Facility (Caulkins) and the vacant Florida Steel Corporation (FSC) site. Both of these facilities border State Road 710 and the CSX Railroad. The ICL project site is bounded on the west by Tampa Farm Products and on the south and east by unimproved industrially zoned land.

The site is currently unimproved and is zoned industrial. There are no existing buildings and the only structures on the site are the transmission towers in the FPL transmission line right-of-way.

Approximately 21 acres of the site will be used to construct the power block portion of the cogeneration plant. The power block includes the boiler, turbine generator, air pollution control equipment, cooling tower, water treatment facilities, lime and ash storage, and administration and maintenance buildings. Another 15 acres will be used for coal handling and storage facilities. A cooling water storage pond will be constructed on approximately 25 acres. A 12-acre area will be used as temporary construction storage and laydown.

Within the site boundary are 23.9 acres of wetlands which will be preserved. Around each of the wetlands a 50-foot buffer zone will be maintained, accounting

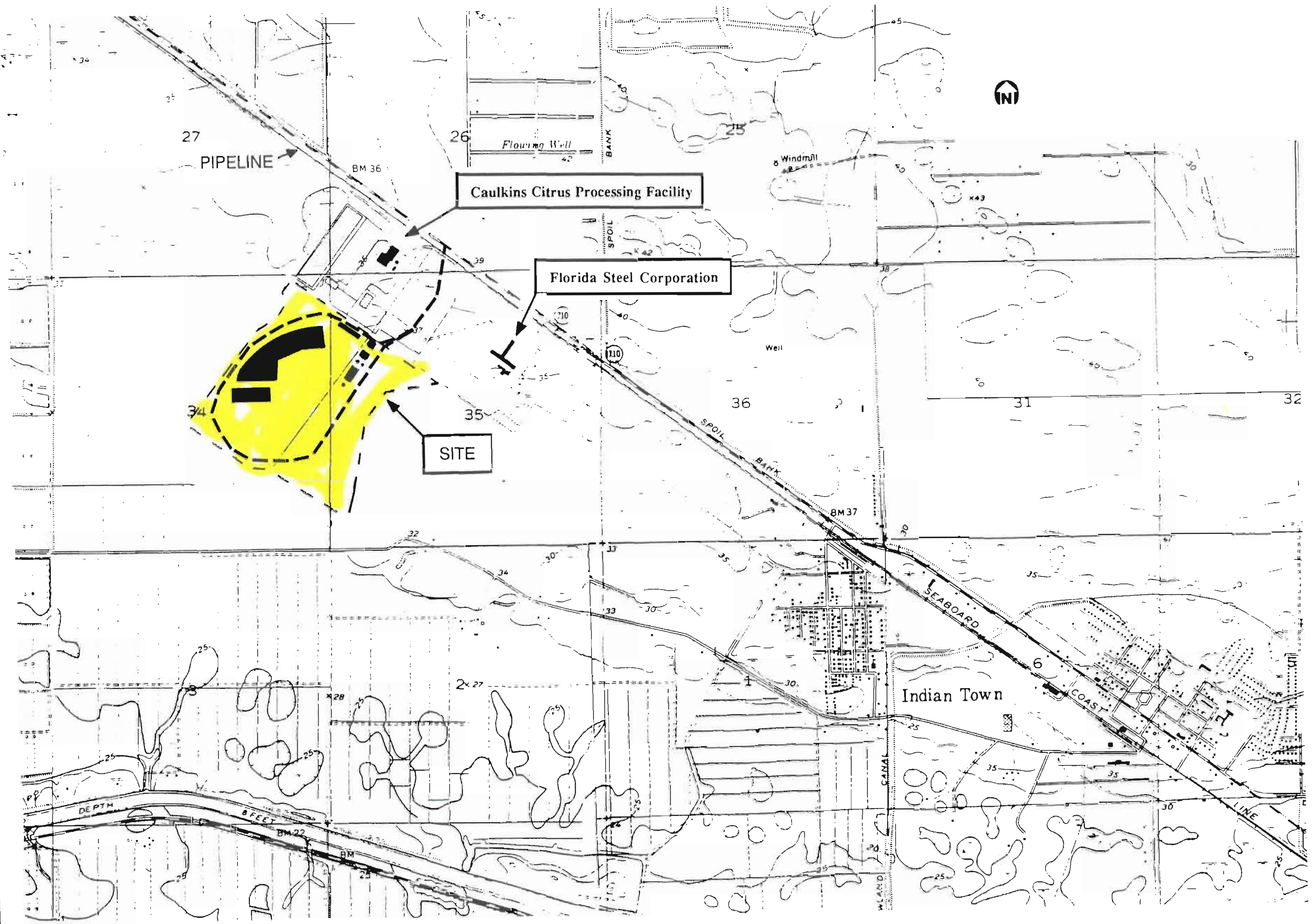

Figure 2.1.0-1.

SITE VICINITY PLAN

LEGEND:

— — SITE BOUNDARY

Scale: 1 Inch = 2000 Ft.

Source: Bechtel, 1990

INDIANTOWN COGENERATION PROJECT

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for an additional 8 acres. As required by Martin County, 25 percent of the pine flatwoods onsite must be preserved as uplands. Therefore, 50.5 acres have been allocated as uplands.

The remaining 76.6 acres include the rail loop, roads, and other miscellaneous non-preserved areas.

The ICL project will be within Zone B as defined by Flood Insurance Rate Maps (FEMA, 1984). Therefore, no portion of the site is within the 100-year flood zone.

In addition to the above mentioned site, an intake structure will be constructed on the canal at Taylor Creek/Nubbin Slough approximately 19 miles from the power plant site. A pipeline will be constructed along the CSX right-of-way (ROW) from the canal to the site. Chapter 6.0 further describes the pipeline and intake structure.

An easement also will be obtained from Florida Steel Corporation to connect the site to the CSX railroad. A new rail spur will be constructed to bring coal and other materials to the site through this easement, which may encompass a maximum of 75 acres.

2.2 <u>SOCIOPOLITICAL ENVIRONMENT</u>

2.2.1 GOVERNMENTAL JURISDICTIONS

The proposed Indiantown Cogeneration, L. P. (ICL) project is located in portions of Sections 26, 27, 34, and 35 of Range 38 East, Township 39 South, in south-western unincorporated Martin County. The ICL site is located along State Road (SR) 710 and the CSX rail line, and lies west of and adjacent to the existing Caulkins Indiantown Citrus Processing Plant and an abandoned Florida Steel Corporation (FSC) plant. The location of the associated cooling water pipeline is discussed in Section 6.2.

The project is located within the local jurisdiction of Martin County, and is also under the regional jurisdiction of the Treasure Coast Regional Planning Council (TCRPC) and the South Florida Water Management District (SFWMD). The study area is shown on Figure 2.2.1-1, with 1-, 2-, 3-, 4-, and 5-mile radii delineated from the approximate center point of the plant's stack.

The majority of Martin County's urban development is located to the east of the ICL site between the Florida Turnpike and the Atlantic Ocean, and includes the Palm City, Stuart, Port Salerno, and Hutchinson Island communities. The nearest community to the proposed project is the unincorporated town of Indiantown, located approximately 3 miles southeast of the site along SR 710.

A review of surrounding areas for land under the jurisdiction of federal, state, or regional agencies shows that none of these are located within 5 miles of the ICL site. Barley Barber Swamp, a wetland preserve, is located about 5 miles to the northwest of the project as shown on Figure 2.2.1-1.

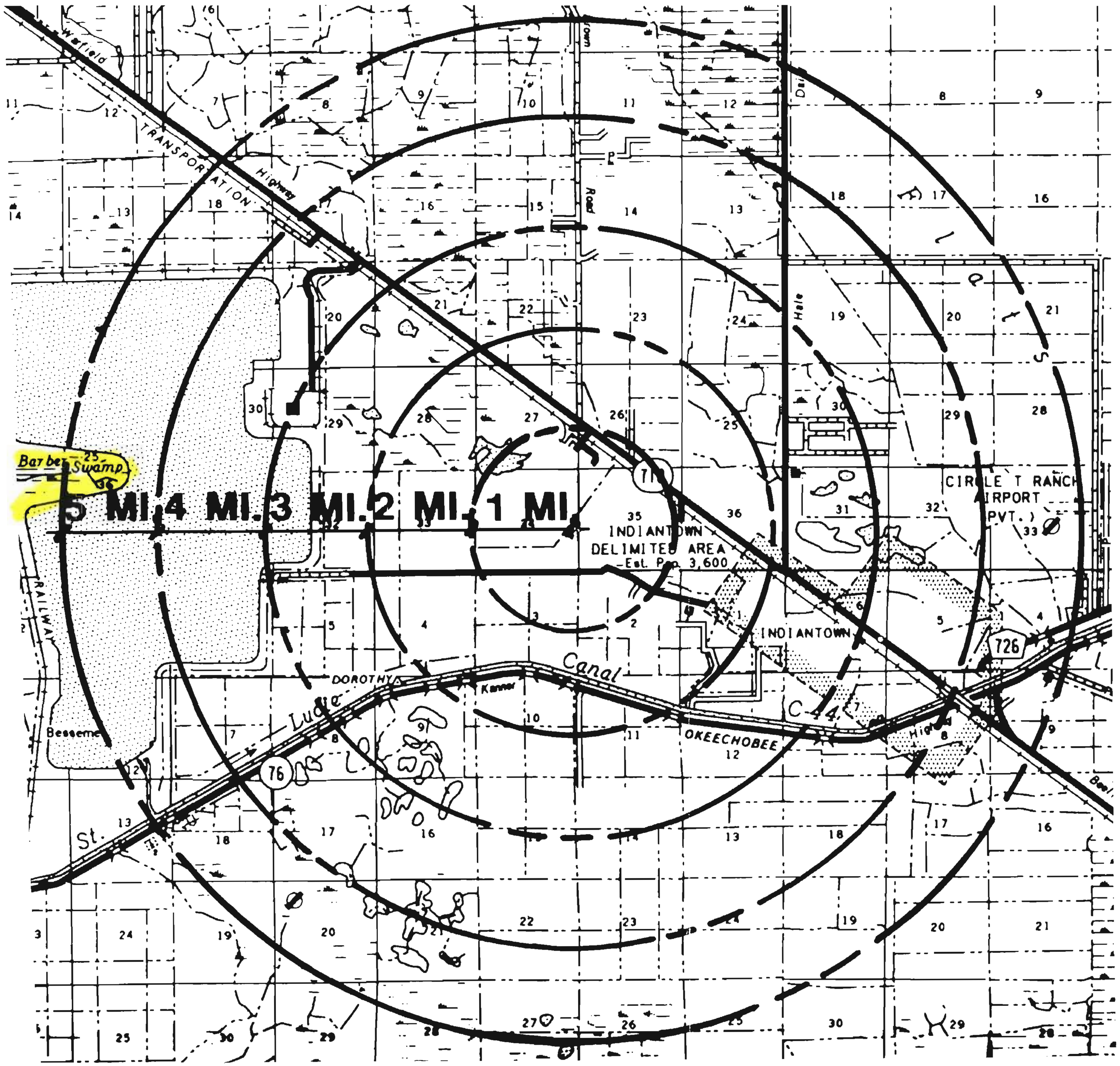

Figure 2.2.1-1.

GOVERNMENTAL JURISDICTIONS WITHIN FIVE MILES OF THE ICL SITE

SCALE: 1" = 1 MILE

Sources: FDOT, 1976, 1985. ETC, 1990.

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Barley Barber Swamp is a 400-acre preservation area maintained as a private landholding by Florida Power & Light Company (FPL). Barley Barber Swamp is maintained as a natural preserve, and consists of ecologically valuable wetland and upland communities. FPL provides public access to the swamp and its boardwalk, restrooms, and parking area, by appointment.

2.2.2 ZONING AND LAND USE PLANS

Martin County has developed its Comprehensive Growth Management Plan (CGMP) in accordance with the requirements of the Local Comprehensive Planning and Land Development Regulation Act, Chapter 163, Part II, *Florida Statutes* (FS); and Chapter 9J-5, Florida Administrative Code (FAC). Martin County's CGMP was adopted by the Martin County Board of County Commissioners on February 20, 1990 (Martin County CGMP, 1990).

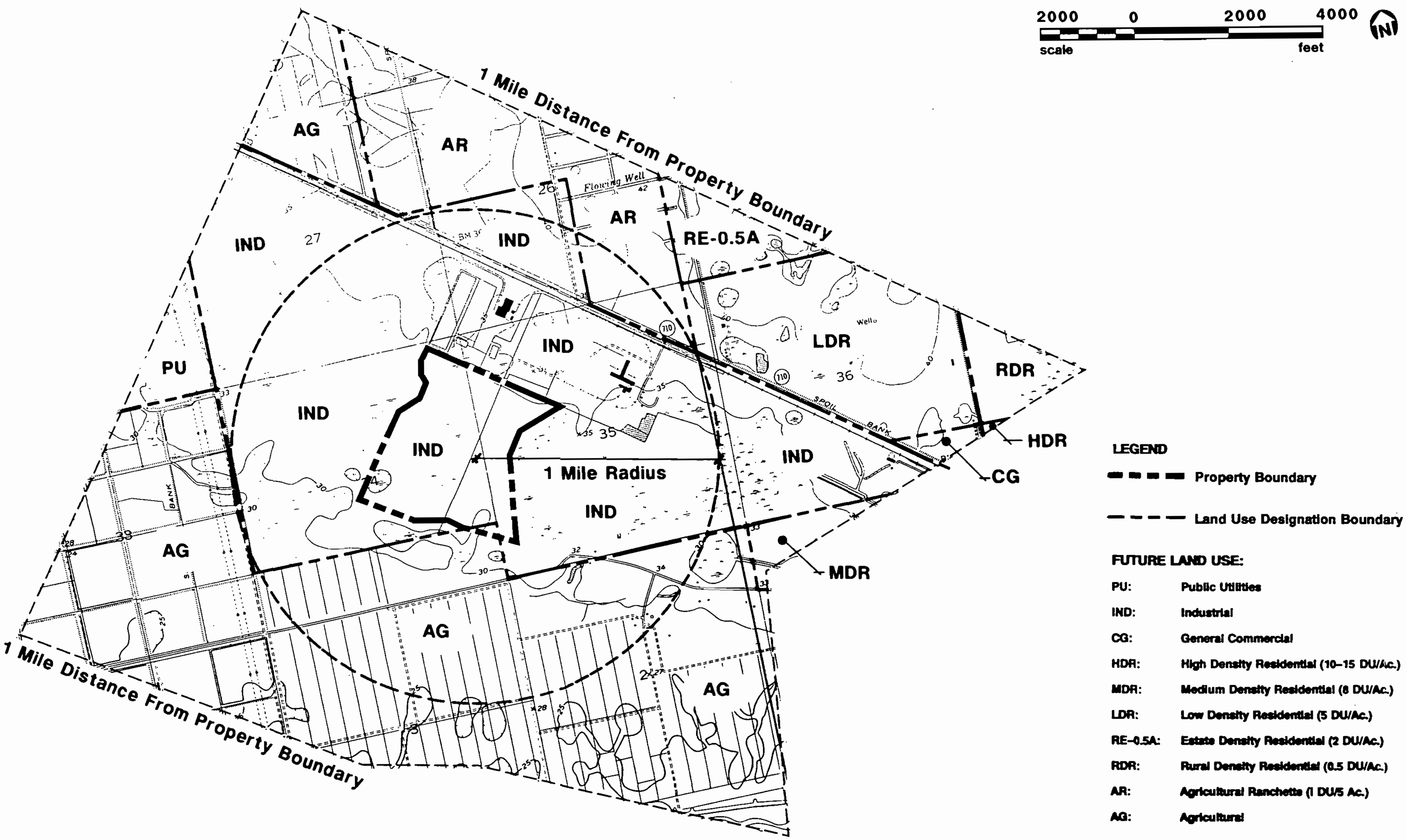
The location of the proposed ICL plant in relation to the county's future land use plan categories is shown on Figure 2.2.2-1. This figure shows that the majority of the project site falls within the industrial land use category. A very small portion, approximately 1.5 acres or 0.65 percent of the total site area, falls within the Agricultural land use category. This area is located in the extreme southeast portion of the site and will not be developed. The site is partially located within Martin County's Primary Urban Service District. Figure 2.2.2-2 shows the current zoning of the site and the surrounding property. Most of the ICL project site is currently zoned M-3, Heavy Industrial. A small portion of the site is zoned M-1, Industrial.

The Future Land Use Element of Martin County's CGMP includes a number of policies related to industrial development. They can generally be characterized as follows:

1. Policies for the concentration of higher intensities of development within Primary Urban Service Districts--Goal G beginning on page 4-39, especially Objective 1, Policies b and c
2. Policies providing for adequate and appropriate lands for industrial land uses--Goal K beginning on page 4-48, including Objectives 1-4
3. Policies for land use allocation--Goal M, Objective 1f (Industrial Development) and 1h (Public Utilities - Major Power Generation Facilities)

Figure 2.2.2-1.

LAND USE PLAN DESIGNATIONS WITHIN ONE MILE OF THE ICL SITE



Sources: USGS, 1983. Martin County Growth Management Department, 1990. ECT, 1990.

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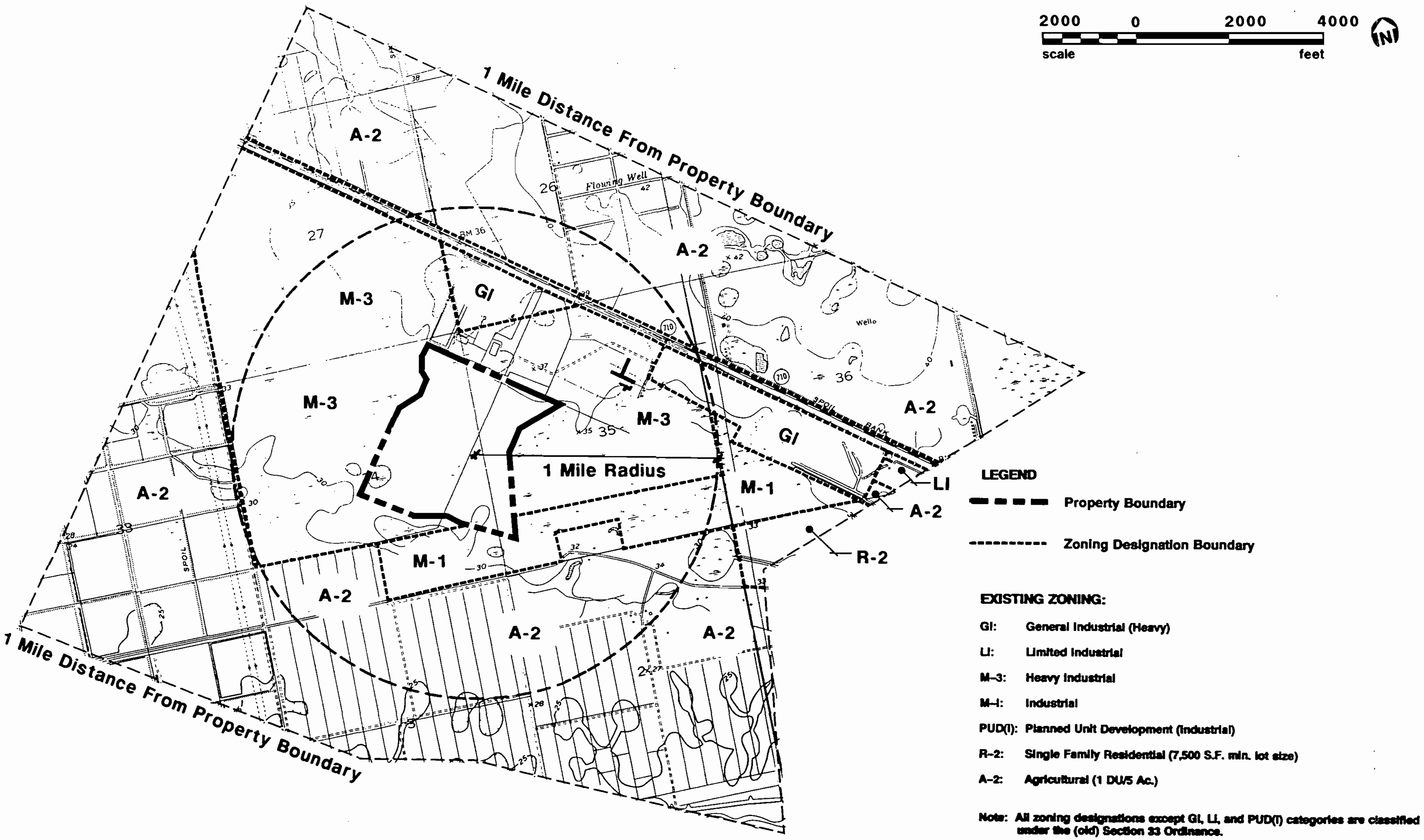
Figure 2.2.2-2.

ZONING DISTRICTS WITHIN ONE MILE OF THE ICL SITE



Sources: USGS, 1983. Martin County Growth Management Department, 1990. ECT, 1990.

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4. Performance standards--Section 4.5B, C, D, F, G, H, I, J, K, and L
5. Implementation strategies--Section 4.6C and D

Applicable excerpts from the Martin County CGMP Future Land Use Element are included in Section 10.3.

The ICL cogeneration facility is designed to provide process steam to the Caulkins citrus processing plant. The cogeneration concept involves efficient use of fuel to produce electricity and a second form of useful energy, in this case process steam. The electricity will be sold to FPL. Proximity to its steam host is a necessary prerequisite to the efficient operation of the cogeneration system. As an integrated part of the Caulkins processing plant, the ICL project is appropriately located in the industrial land use category and will not require a change in Martin County's future land use map.

The project is undergoing Martin County preliminary development plan review in conjunction with a rezoning to Industrial Planned Unit Development [PUD(i)]. The rezoning is being sought because of the County's preference that the project be developed under a PUD zoning rather than the existing M-3 (Heavy Industrial) and M-1 (Industrial) zoning. PUD zoning provides for in-depth development plan review, as well as maximum project design flexibility. Simultaneously with the PUD(i) rezoning, ICL is seeking an exemption from Martin County's height regulations to accommodate the project's stacks and other facilities which may exceed Martin County's 60-foot height restriction. The Martin County Board of County Commissioners' (BOCC) approval of the PUD(i) rezoning, preliminary development plan, and the height exemption are expected in early 1991. Applicable provisions of the Martin County Zoning and Land Development Codes are included in Section 10.2.

2.2.3 DEMOGRAPHY AND ONGOING LAND USE

2.2.3.1 Population of the Surrounding Area

There are no incorporated towns and cities within a 5-mile radius of the Indiantown site. The unincorporated community of Indiantown lies within the 5-mile radius approximately 3 miles southeast of the site. The majority of land surrounding the ICL site is either agricultural or undeveloped in nature.

The Martin County Community Development Department has divided the county into several planning areas for planning and analysis purposes. The Indiantown project 5-mile radius study area includes two of these planning areas: (1) Indiantown, and (2) West County, as shown on Figure 2.2.3-1. On this figure, the West County planning area includes all the area within the 5-mile radius, except for the shaded area for the Indiantown planning area. The population projections for these two planning areas and the entire county are shown in Table 2.2.3-1. The Indiantown area has a significantly higher population and population density in comparison to the West County area. The estimated 1990 population for the Indiantown planning area is 5,852 persons (Martin County CGMP, 1990) and the population density for the 16.5-mi_2 area is approximately 355 persons per square mile. The estimated 1990 population for the West County area is 3,247 persons. This planning area covers approximately 241.3 mi^2; due to its agricultural and undeveloped character, it has a population density of approximately 13 persons per mi^2.

2.2.3.2 Historic and Future Population Growth

Between 1970 and 1980, the population of Martin County grew by 128 percent (Bureau of Economic and Business Research, 1990). During the period 1980 to 1989, the total population of Martin County increased 51 percent (Bureau of Economic and Business Research, 1990). Comparable historic growth rates for

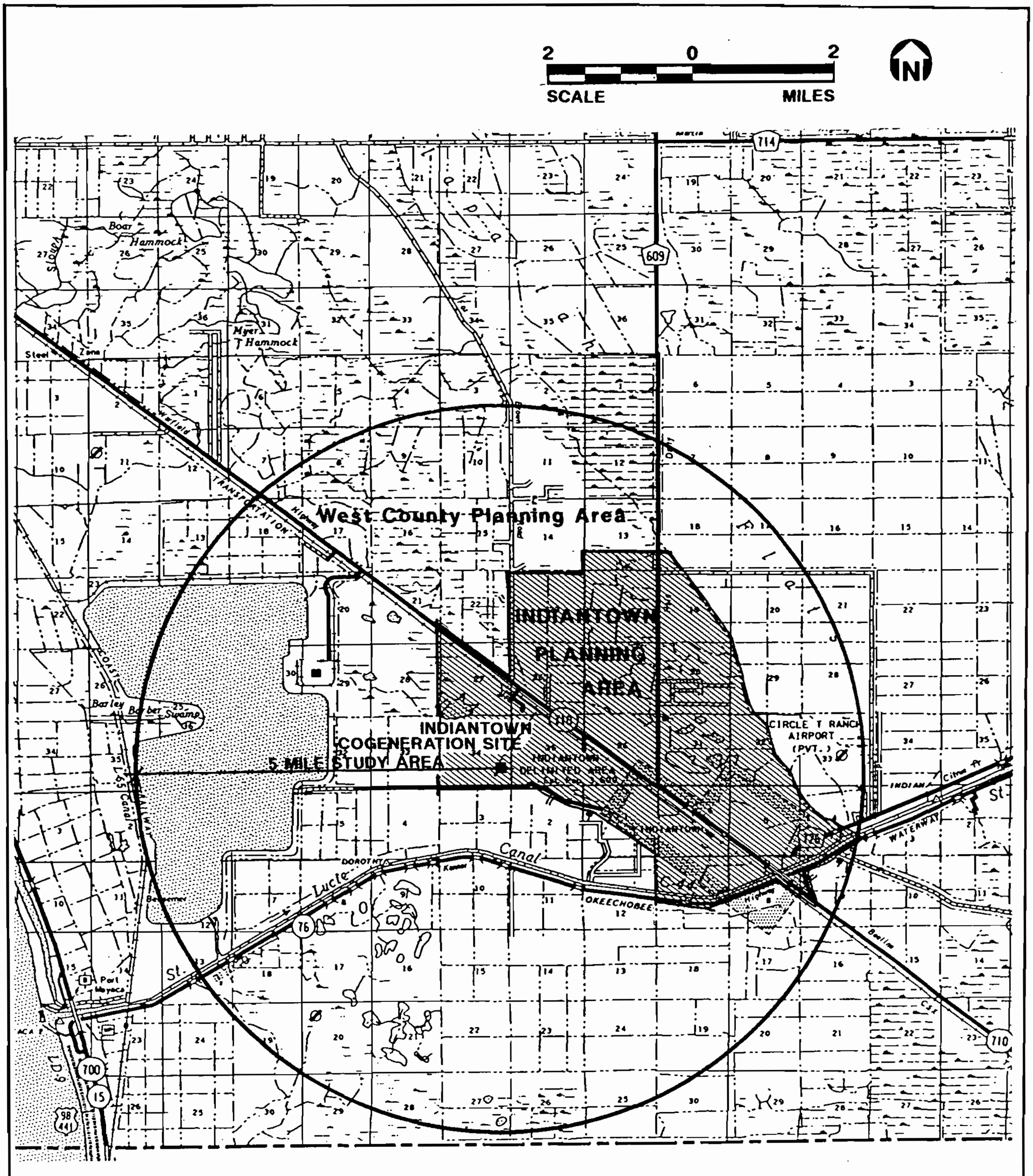

Figure 2.2.3-1
MARTIN COUNTY PLANNING AREA

Sources: FDOT, 1976, 1983. Martin County Growth Management Department, 1990. ECT, 1990.

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Table 2.2.3-1
POPULATION PROJECTIONS, MARTIN COUNTY, FLORIDA

Year	Martin County	Indiantown Planning Area	West County Planning Area
Population (number of persons)			
1990	107,437	5,852	3,247
1995	127,527	6,910	4,079
2000	149,845	8,085	5,004
2005	172,165	9,260	5,929
Average Annual Growth Rate %			
1990 - 1995	3.5	3.4	4.7
1995 - 2000	3.3	3.2	4.2
2000 - 2005	2.8	2.8	3.5

Source: Martin County CGMP, 1990.

the planning areas are not available because the planning boundaries have changed over time.

Projected future annual population growth rates for the Indiantown planning area, as previously shown in Table 2.2.3-1, will be slightly slower than for the entire county, at 3.4 percent per year from 1990 to 1995, 3.2 percent per year from 1995 to 2000, and approximately 2.8 percent per year from 2000 to 2005. The 2005 population for the Indiantown planning area is projected to be 9,260 permanent residents (Martin County CGMP, 1990).

The projected future annual population growth rates for the West County planning area, as previously shown in Table 2.2.3-1, are slightly higher than those for the entire county due to the amount of land available for development, and the low density of the existing population. The average annual growth rates for the period 1990 to 1995 are projected at 4.7 percent per year, 4.2 percent per year during the period 1995 to 2000, and 3.5 percent per year for the years 1995 to 2000. The West County planning area population for the year 2005 is projected to be 5,929 permanent residents (Martin County CGMP, 1990).

2.2.3.3 Land Uses of the Surrounding Area

The land use analysis of the 5-mile study area was based on 1986 SFWMD land use maps prepared as overlays on U.S. Geological Survey (USGS) 7.5 minute quadrangle maps. The information contained in these maps is shown in a reduced form on Figures 2.2.3-2 and 2.2.3-3 (pages 1 through 11). This information was also field verified. A complete listing of land uses found within the 5-mile radius is shown in Table 2.2.3-2.

The majority of the lands within a 5-mile radius of the project site are undeveloped or agricultural in nature. These undeveloped lands contain grasslands, brushland, old fields, pastures, water bodies, and forested, non-forested, and mixed forested wetlands. Lands utilized for agriculture within the 5-mile radius are primarily

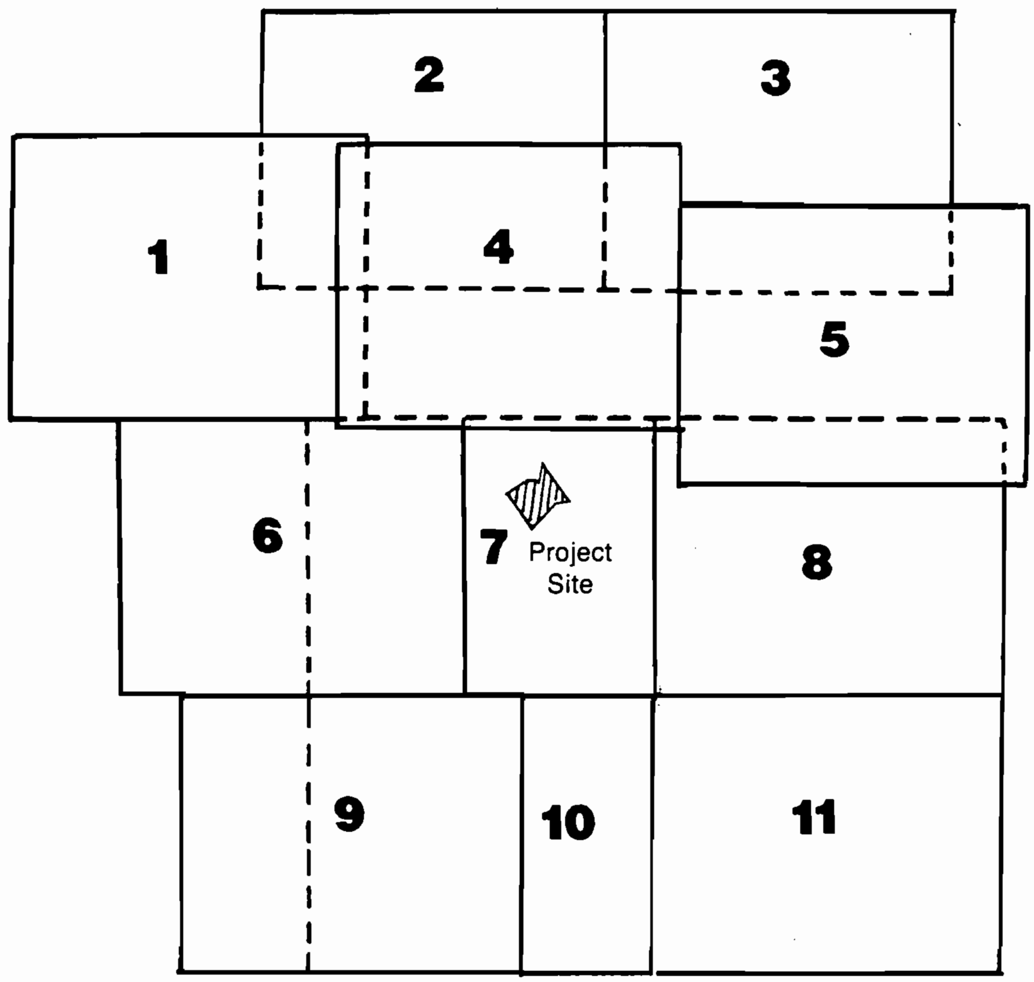

Figure 2.2.3-2
LAND USE AND LAND COVER MAP KEY SHEET
FOR THE FIVE-MILE STUDY AREA

Source: ECT, 1990.

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Figure 2.2.3-3. (Page 1 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE

2000 0 2000 4000
scale feet

LEGEND

▬ ▬ ▬ 5-Mile Radius Study Area

Agriculture

ACSC	Sugar cane
ACTC	Truck crops
AFDF	Dairy farms
AMCT	Citrus
APIM	Improved pasture

Forested Uplands

FEPF	Pine flatwoods
FM	Mixed forested
FMCO	Cabbage palms/Oaks
FMOF	Old fields forested
FMPC	Pine/Cabbage palms

Water Bodies

H	Water

Grassland

RG	Grassland

Scrub and Brushland

RSPP	Palmetto prairies
RSSB	Brushland

Commercial and Services

UCMC	Marine commercial (Marinas)
UCSS	Sales and services

Industrial

UI	Industrial

Open and Other

UOCM	Cemeteries
UOGC	Golf courses
UOPK	Parks
UOUN	Open and undeveloped within urban area

Residential

URMF	Multi-family building
URMH	Mobile homes
URSL	Single-family, Low Density (under 2 D.U./gross acre)
URSM	Single-family, Medium Density (under 2 to 5 D.U./gross acre)
USED	Educational
UTAG	Small grass airports
UTEP	Electrical power facilities
UTTL	Major highway and rights-of-way
UTWS	Water supply plants

Wetlands

WFCY	Cypress
WN	Non-forested fresh
WXPP	Pine and wet prairies
WFMX	Mixed forested

Barren Land

BL	Levees

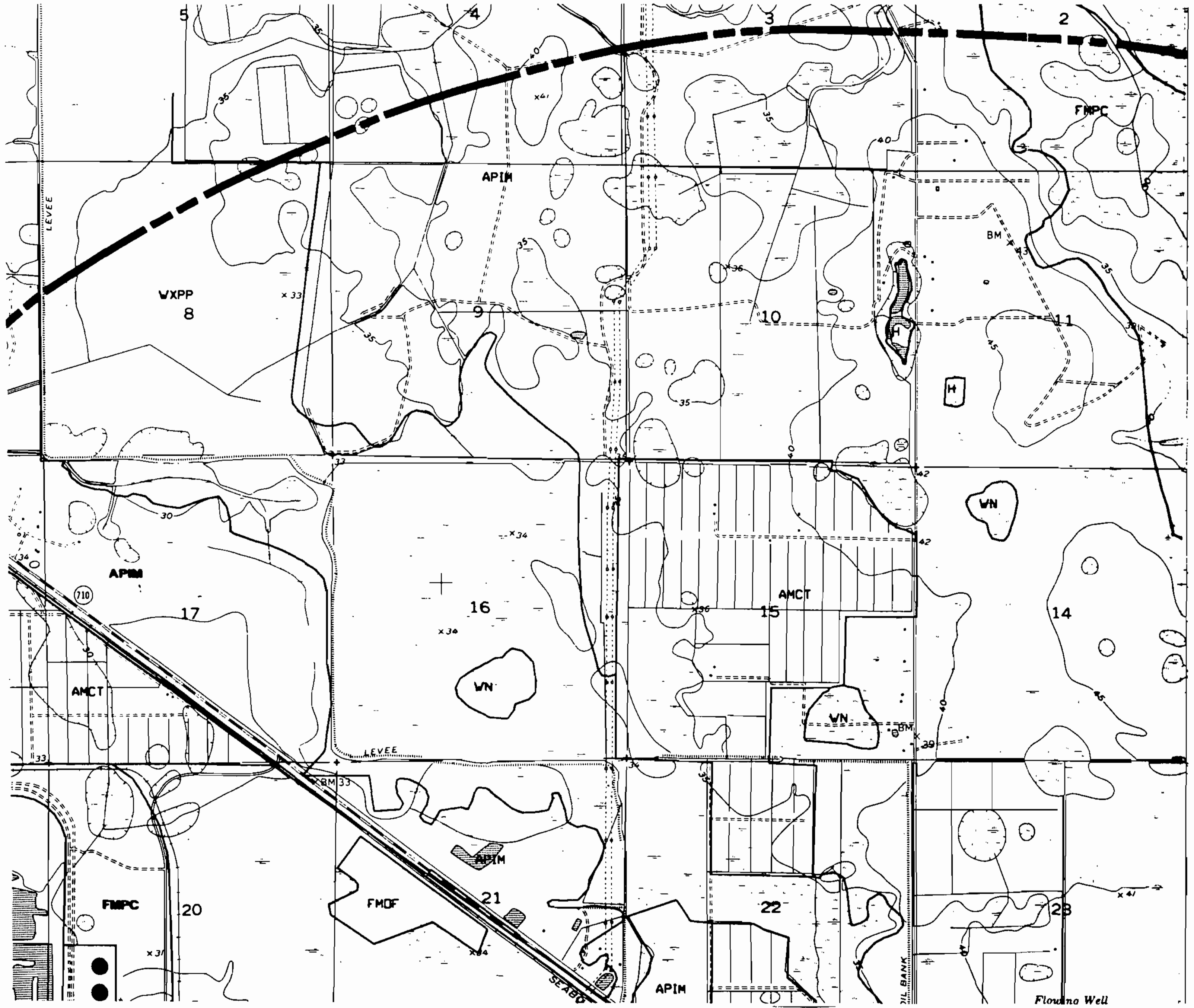
Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

Figure 2.2.3-3. (Page 2 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



2000 0 2000 4000

scale feet

LEGEND

5-Mile Radius Study Area

Agriculture

ACSC Sugar cane
ACTC Truck crops
AFDF Dairy farms
AMCT Citrus
APIM Improved pasture

Forested Uplands

FEPF Pine flatwoods
FM Mixed forested
FMCO Cabbage palms/Oaks
FMOF Old fields forested
FMPC Pine/Cabbage palms

Water Bodies

H Water

Grassland

RG Grassland

Scrub and Brushland

RSPP Palmetto prairies
RSSB Brushland

Commercial and Services

UCMC Marine commercial (Marinas)
UCSS Sales and services

Industrial

UI Industrial

Open and Other

UOCM Cemeteries
UOGC Golf courses
UOPK Parks
UOUN Open and undeveloped within urban area

Residential

URMF Multi-family building
URMH Mobile homes
URSL Single-family, Low Density (under 2 D.U./gross acre)
URSM Single-family, Medium Density (under 2 to 5 D.U./gross acre)
USED Educational
UTAG Small grass airports
UTEP Electrical power facilities
UTTL Major highway and rights-of-way
UTWS Water supply plants

Wetlands

WFCY Cypress
WN Non-forested fresh
WXPP Pine and wet prairies
WFMX Mixed forested

Barren Land

BL Levees

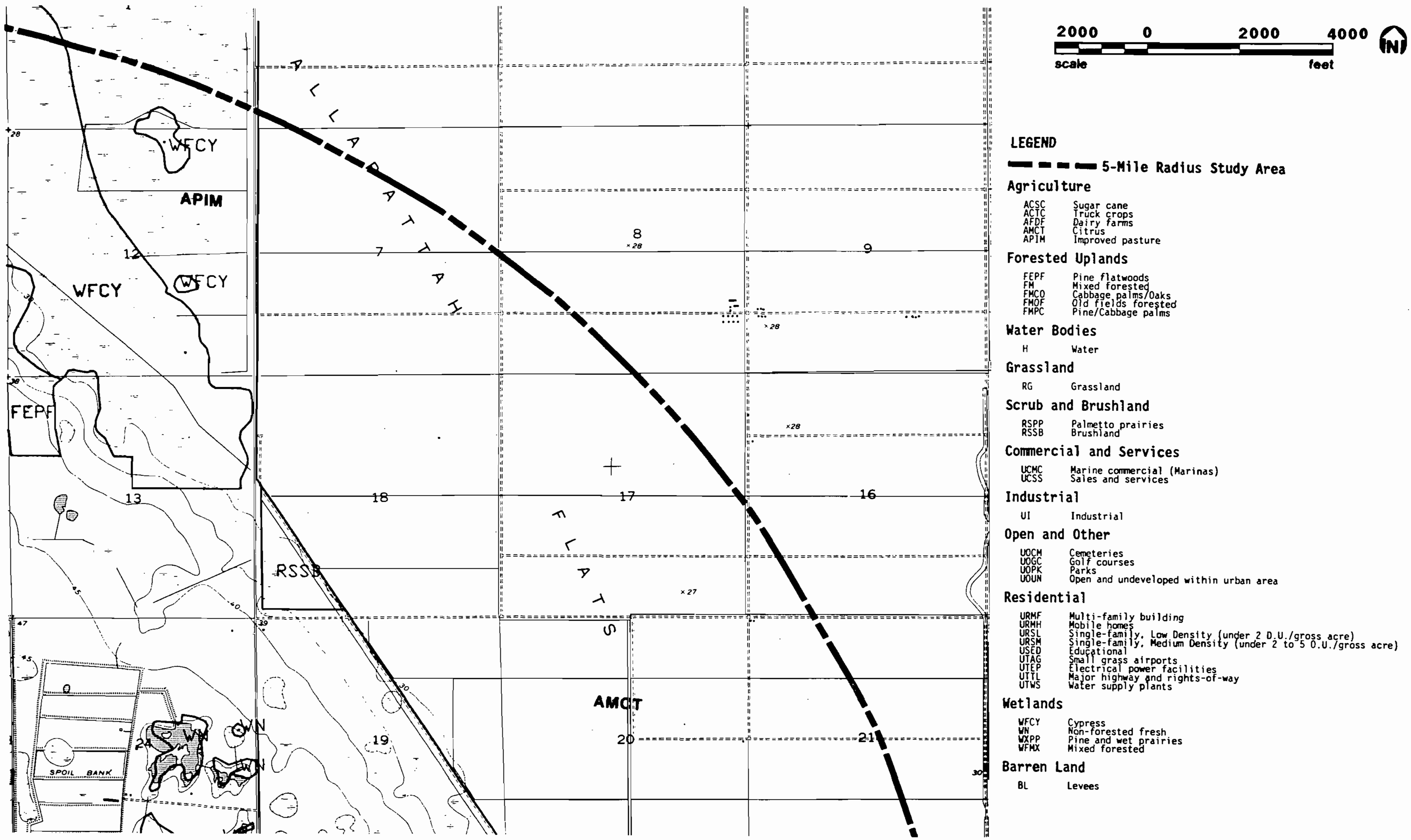
Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

Figure 2.2.3-3. (Page 3 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



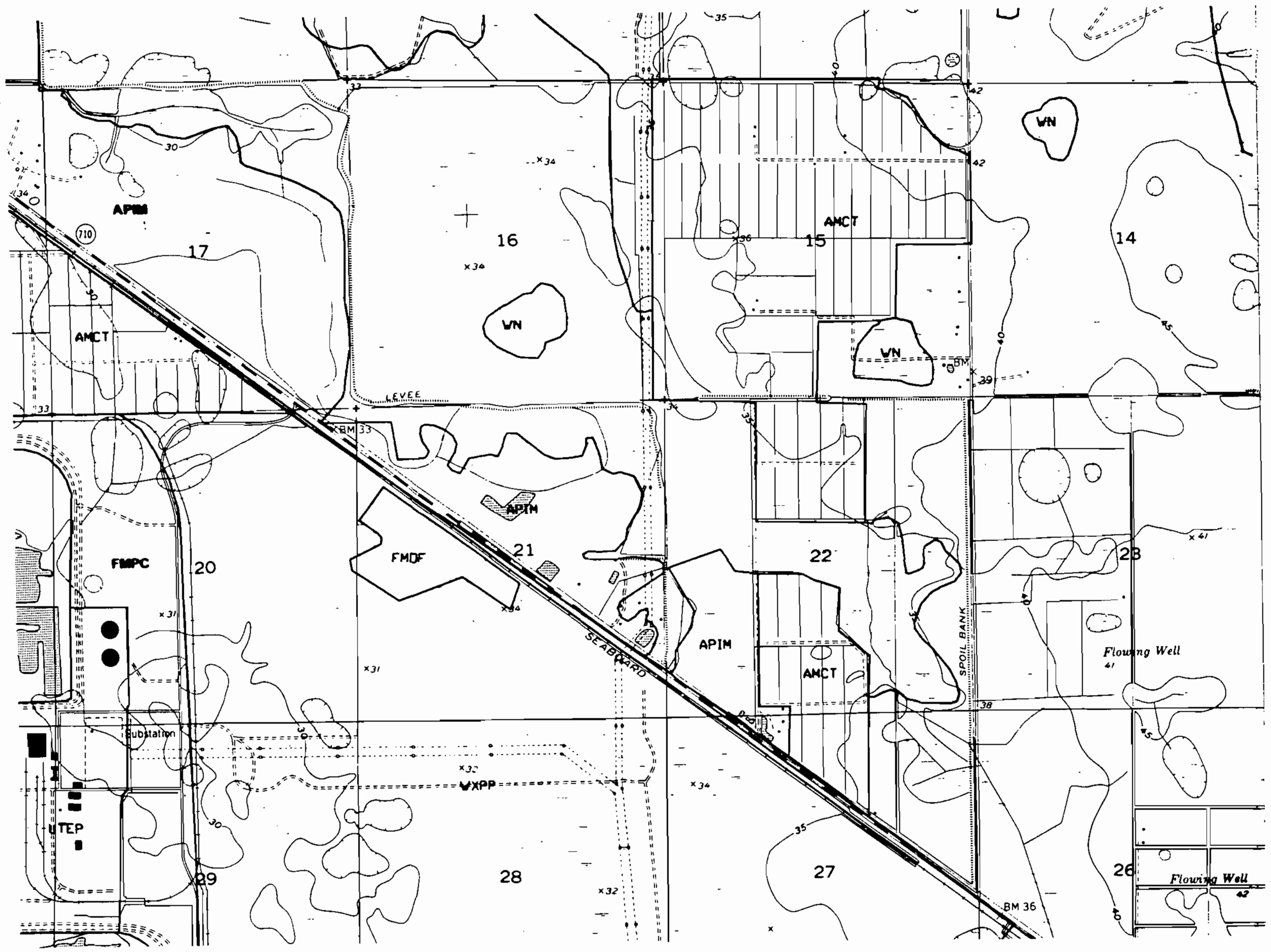
Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

Figure 2.2.3-3. (Page 4 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



2000 0 2000 4000
scale feet
N

LEGEND

▬ ▬ ▬ 5-Mile Radius Study Area

Agriculture

- ACSC Sugar cane
- ACTC Truck crops
- AFDF Dairy farms
- AMCT Citrus
- APIM Improved pasture

Forested Uplands

- FEPF Pine flatwoods
- FM Mixed forested
- FMCO Cabbage palms/Oaks
- FMOF Old fields forested
- FMPC Pine/Cabbage palms

Water Bodies

- H Water

Grassland

- RG Grassland

Scrub and Brushland

- RSPP Palmetto prairies
- RSSB Brushland

Commercial and Services

- UCMC Marine commercial (Marinas)
- UCSS Sales and services

Industrial

- UI Industrial

Open and Other

- UOCM Cemeteries
- UOGC Golf courses
- UOPK Parks
- UOUN Open and undeveloped within urban area

Residential

- URMF Multi-family building
- URMH Mobile homes
- URSL Single-family, Low Density (under 2 D.U./gross acre)
- URSM Single-family, Medium Density (under 2 to 5 D.U./gross acre)
- USED Educational
- UTAG Small grass airports
- UTEP Electrical power facilities
- UTTL Major highway and rights-of-way
- UTWS Water supply plants

Wetlands

- WFCY Cypress
- WN Non-forested fresh
- WXPP Pine and wet prairies
- WFMX Mixed forested

Barren Land

- BL Levees

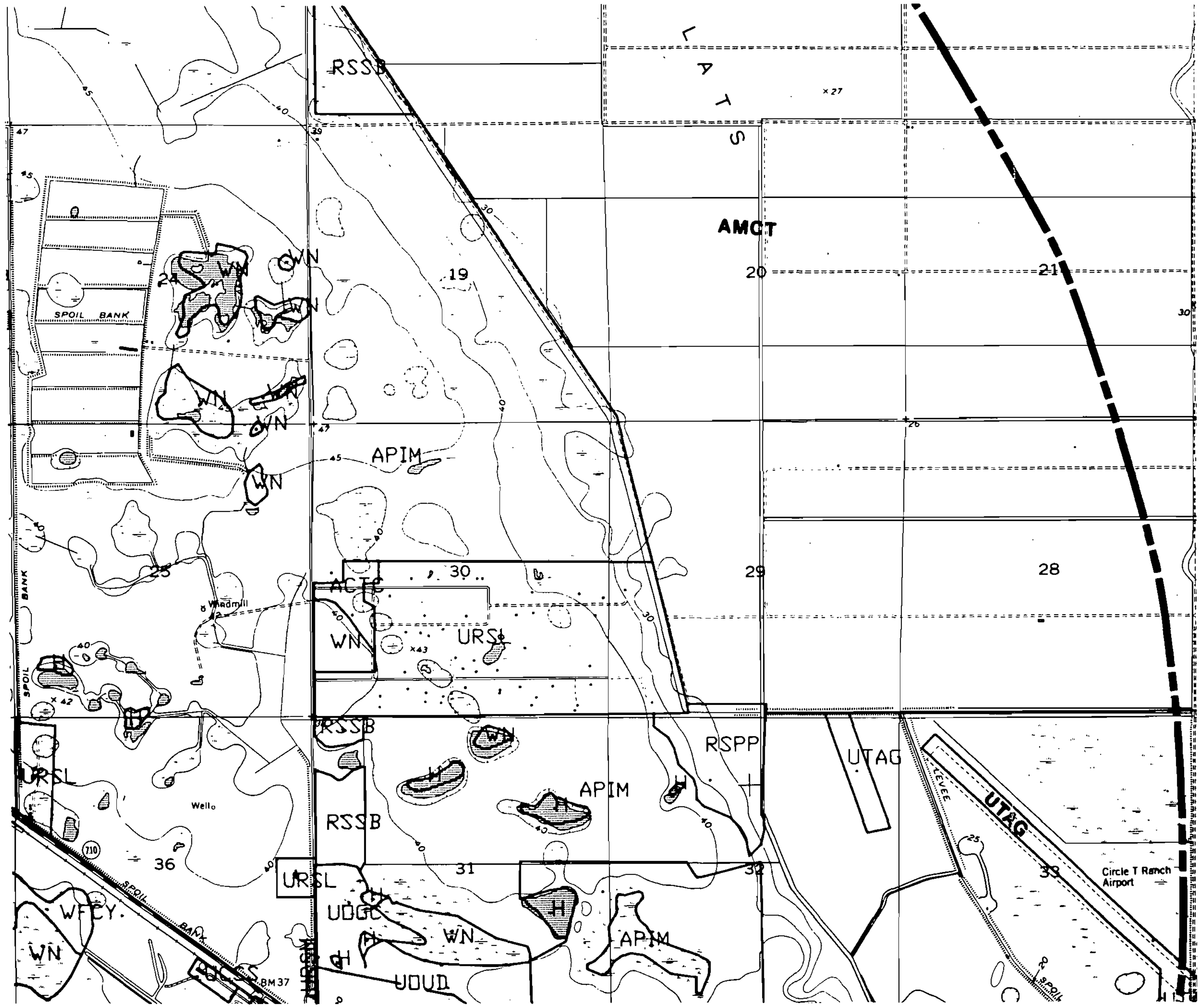
Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

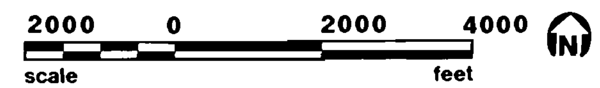
INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

Figure 2.2.3-3. (Page 5 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE





LEGEND

5-Mile Radius Study Area

Agriculture

ACSC	Sugar cane
ACTC	Truck crops
AFDF	Dairy farms
AMCT	Citrus
APIM	Improved pasture

Forested Uplands

FEPF	Pine flatwoods
FM	Mixed forested
FMCO	Cabbage palms/Oaks
FMOF	Old fields forested
FMPC	Pine/Cabbage palms

Water Bodies

H	Water

Grassland

RG	Grassland

Scrub and Brushland

RSPP	Palmetto prairies
RSSB	Brushland

Commercial and Services

UCMC	Marine commercial (Marinas)
UCSS	Sales and services

Industrial

UI	Industrial

Open and Other

UOCM	Cemeteries
UOGC	Golf courses
UOPK	Parks
UOUN	Open and undeveloped within urban area

Residential

URMF	Multi-family building
URMH	Mobile homes
URSL	Single-family, Low Density (under 2 D.U./gross acre)
URSM	Single-family, Medium Density (under 2 to 5 D.U./gross acre)
USED	Educational
UTAG	Small grass airports
UTEP	Electrical power facilities
UTTL	Major highway and rights-of-way
UTWS	Water supply plants

Wetlands

WFCY	Cypress
WN	Non-forested fresh
WXPP	Pine and wet prairies
WFMX	Mixed forested

Barren Land

BL	Levees

Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

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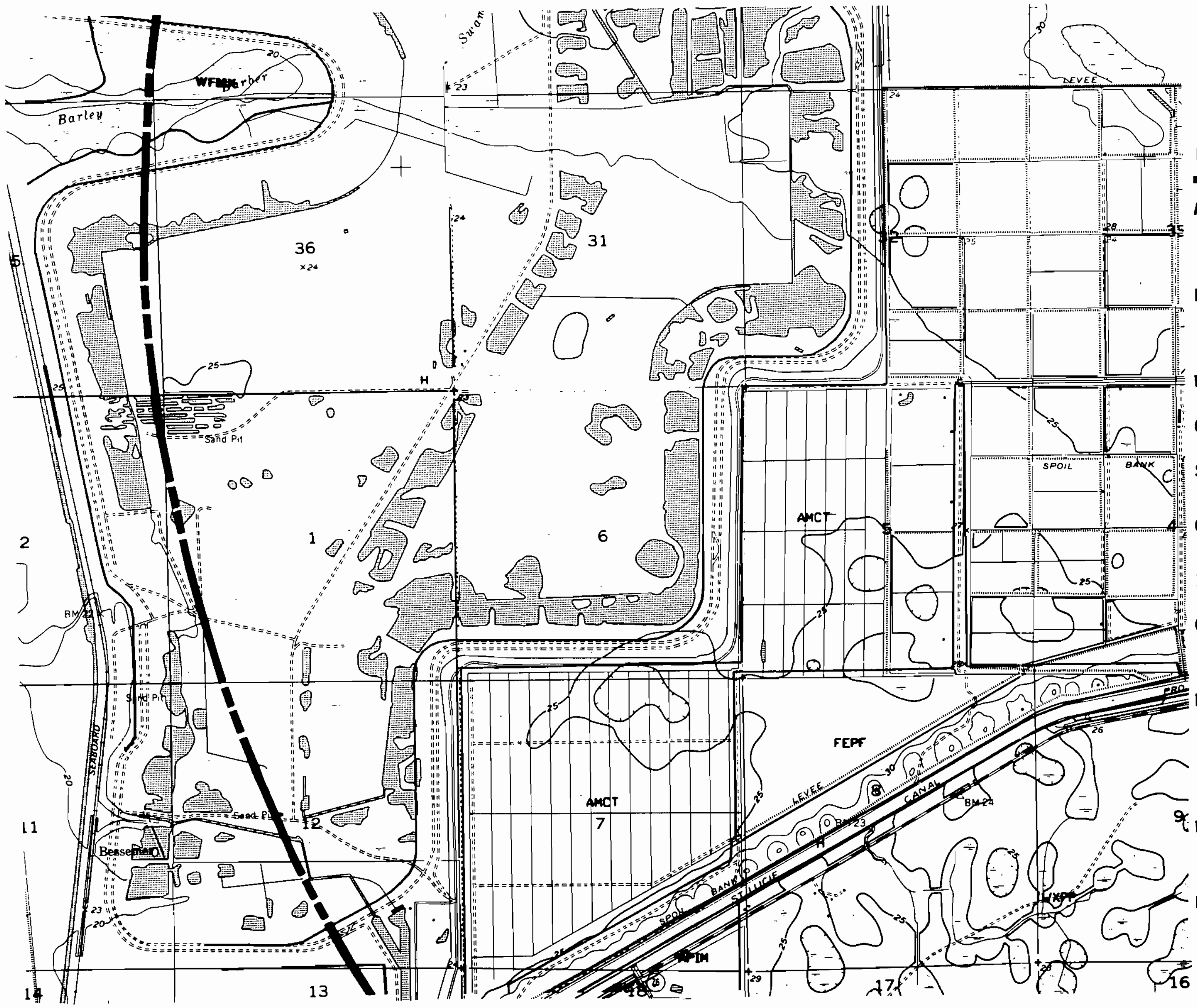
Indiantown Cogeneration, L.P.

Figure 2.2.3-3. (Page 6 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



2000 0 2000 4000
scale feet

LEGEND

5-Mile Radius Study Area

Agriculture

ACSC Sugar cane
ACTC Truck crops
AFDF Dairy farms
AMCT Citrus
APIM Improved pasture

Forested Uplands

FEPF Pine flatwoods
FM Mixed forested
FMCO Cabbage palms/Oaks
FMOF Old fields forested
FMPC Pine/Cabbage palms

Water Bodies

H Water

Grassland

RG Grassland

Scrub and Brushland

RSPP Palmetto prairies
RSSB Brushland

Commercial and Services

UCMC Marine commercial (Marinas)
UCSS Sales and services

Industrial

UI Industrial

Open and Other

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UOGC Golf courses
UOPK Parks
UOUN Open and undeveloped within urban area

Residential

URMF Multi-family building
URMH Mobile homes
URSL Single-family, Low Density (under 2 D.U./gross acre)
URSM Single-family, Medium Density (under 2 to 5 D.U./gross acre)
USED Educational
UTAG Small grass airports
UTEP Electrical power facilities
UTTL Major highway and rights-of-way
UTWS Water supply plants

Wetlands

WFCY Cypress
WN Non-forested fresh
WXPP Pine and wet prairies
WFMX Mixed forested

Barren Land

BL Levees

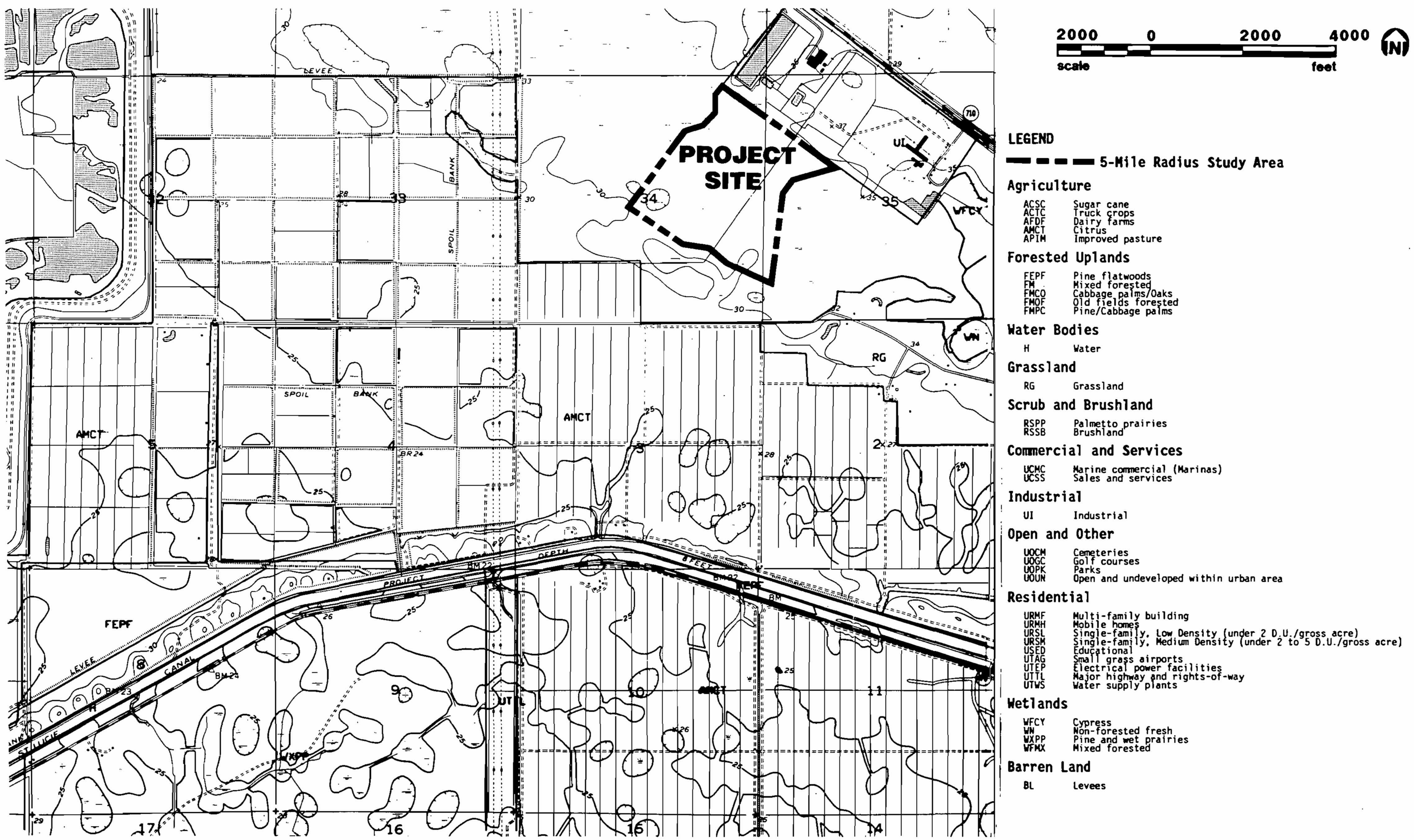
Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

Figure 2.2.3-3. (Page 7 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



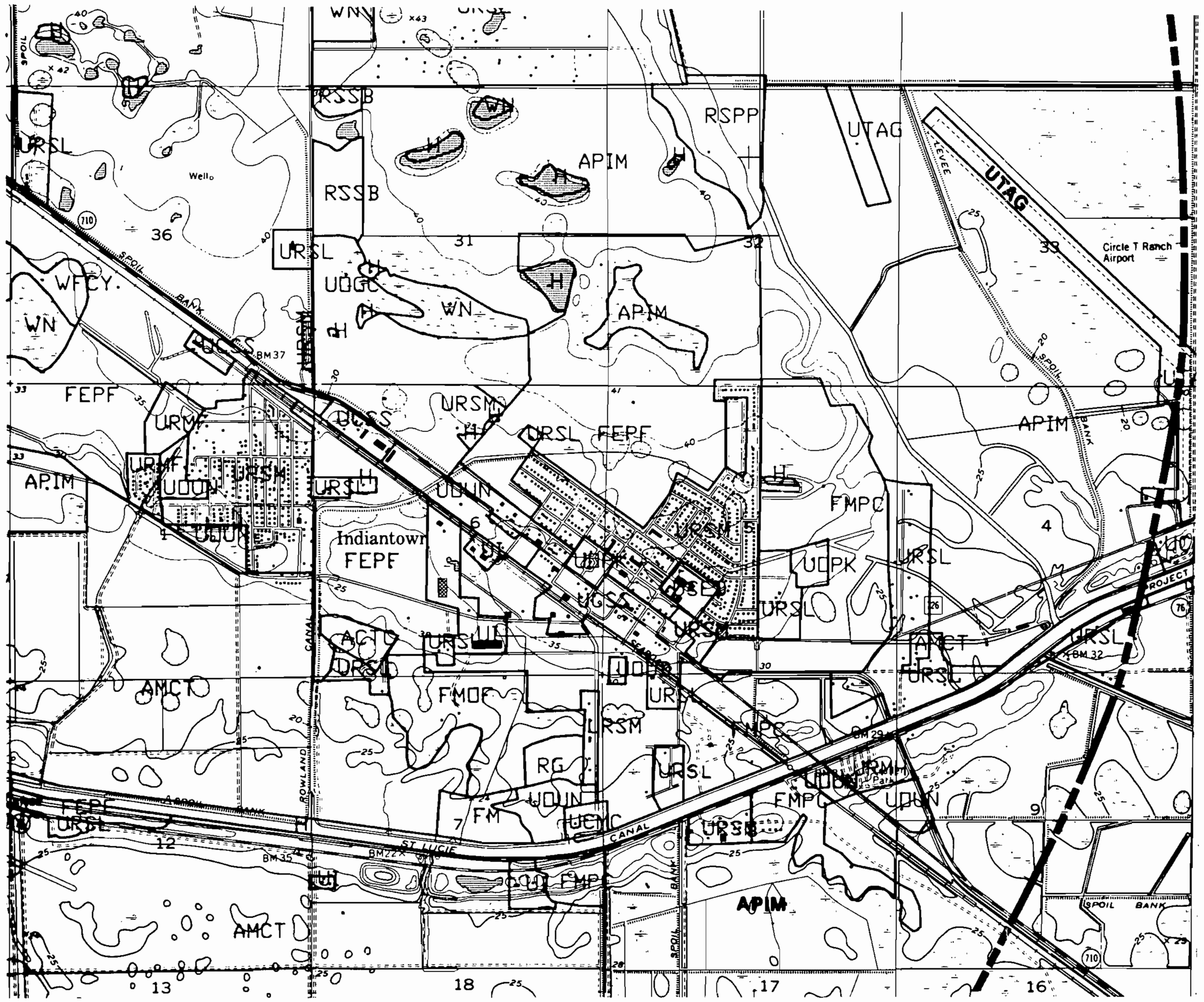
Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

Figure 2.2.3-3. (Page 8 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



2000 0 2000 4000 (N)

scale feet

LEGEND

5-Mile Radius Study Area

Agriculture

ACSC	Sugar cane
ACTC	Truck crops
AFDF	Dairy farms
AMCT	Citrus
APIM	Improved pasture

Forested Uplands

FEPF	Pine flatwoods
FM	Mixed forested
FMCO	Cabbage palms/Oaks
FMDF	Old fields forested
FMPC	Pine/Cabbage palms

Water Bodies

H	Water

Grassland

RG	Grassland

Scrub and Brushland

RSPP	Palmetto prairies
RSSB	Brushland

Commercial and Services

UCMC	Marine commercial (Marinas)
UCSS	Sales and services

Industrial

UI	Industrial

Open and Other

UOCM	Cemeteries
UOGC	Golf courses
UOPK	Parks
UOUN	Open and undeveloped within urban area

Residential/Institutional/Transportation

URMF	Multi-family building
URMH	Mobile homes
URSL	Single-family, Low Density (under 2 D.U./gross acre)
URSM	Single-family, Medium Density (under 2 to 5 D.U./gross acre)
USED	Educational
UTAG	Small grass airports
UTEP	Electrical power facilities
UTTL	Major highway and rights-of-way
UTWS	Water supply plants

Wetlands

WFCY	Cypress
WN	Non-forested fresh
WXPP	Pine and wet prairies
WFMX	Mixed forested

Barren Land

BL	Levees

Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

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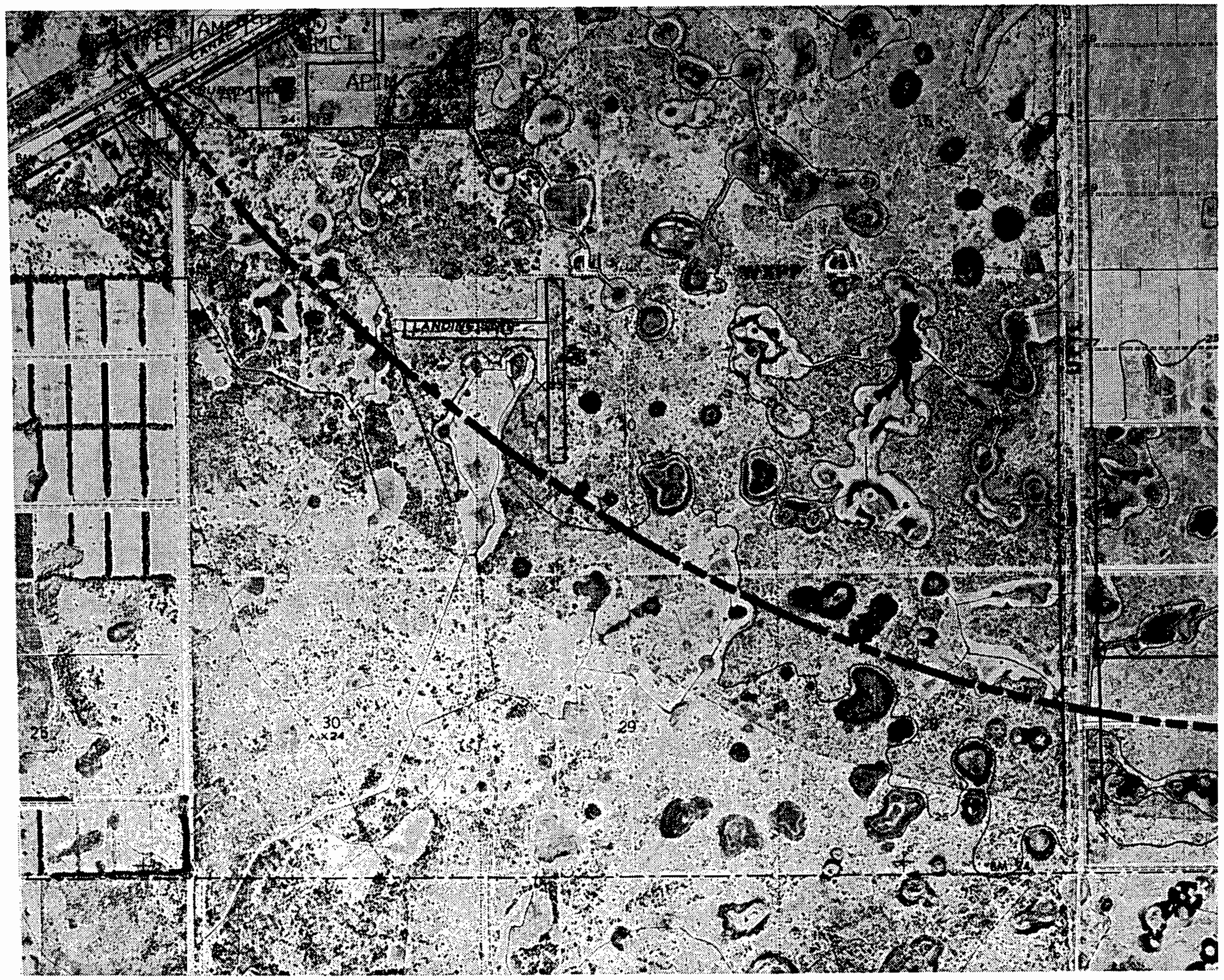
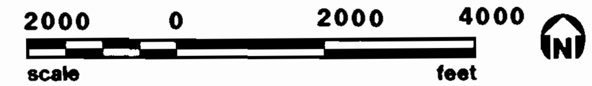
Indiantown Cogeneration, L.P.

Figure 2.2.3-3. (Page 9 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE





LEGEND

5-Mile Radius Study Area

Agriculture

ACSC Sugar cane
ACTC Truck crops
AFDF Dairy farms
AMCT Citrus
APIM Improved pasture

Forested Uplands

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UCSS Sales and services

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UOGC Golf courses
UOPK Parks
UOUN Open and undeveloped within urban area

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URSL Single-family, Low Density (under 2 D.U./gross acre)
URSM Single-family, Medium Density (under 2 to 5 D.U./gross acre)
USED Educational
UTAG Small grass airports
UTEP Electrical power facilities
UTTL Major highway and rights-of-way
UTWS Water supply plants

Wetlands

WFCY Cypress
WN Non-forested fresh
WXPP Pine and wet prairies
WFMX Mixed forested

Barren Land

BL Levees

Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

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Figure 2.2.3-3. (Page 10 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE

2000 0 2000 4000
scale feet

N

LEGEND

5-Mile Radius Study Area

Agriculture

- ACSC Sugar cane
- ACTC Truck crops
- AFDF Dairy farms
- AMCT Citrus
- APIM Improved pasture

Forested Uplands

- FEPF Pine flatwoods
- FM Mixed forested
- FMCD Cabbage palms/Oaks
- FMOF Old fields forested
- FMPC Pine/Cabbage palms

Water Bodies

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Grassland

- RG Grassland

Scrub and Brushland

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- RSSB Brushland

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- UOGC Golf courses
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- WFCY Cypress
- WN Non-forested fresh
- WXPP Pine and wet prairies
- WFMX Mixed forested

Barren Land

- BL Levees

Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

INDIANTOWN COGENERATION PROJECT

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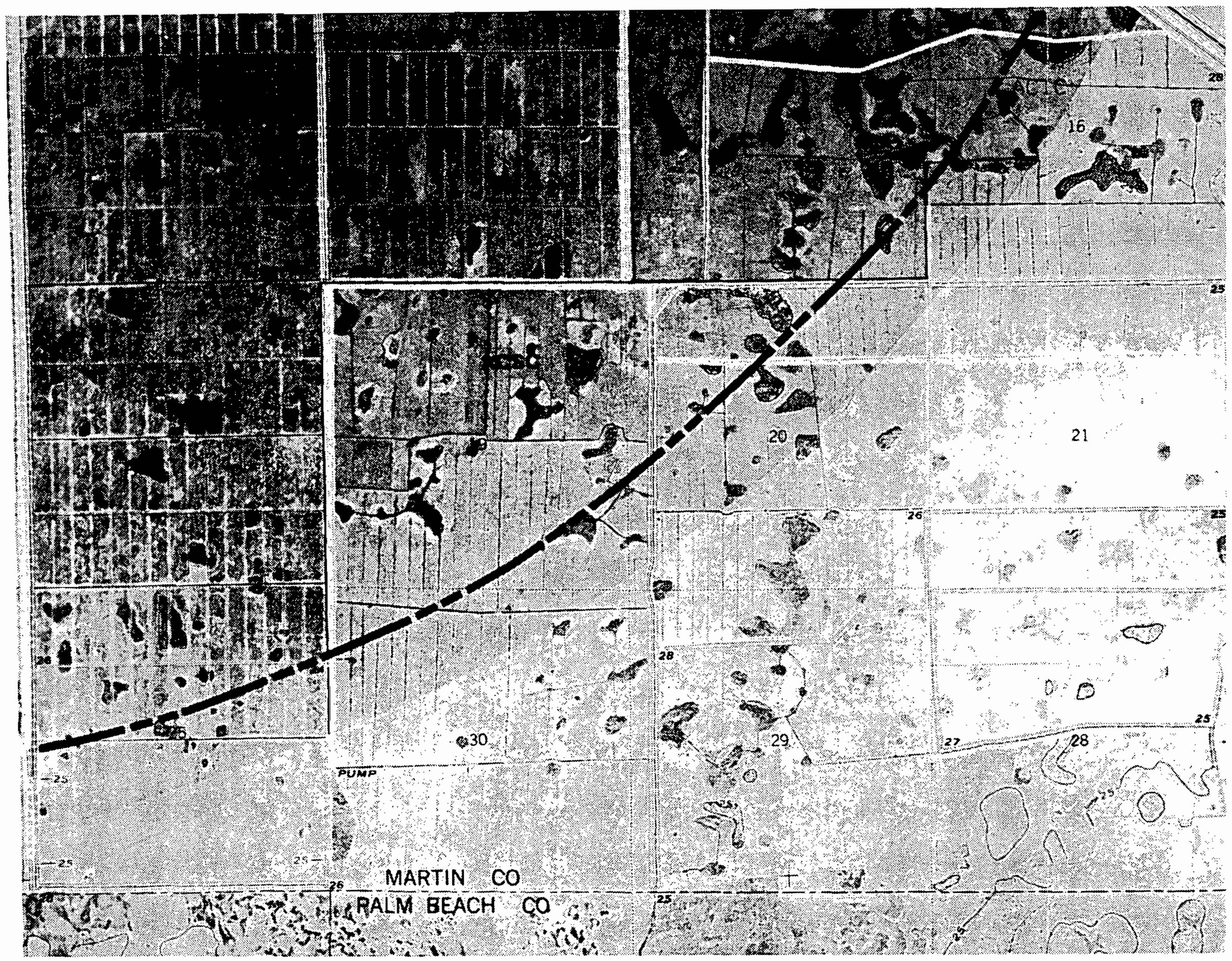
Figure 2.2.3-3. (Page 11 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



2000 0 2000 4000
scale feet
N

LEGEND

▬ ▬ ▬ 5-Mile Radius Study Area

Agriculture

ACSC	Sugar cane
ACTC	Truck crops
AFDF	Dairy farms
AMCT	Citrus
APIM	Improved pasture

Forested Uplands

FEPF	Pine flatwoods
FM	Mixed forested
FMCO	Cabbage palms/Oaks
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FMPC	Pine/Cabbage palms

Water Bodies

H	Water

Grassland

RG	Grassland

Scrub and Brushland

RSPP	Palmetto prairies
RSSB	Brushland

Commercial and Services

UCMC	Marine commercial (Marinas)
UCSS	Sales and services

Industrial

UI	Industrial

Open and Other

UOCM	Cemeteries
UOGC	Golf courses
UOPK	Parks
UOUN	Open and undeveloped within urban area

Residential

URMF	Multi-family building
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UTTL	Major highway and rights-of-way
UTWS	Water supply plants

Wetlands

WFCY	Cypress
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WXPP	Pine and wet prairies
WFMX	Mixed forested

Barren Land

BL	Levees

Sources: USGS, 1983. SFWMD, 1986. ECT, 1990.

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Table 2.2.3-2
LAND USES FOUND WITHIN THE 5-MILE STUDY AREA OF THE ICL SITE

Agricultural

- Unimproved pasture
- Citrus groves
- Sugar cane
- Truck crops cropland

Residential

- Single-family, low density (less than 2 DU/GA)
- Single-family, medium density (2 to 5 DU/GA)
- Multi-family
- Mobile home

Commercial and services

- Sales and services
- Cultural and entertainment
- Marine commercial

Industrial

Institutional

- Educational

Transportation

- Small grass airports
- Electrical power facilities
- Major transmission lines

Open and others

- Golf courses
- Parks
- Cemeteries
- Open and undeveloped within urban areas

Sources: SFWMD Land Use and Land Cover Classification Code, no date.
ECT, 1990.

categorized within citrus groves and unimproved land uses. A few comparatively small agricultural areas within the 5-mile study area are utilized for cropland land uses including sugar cane and truck crops.

Developed lands classified as urban and built-up land are found in three primary areas within the 5-mile radius study area: in the existing FPL Martin electric generating facility located to the northwest; the Caulkins Indiantown Citrus plant, the Bay State Milling Company, and an abandoned FSC site adjacent to the ICL site; and in the unincorporated community of Indiantown. The FPL plant is categorized broadly under the transportation classification and is specifically designated as an electrical power facility. The FPL site also has associated major transmission lines located within the 5-mile radius. The Caulkins Indiantown Citrus Company operates a processing plant directly adjacent to the ICL site, which is categorized as an industrial land use by the SFWMD Land Use and Land Cover Classification Code. FSC also has industrial property located directly adjacent to the ICL site. However, though structures currently exist on the adjacent FSC site, the buildings are abandoned and no steel processing or manufacturing takes place.

The majority of urban or built-up lands within the 5-mile radius are located within the unincorporated community of Indiantown. The general pattern of development in Indiantown consists of residential uses formed around a linear strip of commercial services fronting SR 710. The majority of land uses adjacent to and behind the SR 710 commercial strip primarily consist of low and medium density single family and mobile home residential development. A more recent mobile home development, not shown on the SFWMD maps, is located adjacent to the Indianwood Golf and Country Club.

A few other land uses are located in scattered patterns in Indiantown, which include parks, institutional, and industrial. Several parks are contained in Indiantown and most notably include Big Mound Park and Kiwanis Park. Several institutional land uses are scattered among the commercial area and include the local fire station and several churches. A few industrial parcels are also located among the commercial area, as well as in relatively undeveloped portions and along the St. Lucie Canal.

2.2.3.4 Land Use Projections

Current land use designations within 1 mile of the project site boundary, as dictated by the Martin County CGMP, were previously shown in Figure 2.2.1-1. With the exception of the unincorporated community of Indiantown, the majority of the land within the 5-mile study area is planned to remain in agricultural uses. Though less prevalent, other land use designations are located within the 5-mile study area and include low density residential (less than two dwelling units per acre), an industrial area from the project site east toward Indiantown, and public utilities land use designation for the FPL Martin site located west of the ICL project (Martin County Future Land Use Maps, 1990).

Within Indiantown, a variety of future land use categories are designated, which directly correlate to land use patterns previously discussed in Section 2.3.3.3. Though a variety of future land use designations exist within Indiantown, these projected patterns of land development closely follow the existing character and will not bring about any substantial change. Because of the relatively developed nature of Indiantown, future development will primarily consist of the infilling of currently vacant parcels of land.

2.2.4 EASEMENTS, TITLE, AND AGENCY WORKS

No easement, title, or crossing approval other than those required for the water pipeline are required from any governmental agency. For a discussion of the water pipeline, see Section 6.2.

2.2.5 REGIONAL SCENIC, CULTURAL, AND NATURAL LANDMARKS

As previously discussed in Section 2.2.1, only one area valued for its natural, scenic, or cultural significance lies within the 5-mile radius study area for the ICL project. This natural feature, Barley Barber Swamp, is a 400-acre freshwater cypress swamp located adjacent to the Martin FPL power plant cooling pond. This natural feature is managed by FPL as a nature preserve, and is open to the public by appointment.

2.2.6 ARCHAEOLOGICAL AND HISTORIC SITES

A comprehensive evaluation of archaeological and historic resources within the ICL site was conducted by Piper Archaeological Research, Inc., and is presented in Section 10.8.

The methodology utilized for the assessment of cultural and archaeological resources is in accordance with guidelines established in the Historic Preservation Compliance Review Procedures of the Florida Department of State, Division of Historical Resources, Final Draft, 1990. In addition, the assessment was based on a comprehensive, detailed site evaluation of the ICL project site, as opposed to a random sample site area review. The general methodology, including the comprehensive field review techniques, were discussed and verbally approved by a representative of the Florida Department of State, Department of Historical Resources (DHR) prior to research and site assessment (Piper, 1990).

This research found no previously recorded archaeological sites, and a low probability of finding additional significant historical resources on the project site. No archaeological or historic sites eligible for inclusion on the National Register of Historic Places were found during research and assessment (Piper, 1990).

Prehistoric earthen embankments were found in the vicinity of the Barley Barber Swamp, approximately 5 miles west of the project site. However, during field evaluation, no similar mounds were found on the project site (Piper, 1990).

2.2.7 SOCIOECONOMICS AND PUBLIC SERVICES

2.2.7.1 Study Area Definition

The study area for the analysis of existing baseline socioeconomic and public services conditions in this section is Martin County. As shown on Figure 2.2.7-1, Martin County is bordered by the Atlantic Ocean to the east, Lake Okeechobee to the west, Palm Beach County to the south, St. Lucie County to the north, and Okeechobee County to the northwest.

Martin County is expected to be the primary area to experience potential socioeconomic and public services effects resulting from the construction and operation of the project. As discussed in Section 7.0, overall, these potential effects are expected to be beneficial to the county's economy, primarily due to increases in employment opportunities and the county's tax base and revenues. Potential socioeconomic and public services effects of a proposed power plant in an area are related to the expected permanent in-migration and settlement patterns of workers who fill the new employment opportunities created by the project and their families.

Based on the temporary nature of construction employment and the size of the available workforce within a reasonable commuting distance from the site, only a minimal number of persons are expected to relocate to Martin County or adjacent counties during construction of the ICL project. In addition, ICL will initiate programs to encourage car pooling and, possibly, private busing services to further reduce the potential for changes and related effects in workforce in-migration patterns in Martin County and the region. Therefore, Martin County is expected to be the primary area to experience temporary, potential socioeconomic effects during the construction of the ICL project.

The ICL project will employ a total operational workforce of 80 persons. This number of permanent employees, while beneficial in creating new job opportunities,

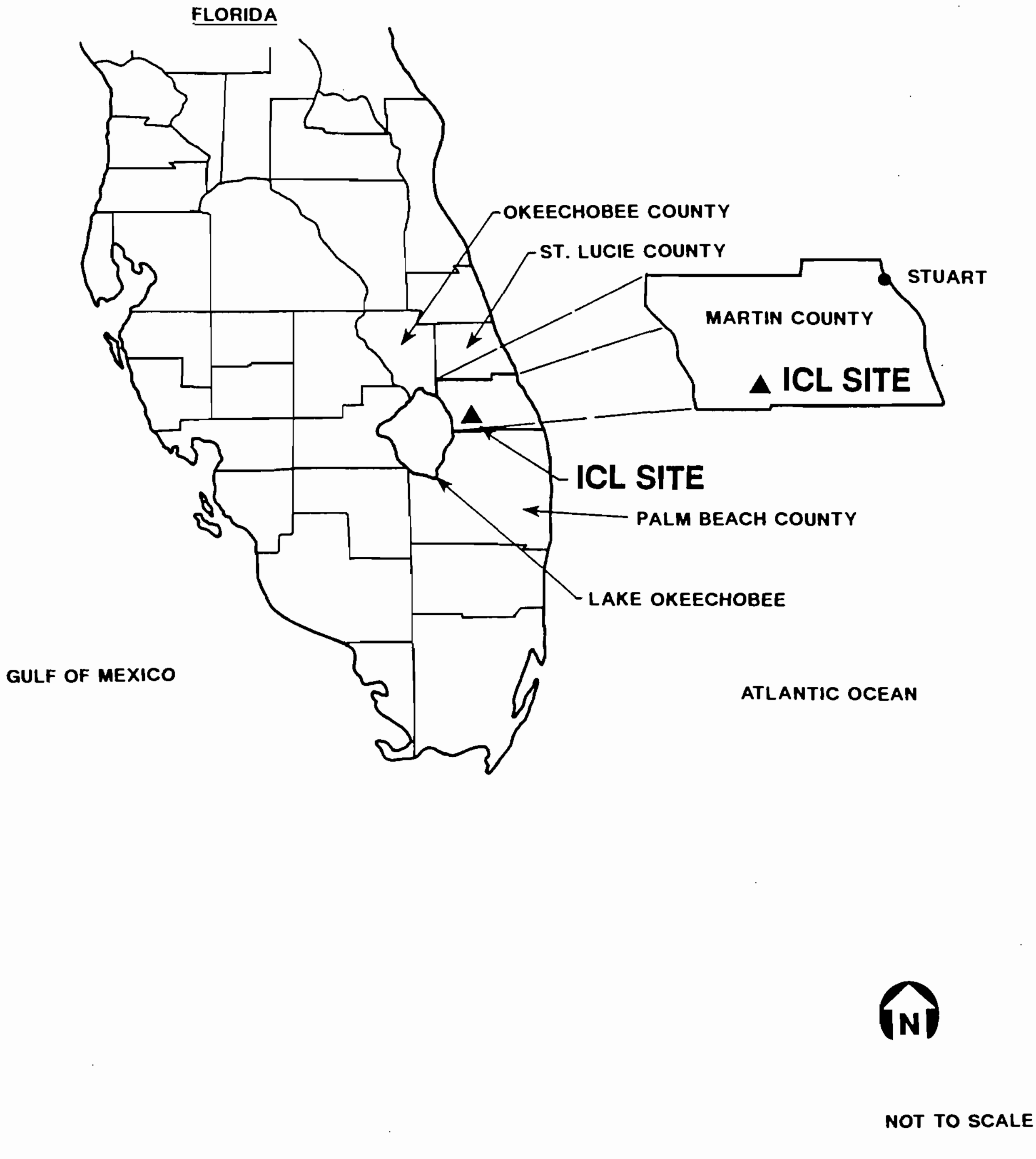

Figure 2.2.7-1
SOCIOECONOMIC STUDY AREA FOR THE INDIANTOWN COGENERATION PROJECT

Source: ECT, 1990.

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is small compared to the total population and workforce in Martin County. ICL will actively encourage the hiring of operational workers from the local Indiantown and Martin County areas. Also, ICL will encourage any workers hired from other areas to relocate and live in Martin County. Thus, any identifiable socioeconomic and public service effects resulting from the operation of the ICL project are expected to occur in Martin County.

Based on these considerations, the study area for the socioeconomic and public service baseline characteristic descriptions and affect analyses was focused on Martin County. Any potential effects resulting from the operational employment opportunities of the ICL project in other adjacent counties are expected to be negligible, although positive on the local economies.

2.2.7.2 Labor Force and Employment

The most current data regarding the labor force and employment in Martin County was obtained from the Florida Department of Labor and Employment Security, Bureau of Labor Market Information. Table 2.2.7-1 contains 1989 labor force and unemployment information for Martin County and, for comparison purposes, the state of Florida. The percentage of the population in the labor force in Martin County is lower than the statewide average, which is partially explained by the relatively larger number of retirees living in the county. The 1989 unemployment rate in Martin County is higher than the statewide rate.

Table 2.2.7-2 provides the 1987 baseline estimates for employment by occupation in Martin County and projected levels for the year 2000. As shown in this table, the production, operation, and maintenance occupational category was the largest occupational employment group for both 1987 and projected year 2000 levels.

Table 2.2.7-3 provides the estimated and projected employment in Martin County by industrial sector. In the county, the largest employment group for both 1987

Table 2.2.7-1
LABOR FORCE AND EMPLOYMENT (1989)

	Florida	Martin County
Population*	12,797,318	96,636
Labor force+	6,193,000	41,126
Labor force as percent of population	48.4	42.5
Percent unemployment	5.6	6.4

* Population figures as of April 1989.
+ Labor force represents the annual average.

Sources: Florida Department of Labor and Employment Security, 1990.
ECT, 1990.

Table 2.2.7-2
EXISTING AND PROJECTED EMPLOYMENT BY OCCUPATION, MARTIN COUNTY

Occupation Code	Occupation Title	1987 Total Employment	1987 Percent of Total	2000 Total Employment	2000 Percent of Total	Change in Employment	Percent Change
00000000	Total, all occupations	36,788	100.00	56,558	100.00	19,770	53.74
10000001	Managerial and management related	2,806 (6)	7.63	4,334 (6)	7.66	1,528	54.45
20000000	Professional, para-professional, technical	5,800 (3)	15.77	8,700 (4)	15.38	2,900	50.00
40000269	Sales and related	4,526 (5)	12.30	7,523 (5)	13.30	2,997	66.21
50000293	Clerical and administrative support	5,749 (4)	15.63	8,723 (3)	15.42	2,974	51.73
60000396	Service	6,324 (2)	17.19	10,414 (2)	18.42	4,090	64.67
70010494	Agriculture, forestry, fishing	2,575 (7)	6.99	3,125 (7)	5.52	550	21.35
80000000	Production, operation, maintenance	9,008 (1)	24.49	13,739 (1)	24.30	4,731	52.52

Note: ( ) = ranking.

Sources: Florida Department of Labor and Employment Security, Bureau of Labor Market Information, 1990.
ECT, 1990.

Table 2.2.7-3
ESTIMATED AND PROJECTED EMPLOYMENT BY INDUSTRIAL SECTOR
(PAGE 1 OF 2)

SIC Industry Code	Industry	Martin County			
		1987 Annual Average Employment	Projected Employment	Change in Employment	Percent Change
01 - 99	Total all industries	36,781	56,558	19,777	53.77
01 - 09	Agriculture, forestry, and fishing	2,292 (6.3%) [7]	2,778 (4.9%) [7]	486	21.20
10 - 14	Mining	0 (0%) [10]	0 (0%) [10]	0	0
15 - 17	Construction	3,916 (10.6%) [3]	5,924 (10.4%) [3]	2,008	51.28
20 - 39	Manufacturing	3,410 (9.3%) [5]	5,229 (9.4%) [5]	1,819	53.54
40 - 49	Transportation, communication, and utilities	1,428 (3.9%) [2]	2,014 (3.5%) [9]	586	41.04
50 - 59	Wholesale and retail trade	8,464 (23.0%) [2]	14,003 (24.7%) [2]	5,539	65.44
60 - 67	Finance, insurance, and real estate	2,499 (6.7%) [6]	3,847 (6.8%) [6]	1,348	53.94

Table 2.2.7-3
ESTIMATED AND PROJECTED EMPLOYMENT BY INDUSTRIAL SECTOR
(PAGE 2 OF 2)

		Martin County			
SIC Industry Code	Industry	1987 Annual Average Employment	Projected Employment	Change in Employment	Percent Change
70 - 89	Services	9,237 (25.1%) [1]	14,996 (26.5%) [1]	5,759	62.35
91- 97	Government	1,754 (4.8%) [8]	2,491 (4.9%) [8]	737	42.02
99	Self-employed, unpaid family, workers, private households	3,781 (10.3%) [4]	5,276 (9.4%) [4]	1,495	39.54

Note: ( ) = percentage of total.
[ ] = ranking.

Sources: Florida Department of Labor and Employment Security, Bureau of Labor Market Information, 1990.
ECT, 1990.

and projected in 2000 timeframes is within the services sector; the second largest sector is wholesale and retail trade.

2.2.7.3 General Income Characteristics

A description of general income characteristics, including per capita income, is shown in Table 2.2.7-4. As shown in this table, the Martin County per capita income is 26 percent higher than the statewide average. This is mainly due to the relatively high percentage of income generated by retirement benefits and also from dividends, interest, and rent.

Average wage and salary information as derived by the Florida Department of Labor and Employment Security is shown in Table 2.2.7-5. The average annual wages for covered workers for all industries is approximately 6 percent lower in Martin County than the statewide average. The two categories of industries with the highest average annual wages for Martin County are transportation, communication, and public utilities; and federal government.

Projected numbers of households by income group in Martin County for the years 1995, 2000, and 2005 are shown in Table 2.2.7-6. This information is based on data contained in the Martin County CGMP.

2.2.7.4 Existing Housing Stock

Changes in the existing inventory of housing within Martin County have directly reflected the growth patterns in population. During the period from 1980 to 1987, total single-family and multi-family dwelling units increased 45 percent, from 34,000 units to 49,337 units in January 1987. This growth represented an approximate annual average growth rate of 2,200 units for the entire county and 1,900 units for unincorporated areas of the county (Martin County CGMP, 1990).

Table 2.2.7-4
GENERAL INCOME CHARACTERISTICS, 1988

	State of Florida ($)	Martin County ($)
Total personal income	204,855,400	2,150,980
Per capita income	16,607	22,450
Total earnings	130,087,000	958,222
Transfer payments	32,161,620	283,135
Dividends, interest, and rent	50,483,260	856,109

Sources: University of Florida Bureau of Economic and Business Research, 1990. U.S. Department of Commerce, Bureau of Economic Analysis, unpublished data.

Table 2.2.7-5
AVERAGE ANNUAL WAGES OF WORKERS COVERED BY UNEMPLOYMENT COMPENSATION BY INDUSTRY AND COUNTY, 1987

	Martin County ($)	State of Florida ($)
All industries	18,860	20,065
Agriculture	13,369	24,455
Mining	--	28,314
Construction	22,636	20,979
Manufacturing	24,745	24,248
Transportation, communication, and public utilities	28,693	26,477
Wholesale	24,176	27,077
Retail	12,257	12,373
Finance, insurance, and real estate	25,653	24,936
Services	20,528	19,907
Government		
Federal	26,684	28,138
State	22,031	20,174
Local	18,241	22,549

Sources: Florida Department of Labor and Employment Security, Bureau of Labor Market Information, 1990.
ECT, 1990.

Table 2.2.7-6
PROJECTED NUMBER OF HOUSEHOLDS BY INCOME

Year	Under $5,000	$5,000 to $9,999	$10,000 to $14,999	$15,000 to $19,999	$20,000 to $24,999	$25,000 to $34,999	$35,000 to $49,999	$50,000 to and above
Martin County								
1995	4,570	6,076	5,072	5,172	5,172	5,373	5,976	6,578
2000	5,116	6,802	5,678	5,790	5,790	6,015	6,690	7,364
2005	5,583	7,432	6,196	6,318	6,318	6,564	7,300	8,036

Source: Martin County CGMP, 1990
ECT, 1990

The Martin County Growth Management Department conducted a windshield survey in July 1987, to determine the amount of substandard housing units within the county. At that time, it was found that 0.65 percent of the unincorporated county's housing stock, or 321 units, were found to be substandard (Martin County CGMP, 1990). Within the Martin County Comprehensive Plan, the priority of resolving the substandard housing issue was emphasized. Within the Indiantown Action Plan, resolving the presence of substandard housing units was also emphasized. Within this document, it was estimated that 71 percent of the total substandard housing units within Martin County were located in southern and western portions of the county (Indiantown Action Plan, 1990). In addition, the Indiantown Action Plan also estimated that approximately 16 percent of the total 1,627 housing units in Indiantown were overcrowded, having more than 1.01 persons per room (Indiantown Action Plan, 1990). The Indiantown Action Plan also stated that 56 percent of the total dwelling units within Indiantown were constructed prior to 1970, as compared to 38 percent for all of Martin County (Indiantown Action Plan, 1990).

A substantial residential element in Indiantown is the migrant camps, which may house as many as 3,500 Guatemalan Indian migrant farm workers. The majority of these workers live in these camps which include Blue Camp, White Camp, Goat Camp, and Waynesboro (Indiantown Action Plan, 1990).

The largest residential development in Indiantown is the planned unit development of the Indianwood mobile home park. This development primarily caters to retirees, and contains an adjacent 125-acre golf course. All of the units in Indianwood are considered to be in good condition, and the development is planned to expand an additional 1,465 units on 565 acres (Indiantown Action Plan, 1990).

Housing Costs

The average selling prices of homes within Martin County are shown in Table 2.2.7-7. This table shows that the largest percentage (i.e., 24.3 percent) of single-family homes by selling price increment were those homes valued over $100,000. The second largest grouping of homes by selling price was the $50,000 to $74,000 group, which represented 22.9 percent of the total homes. For multi-family units, the largest grouping by selling price increment was the $50,000 to $74,000 group, which represented 29.4 percent of the total units. These values do not reflect the overall low to moderate income economic character of the Indiantown community, whose average price for single-family units was $56,000, the lowest of all areas in the county (Indiantown Action Plan, 1990). This relatively low housing value reflects the high percentage of low income households within unincorporated Martin County. As shown in Table 2.2.7-8, the total percentage of households earning less than $15,200 in unincorporated Martin County was 31.3 percent (Indiantown Action Plan, 1990).

Building Activity

Building activity in Martin County for the years 1980 to 1986 is shown in Table 2.2.7-9. For the year 1989, Martin County experienced an increase of 1,501 single-family homes and 659 multifamily homes (Bureau of Economic and Business Research, 1990).

2.2.7.5 Education

Information regarding public education characteristics for Martin County is provided in Table 2.2.7-10. Martin County has its own board of education with jurisdiction over each public school. Although the Florida Department of Education has not established a minimum ratio for teachers to students, the fall 1989 statewide average teacher/student ratio is 1 to 17.18 (Florida Department of Education,

Table 2.2.7-7
SELLING PRICE OF HOUSING UNITS BY TYPE, MARTIN COUNTY, 1981 TO 1986

Price	Single-Family		Multifamily		Total	
(in $1,000)	No.	Percent	No.	Percent	No.	Percent
<25	1,240	19.4	436	8.9	1,676	14.8
25 - 49	1,268	19.8	952	19.5	2,220	19.7
50 - 74	1,466	22.9	1,853	37.9	3,319	29.4
75 - 99	867	13.6	493	10.1	1,360	12.1
100 >	1,561	24.3	1,155	23.6	2,716	24.0
TOTAL	**6,402**	**100.0**	**4,889**	**100.0**	**11,291**	**100.0**

Source: Martin County CGMP, Martin County Property Appraiser's 1986 Tax Roll, 1990.

Table 2.2.7-8
AFFORDABLE RENTS AND HOME PURCHASE PRICES, BASED ON INCOME DISTRIBUTION OF PROJECTED NEW HOUSEHOLDS FOR UNINCORPORATED MARTIN COUNTY, 1987

Category	Percent Households	Mid-Point	Monthly Rent	Purchase Price
Very low income households				
Under $7,400	12.1	5,000	$104	$13,500
7,400 to 11,000	9.1	9,250	193	24,975
11,101 to 15,200	10.1	13,151	274	35,508
SUBTOTAL	31.3			
Low income households				
15,201 to 24,390	20.6	19,796	412	53,449
Moderate income households				
24,391 to 29,670	10.7	27,031	563	72,984
29,671 to 37,090	11.9	33,381	695	90,129
SUBTOTAL	22.6			
Middle and high income households				
37,091 to 51,920	13.4	44,505	927	120,163
51,921 to 74,180	7.0	63,050	1,314	170,235
74181 +	5.1	74,101	1,544	200,073
SUBTOTAL	25.5			
SUBTOTAL	**100.0**			

Note: The mid-point or average income in each range was used (with the exception of the lowest and highest ranges) to calculate affordable rent or the purchase price of a home for each income range. Median home for the Martin County area as of January 1988 is $27,700 (U.S. Department of Housing and Urban Development). It was assumed that 90 percent of all households desired to purchase and that it may be practical to accommodate this demand, except for very low income households, where 100 percent of demand was calculated for rental use.

Source: Martin County CGMP, 1990.

Table 2.2.7-9
BUILDING ACTIVITY, 1980 TO 1986

	1980	1981	1982	1983	1984	1985	1986	Total
Martin County								
Single-family	937	777	597	934	871	918	1,066	6,100
Multi-family	1,345	1,681	783	1,203	942	854	1,045	7,933
Mobile home	148	208	159	228	177	198	186	1,304

Note: NA = not available.

Source: Bureau of Economic and Business Research, 1990
ECT, 1990

Table 2.2.7-10
PUBLIC EDUCATION SYSTEM CHARACTERISTICS, 1990

	Martin County
Elementary schools	8
Elementary school students	5,618
Middle schools	3
Middle school students	2,571
High schools	3
High school students	3,233
Teacher/student overall ratio	1:15.75

Sources: Martin County Board of Education, 1990.
Florida Department of Education, Management Information Systems, 1990.
ECT, 1990.

1990). Martin County's overall teacher/student ratio is slightly lower (i.e., better) at 1:15.75.

Martin County has recently completed the construction of one new elementary school which opened in the fall of 1990. No additional new schools are planned at this time (Martin County Board of Education, 1990).

2.2.7.6 Transportation

Existing Transportation Networks

Major transportation facilities within Martin County are shown on Figure 2.2.7-2, and described in Table 2.2.7-11.

In Martin County, the two major highway transportation corridors are the Florida Turnpike and Interstate (I) 95, which provide north-south movement. Both facilities operate at Level of Service (LOS) A, indicating a generally free flow of traffic, and the least level of congestion on the A to F scale. Both of these roadways are multi-laned, limited access facilities. Western Martin County's major arterial is SR 710, a two-lane undivided facility, which operates at LOS A.

Additional roadway networks servicing Martin County as shown in Figure 2.2.7-2 include the principal arterials of U.S. Highway (U.S.) 1 and SR 714, and the collector SR A1A. Segments of U.S. 1, SR A1A, and SR 714 operate below acceptable LOS, at either E or F, and these deficiencies have been identified within the Martin County CGMP. Roadway improvements are planned to upgrade the segments' capacities to acceptable LOS (Martin CGMP, 1990).

Within Martin County, two rail lines are operated by the Florida East Coast (FEC) Railway, consisting of a main freight line which roughly parallels the Atlantic coastline, and a secondary track running northeasterly from the Palm Beach County line across SR 710 into St. Lucie County. These two rail lines provide

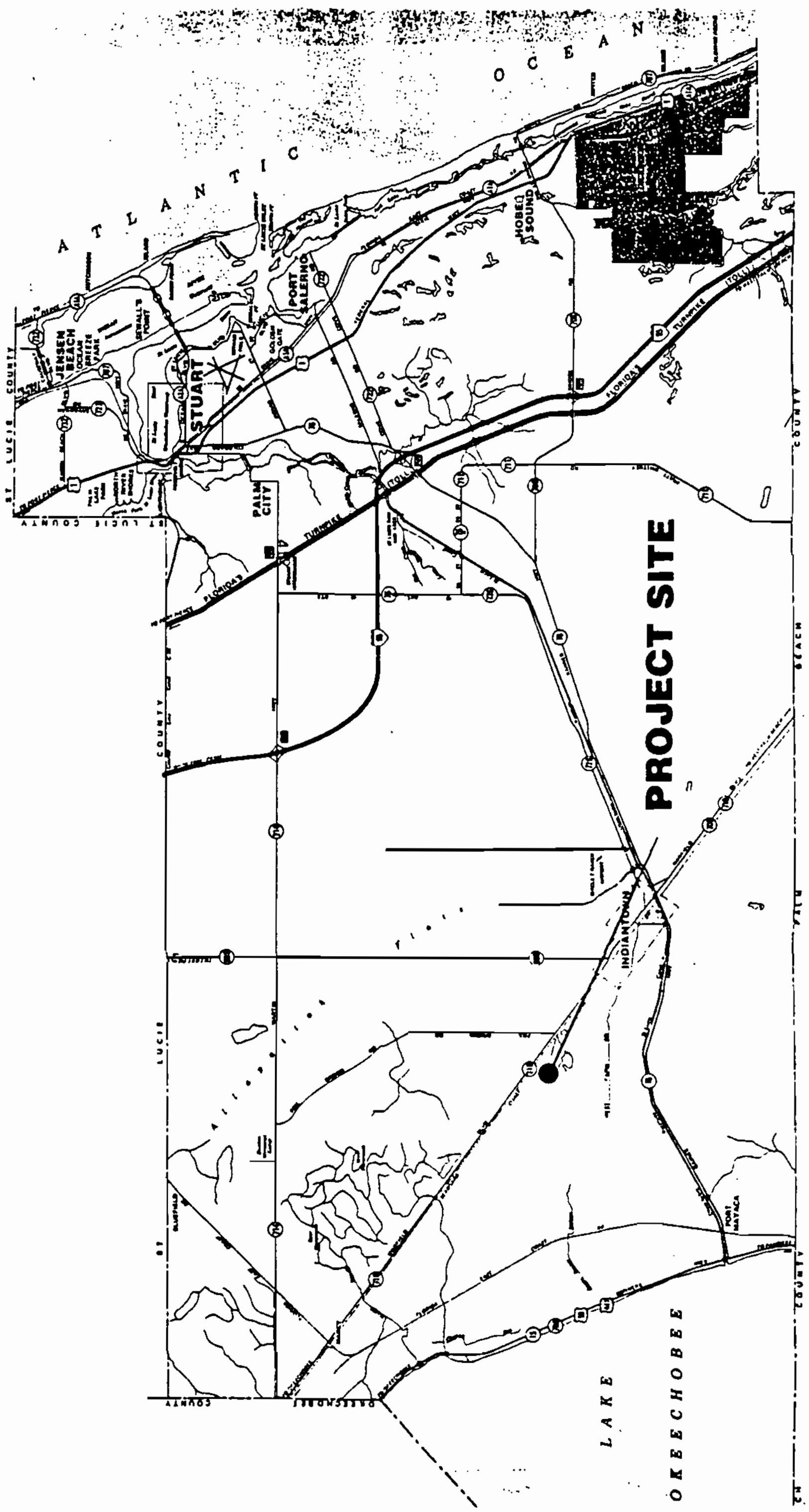

Figure 2.2.7-2.

MAJOR HIGHWAYS IN MARTIN COUNTY

Source: AAA, 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.

Table 2.2.7-11
MAJOR TRANSPORTATION FACILITIES IN MARTIN COUNTY

Facility	Martin County
Major north/south routes	I-95 Florida Turnpike
Major east/west routes	SR 710 SR 76 SR 714
Proposed or adopted county-wide LOS	Urban service area, LOS D; all others, LOS C
Mass transit	COA shuttle
Airports	Witham Field; Indiantown Airport
Average no. of aircraft operations per day	246
Rail--passenger service	None
Proposed Florida High-Speed Rail	Yes
Freight service	FEC CSX

Sources: ECT, 1990.

freight service between Jacksonville, Tampa, and Miami. The CSX Railroad and Amtrak share service along a third rail line which parallels SR 710.

The Florida High Speed Rail Corporation (FHSRC) has proposed a corridor which traverses Martin County along SR 710 from the Palm Beach County line through Indiantown to a point approximately 1 mile past the project site, where it turns north into St. Lucie County. No stations are planned for Martin County at this time (Martin County CGMP, 1990).

The Council on Aging (COA) provides a shuttle transit service within Martin County. Round-trip service from Indiantown to Stuart is provided each Monday, Wednesday, and Friday excluding holidays; service within Indiantown is provided on Thursdays. The primary public transportation service area within Martin County covers an area from the Atlantic coast to approximately 2 miles west of the Florida Turnpike.

The long-range public transportation plans for Martin County include the expansion of service in several different capacities. These plans include the following: the expansion of local public transit service within the Stuart urban area; the expansion of shuttle service within Indiantown; the establishment of a fast-link express service connection to Palm Beach and St. Lucie Counties; the establishment of a subsidized public transportation system or comparable private enterprise system; the provision of transit links to proposed FHSRC stations planned for Palm Beach and St. Lucie Counties; and a connection to a potential Martin County station which may become part of the FHSRC's ultimate long-range plans (Martin County CGMP, 1990).

In terms of aviation transportation, Martin County is serviced by two public use airports, Witham Field and the Indiantown Airport (formerly the Circle "T" Ranch). Witham Field is located in the Stuart urban area, south of Monterey Road and east of Dixie Highway [County Road (CR) A1A], and is a county-owned facility leased to Grumman Aircraft Systems. Witham Field has 90,000 estimated annual aircraft operations. Indiantown Airport is closer in proximity to the project site, located north of CR 726 and east of CR 609, and is a privately-owned public use airport. Indiantown Airport has 10,000 estimated annual aircraft operations. One privately-owned, private use airport, Cox's Hammock, is located north of SR 710 and west of Fox Brown Road, and is in relatively close proximity to the project site (Martin County CGMP, 1990).

Programmed Transportation Improvements

Programmed improvements to roadways within Martin County to be implemented by the end of 1995 are shown in Figure 2.2.7-3. A complete listing of all transportation improvements planned for Martin County, as described in the Capital Improvements Element of the Martin County CGMP as well as in the FDOT and Florida Turnpike Five-Year Work Programs, are found in Section 10.6. The majority of programmed improvements in terms of road widening or new roadways to expand the existing capacity and levels of service are located east of I-95 in the urbanized areas of Stuart and Port Salerno.

According to the current FDOT Five-Year Work Program for Martin County, a widening improvement is planned for a segment of SR 710 within Indiantown, and repaving is planned for essentially the entire remaining span of SR 710 within Martin County. As scheduled for implementation by the end of Fiscal Year (FY) 1993/1994, a widening improvement from two lanes to five lanes (center turn) for approximately 2.2 miles of SR 710, from west of 5th Street west of Adams Avenue within Indiantown is programmed.

The repaving of SR 710 from the St. Lucie Canal Bridge to SR 76 juncture, and from the SR 76 juncture to the Palm Beach County line is scheduled for FY 1992/1993 and FY 1990/1991, respectively. Construction is planned for FY 1992/1993 for the resurfacing and repaving of SR 710 from Hale Dairy Road/CR 609 east to the Okeechobee County line (FDOT, 1990).

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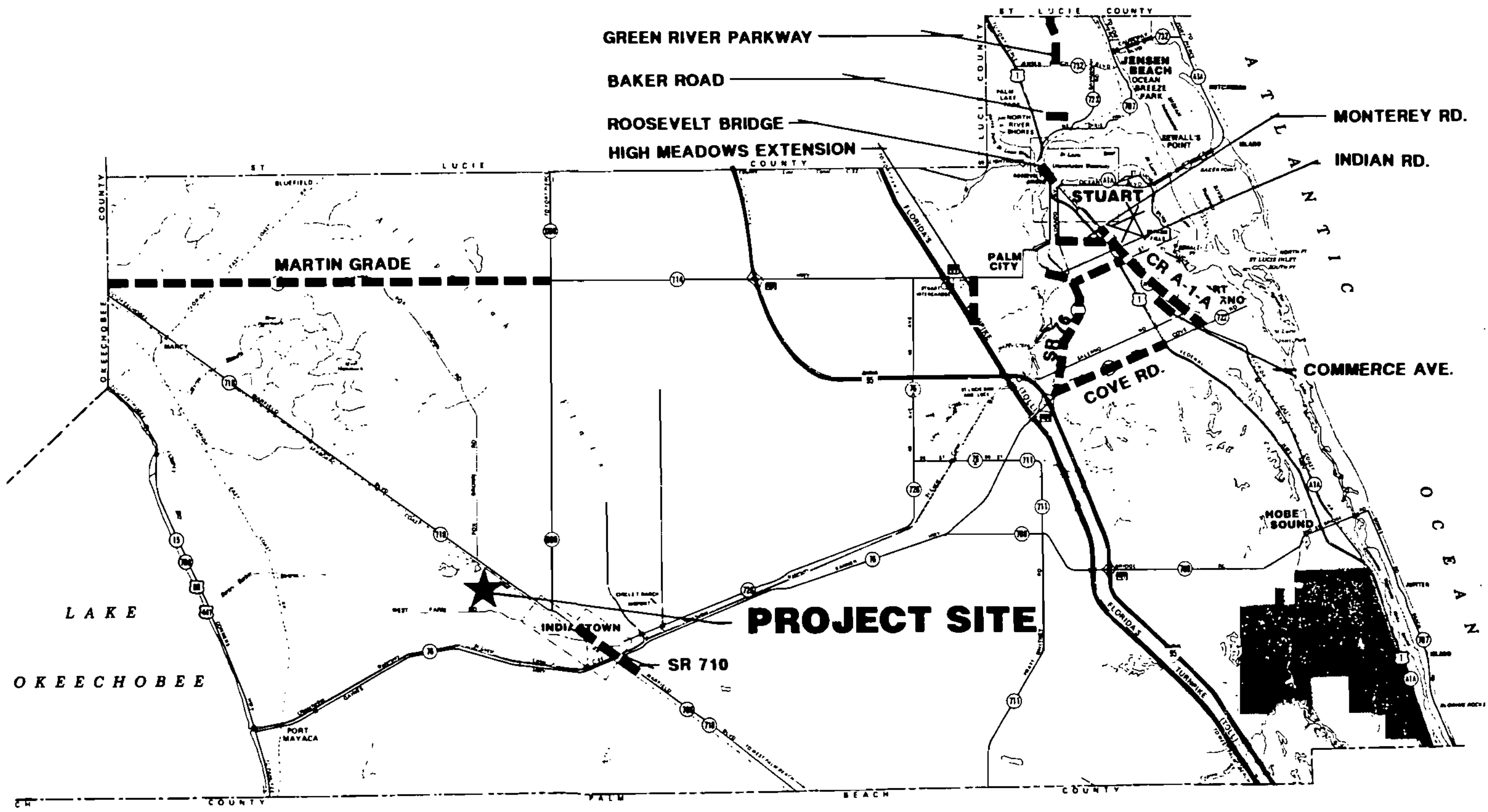

Figure 2.2.7-3.

PROGRAMMED ROADWAY IMPROVEMENTS WITHIN MARTIN COUNTY TO BE CONSTRUCTED BY 1995

Source: Traffic Circulation Element, Martin County Comprehensive Plan Update, 1990. ECT, 1990.

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

The remainder of programmed improvements within Martin County are associated with roadways located east of I-95, and will improve service within the urbanized areas of Stuart and Port Salerno.

The FDOT Five-Year Improvement Plan for Martin County has also identified $4,616,000 worth of improvements to be made to Witham Field Airport over the period FY 1990/1991 to 1994/1995.

2.2.7.7 Utilities and Public Services

Medical Services

The primary health care provider in Martin County is the Martin Memorial Hospital. As shown in Table 2.2.7-12, this hospital is licensed for 336 beds, staffed by approximately 180 physicians, and includes pediatric care and a 24-hour emergency room (Martin County Medical Society, 1990). The hospital is transferring 100 beds to a separate satellite facility located on Port Salerno Road in Port Salerno. This facility will also contain office space and laboratory facilities, and is expected to be completed and occupied by the end of October 1990 (Martin County Medical Society, 1990). This transfer will allow an increase in utilization of the facility by enabling the privatization of rooms. The Martin Memorial Hospital also operates the Coastal Medical Center, a private medical facility with full-time physician and nursing staff. Emergency medical services (EMS) are provided by emergency medical technicians located at each county fire station. The closest EMS-equipped fire station is located in Indiantown. Indiantown also has a public health clinic staffed one day per month by county health department staff.

The ratio of 214 physicians to 100,000 population for Martin County, as shown in Table 2.2.7-12, is below the national and state averages of 241 and 225, respectively (Martin County Medical Society, 1990). With the exception of the transfer of the beds within Martin Memorial Hospital, no expansion of medical

Table 2.2.7-12
PUBLIC SAFETY FACILITIES IN MARTIN COUNTY

	Martin County
<u>Medical</u>	
Hospitals	1
Hospital beds	336
Physicians	180
24-Hour physician-staffed emergency room	Yes
Physicians/100,000 population	214
<u>Firefighting Facilities</u>	
Fire stations	14
Firefighters	
Full-time	90
Volunteers	200
Firefighters/1,000 population	3.6
Average response time (minutes)	
Developed areas	5
Rural areas	10
<u>Law Enforcement</u>	
Sheriff's stations	2
Sworn officers	241
Patrol units	21
Officers/1,000 population	2.70
Auxiliary/volunteer officers	10-12
Average response time (minutes)	7-10

Sources: Martin County Medical Society, 1990.
Martin County Sheriff's Department, 1990.
Martin County Fire Department, 1990.

facilities is planned for Martin County (Florida Department of Health and Rehabilitative Services Monitoring Department, 1990).

Firefighting Facilities

Data regarding firefighting facilities is shown in Table 2.2.7-12. Martin County utilizes a combination of full-time firefighters in addition to trained volunteers. Within Martin County, the combined number of full-time and volunteer firefighters yields a ratio of 3.6 firefighters per 1,000 residents, which is above the national average of 2.2 (Martin County Fire Department, 1990).

The nearest full-time fire station to the project site is Station 50, located in Indiantown. This station is manned by 3 full-time firefighters in addition to volunteers. Another all-volunteer station manned by approximately 10 volunteers is located within the Booker Park area of Indiantown (Martin County Fire Department, 1990).

Law Enforcement

Data pertaining to existing law enforcement services for Martin County is shown in Table 2.2.7-12. Martin County has an officer-to-population ratio above the national standard of 2.2 officers per 1,000 population. The nearest station to the project is the Indiantown station, which is manned by 15 sworn officers (Martin County Sheriff's Department, 1990).

Recreational Facilities

Because of the presence of numerous rivers, Lake Okeechobee, and the Atlantic Ocean, many recreational opportunities are available to residents of Martin County. Martin County contains two regional and urban district parks, Jonathan Dickinson State Park and the St. Lucie Inlet Park (Martin County CGMP, 1990).

Martin County has identified, within their comprehensive plans, a LOS standard for providing recreational facilities. Martin County has recommended a recreational LOS standard of 2 acres per 1,000 residents (Martin CGMP, 1990). Based on this standard, Martin County has projected the need for 145 acres of parks by the year 2000 (Martin CGMP, 1990).

The nearest recreational facilities to the ICL project site are located within Indiantown. The total acreage of the five recreational facilities located within Indiantown equals 34 acres, with Big Mound Park accounting for 21 acres, or 61.7 percent of the total acreage (Martin County CGMP, 1990). Two of these five facilities are shared at school sites. The Indiantown Action Plan has proposed an additional 20-acre site for recreation to be located on county school board property along Southwest Farm Road across from the Indianwood Mobile Home Park (Indiantown Action Plan, 1990).

Electricity and Gas

FPL provides electricity to Martin County. The two major FPL power generation facilities within the regional area are the Martin site, and the nuclear powered facility located on Hutchinson Island.

Natural gas service to residential and commercial users is supplied by private suppliers. The principal suppliers are Tri-County Gas and Tropigas. Within Indiantown, the Indiantown Gas Company supplies services to residential and commercial users. ICL will purchase gas from this local supplier for the proposed project.

Water and Sanitary Sewer Facilities

Central water and sanitary sewage facilities in Martin County are provided by both private and public entities. Information regarding average daily flows and design capacities are shown for potable water and wastewater in Tables 2.2.7-13 and

Table 2.2.7-13
EXISTING POTABLE WATER FACILITIES IN MARTIN COUNTY, 1989

	Average Daily Flow (MGD)	Design Capacity (MGD)	Existing Size/ Population of Service Area
<u>Martin County</u>			
North Martin County (county)	2.01	3.80	17.1 mi^2/28,907
Port Salerno (county)	1.20	3.00	14 mi^2/29,386
Yacht and Country Club$^+$ (county)	0.50	0.50	*
City of Stuart (city)	3.45	6.00	5.5 mi^2/25,293
Martin Downs Utilities (private)	0.48	1.00	13 mi^2/13,234
Hydratech Utilities (private)	0.94	1.70	12.4 mi^2/11,865
Hobe Sound (private)	2.23	3.60	5.8 mi^2/4,713
Indiantown Utilities (private)	0.67	1.30	16 mi^2/6,714

* System is interconnected with Port Salerno service area.

Sources: Martin County CGMP, 1990.
Martin County Public Utilities Department, 1990.

2.2.7-14, respectively. The nearest potable water and wastewater facilities to the project site is the Indiantown Company in Indiantown. This private supplier serves an area slightly larger than the community of Indiantown (Martin County CGMP, 1990). As shown in Tables 2.2.7-13 and 2.2.7-14, the design capacities of both water and wastewater are above average daily flows.

Portions of Martin County are not within the service areas of public or private suppliers of potable water and wastewater services. In these areas, individual private wells and septic tanks are used.

Solid Waste Facilities

Solid waste collection in Martin County is provided primarily by private franchised hauling companies. However, within the incorporated area of Stuart, refuse collection is provided by the city.

Solid waste is deposited at a county-owned and operated landfill. The total capacity of Martin County's Palm City Landfill Number 2 is 320 acres, and has 258 acres of remaining capacity. This equates to approximately 80.6 percent available capacity, and has an anticipated closing in 2003 (Martin County Public Works Department, 1990).

2.2.7.8 County Revenues and Expenditures

A summary of revenues for Martin County for the fiscal year ending September 30, 1989 is provided in Table 2.2.7-15. This table illustrates that the major source of revenues are generated from taxes, which include ad valorem or personal property taxes, sales and franchise taxes, and utility services taxes.

A summary of Martin County's expenditures is shown in Table 2.2.7-16, for the fiscal year ending September 30, 1989. The greatest demand for expenditures was required for providing public safety, which includes law enforcement, fire control,

Table 2.2.7-14
EXISTING SANITARY SEWER FACILITIES IN MARTIN COUNTY, 1989

	Existing Daily Flow (MGD)	Design Capacity (MGD)
North Martin County (county)	1.20	0.60
Port Salerno (county)	0.80	1.00
City of Stuart (city)	1.56	3.00
Martin Downs Utilities (private)	0.34	0.50
Hydratech Utilities (private)	0.37	0.60
Indiantown Utilities (private)	0.41	1.0

Sources: Martin County CGMP, 1990.

Table 2.2.7-15
SUMMARY OF MARTIN COUNTY REVENUES, FISCAL YEAR ENDING SEPTEMBER 30, 1989

	Martin County
Population*	110,012
Taxes+	55,956,158
Licenses and permits	5,324,802
Intragovernmental revenue**	26,501,060
Charges for service	39,938,476
Fines and forfeitures	6,187,336
Miscellaneous revenue++	47,447,760
Other financing sources***	25,199,842
Total Revenues	205,555,434
Revenue per capita	1,868

* Based on Department of Banking and Finance population figures.
\+ Includes property, sales, franchise, and utility services taxes.
** Includes federal, state, and local grants and shared/pilot programs.
\++ Includes interest earnings, rents and royalties, special assessments, sales and compensation for assets, and contributions and donations.
*** Includes interfund transfers, contributions, dept proceeds, and trust fund receipt.

Sources: Florida Department of Banking and Finance, 1990.
ECT, 1990.

Table 2.2.7-16
SUMMARY OF MARTIN COUNTY REVENUES, FISCAL YEAR ENDING SEPTEMBER 30, 1989

	Martin County
Population	110,012
General governmental services	18,978,053
Public safety	37,404,127
Physical environment	16,582,821
Transportation	13,734,415
Economic environment	94,726
Human services	4,003,667
Culture and recreation	4,840,878
Debt service	11,838,863
Other*	10,789,767
Total	118,264,320
Expenditures per capita	1,075.01

*Includes interfund transfers and capital asset acquisitions.

Sources: Florida Department of Banking and Finance, 1990.
ECT, 1990.

detention or correction facilities, protective inspections, and ambulance and rescue services.

2.3 BIOPHYSICAL ENVIRONMENT

2.3.1 GEOHYDROLOGY

2.3.1.1 Geologic Description of the Site Area

The Indiantown Cogeneration, L.P. (ICL) site is in an area underlain by approximately 13,000 feet of sedimentary rock strata (Lichtler, 1960). The basement complex in this area consists of Paleozoic age igneous and metamorphic rocks about which little is known due to their great depth.

Overlying the basement complex to the ground surface are sedimentary rock strata and unconsolidated deposits that are primarily marine in origin. Below a depth of about 400 feet these rocks are predominantly limestone and dolomite, while above 400 feet the deposits are largely composed of sand, silt, or clay. The deepest formation in Martin County on which significant published data are available is the Eocene age Avon Park, although limited information is available from wells penetrating the underlying Lake City Formation (Lichtler, 1960). The published information on the sediments comprising the formations below the Avon Park Limestone in western Martin County is based on projections from deep wells in Okeechobee, St. Lucie, and Palm Beach Counties (Miller, 1986; Puri and Winston, 1974). Figure 2.3.1-1 is a stratigraphic section showing the Cenozoic age units present beneath Martin County. The combined thickness of these units is about 4,800 feet (Miller, 1986). Brief descriptions of the formations shown in this section are presented below.

Cedar Keys Formation

The lowermost Cenozoic unit is the Paleocene age Cedar Keys Formation which conformably overlies sediments deposited during the Late Cretaceous period. The Cedar Keys Formation in south Florida consists predominantly of dolomite, gypsum, and anhydrite, and is about 1,500 feet thick (Puri and Winston, 1974).

GEOLOGIC AGE	FORMATION/GROUP	AQUIFER
Post-Miocene	Pamlico Sand Fort Thompson/Anastasia Fms Caloosahatchee Marl	Surficial Aquifer (90-200' thick)
Miocene	Tamiami Formation	
	Hawthorn Group: Peace River Fm.; Arcardia Fm.	Confining Layers (350-600' thick) Top of Floridan Aquifer System (2800-3400' thick)
Oligocene	Suwannee Limestone	Producing Zone 1
Eocene	Ocala Limestone	Semi-permeable zone
	Avon Park Limestone	Producing Zone 2 Semi-permeable zone Producing Zones 3 and 4
	Lake City Limestone	Semi-permeable zone
	Oldsmar Formation	Boulder Zone
Paleocene	Cedar Keys Formation	Semi-permeable zone

Figure 2.3.1–1
GENERALIZED HYDROSTRATIGRAPHY OF MARTIN COUNTY (AFTER LICHTLER, 1960: BROWN AND REECE, 1979: JOHNSTON AND BUSH, 1988: SCOTT, 1988)

Source: FPL, 1989

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The upper third of the Cedar Keys Formation is generally characterized as a gray to cream, coarsely crystalline dolomite which is moderately to highly porous (Miller, 1986). The pores are commonly filled with gypsum (Stringfield, 1966). Interbedded tan to gray, finely crystalline to microcrystalline dolomite and white to clear anhydrite comprise the lower two thirds of the Cedar Keys Formation (Miller, 1986).

As shown on Figure 2.3.1-2, the top of the Paleocene age strata in the site area is at approximately El. -3,250 feet (Miller, 1986).

Oldsmar Formation

The Early Eocene age Oldsmar Formation conformably overlies the Cedar Keys Formation. The Oldsmar Formation is composed of off-white to light gray, very fine grained, pelletal limestone that is interbedded with gray, tan, and light brown, fine to medium crystalline dolomite which is commonly vuggy. The thickness of the limestone and dolomite interbeds is quite variable within the section. The lower part of the Oldsmar Formation is more extensively dolomitized than is the upper part (Miller, 1986). Within this lower part of the Oldsmar Formation in south Florida is a zone of extremely high transmissivity called the "Boulder Zone" due to its difficult drilling characteristics. This zone has developed an extensive cavernous permeability, as a result of the paleosolutioning of horizontal and vertical fractures, that allows it to be used for the underground injection of treated sewage and other industrial wastes.

The Oldsmar Formation extends throughout the peninsular area of Florida to the southeastern corner of Georgia. The top of the Early Eocene age strata, which corresponds to the top of the Oldsmar Formation, is at about El. -2,000 feet in the area of the ICL site (Figure 2.3.1-3). As determined from Figure 2.3.1-4, the thickness of this strata in Martin County varies from approximately 1,100 feet in the eastern part of the county to 1,200 feet in the area of the ICL site in western Martin County (Miller, 1986).

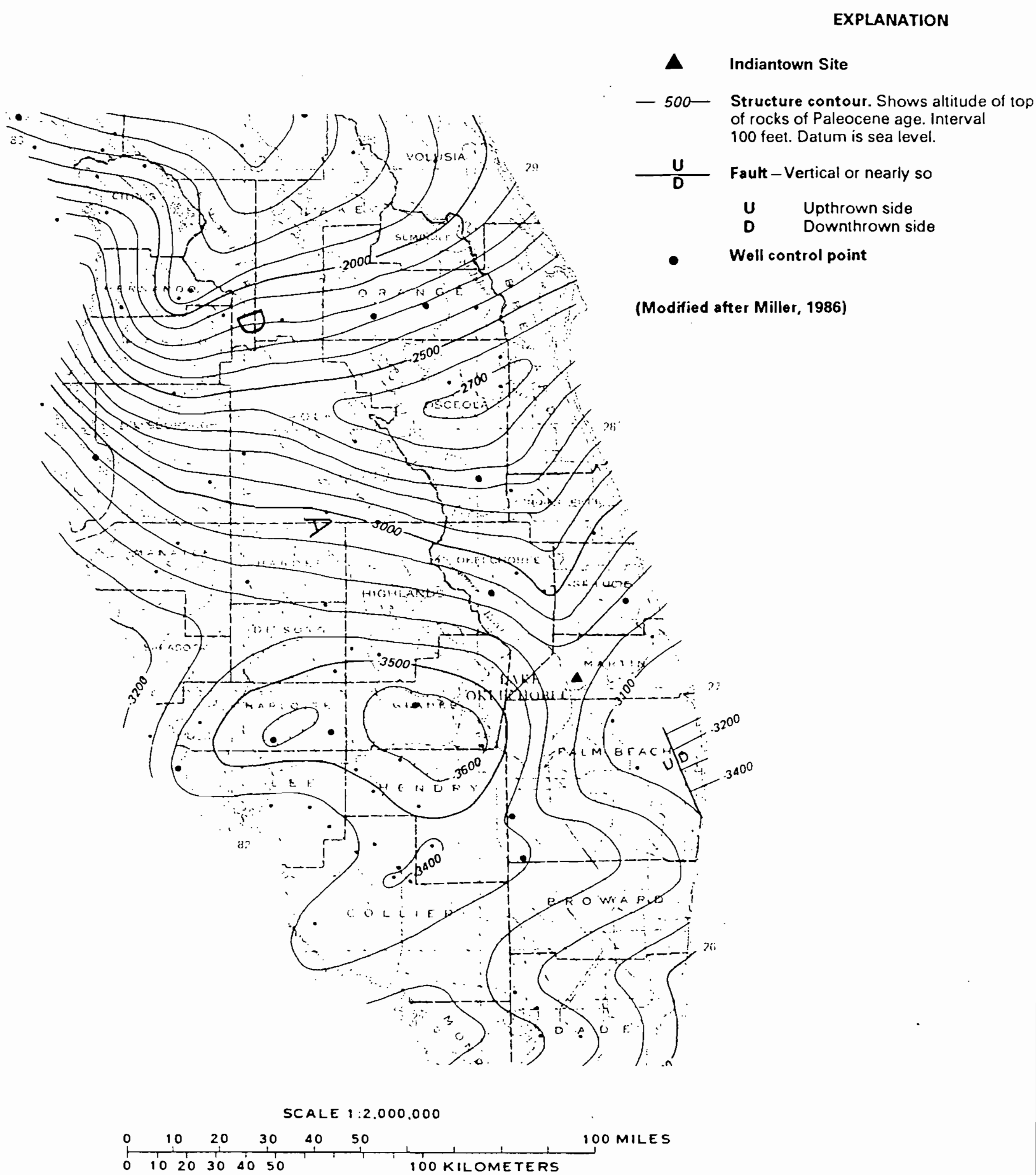

Figure 2.3.1-2.

STRUCTURE CONTOURS ON TOP OF PALEOCENE AGE STRATA (CORRESPONDS TO CEDAR KEYS FORMATION IN MARTIN COUNTY)

Source: FPL, 1989

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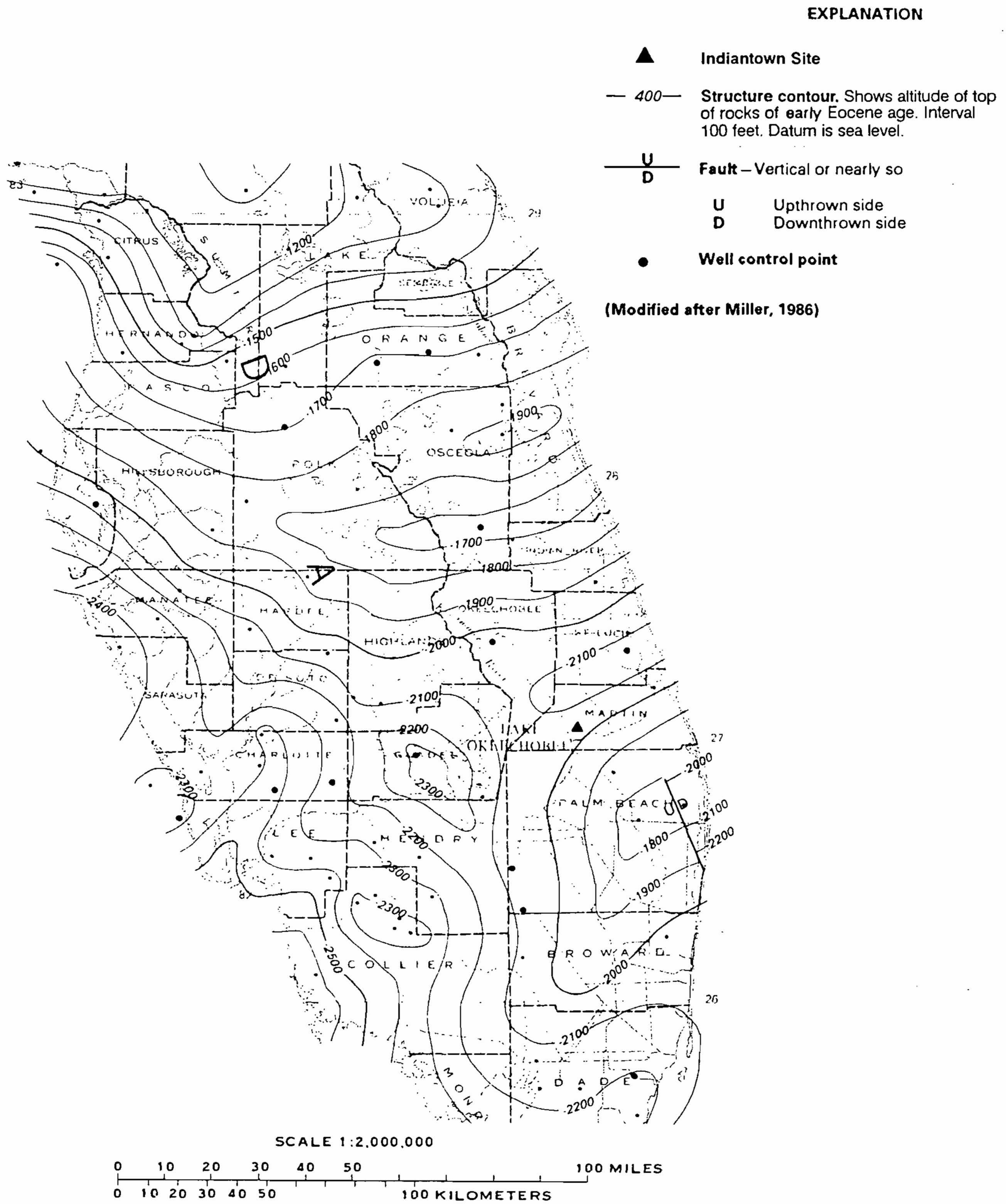

Figure 2.3.1-3.

STRUCTURE CONTOURS ON TOP OF EARLY EOCENE AGE STRATA (CORRESPONDS TO OLDSMAR FORMATION IN MARTIN COUNTY)

Source: FPL, 1989

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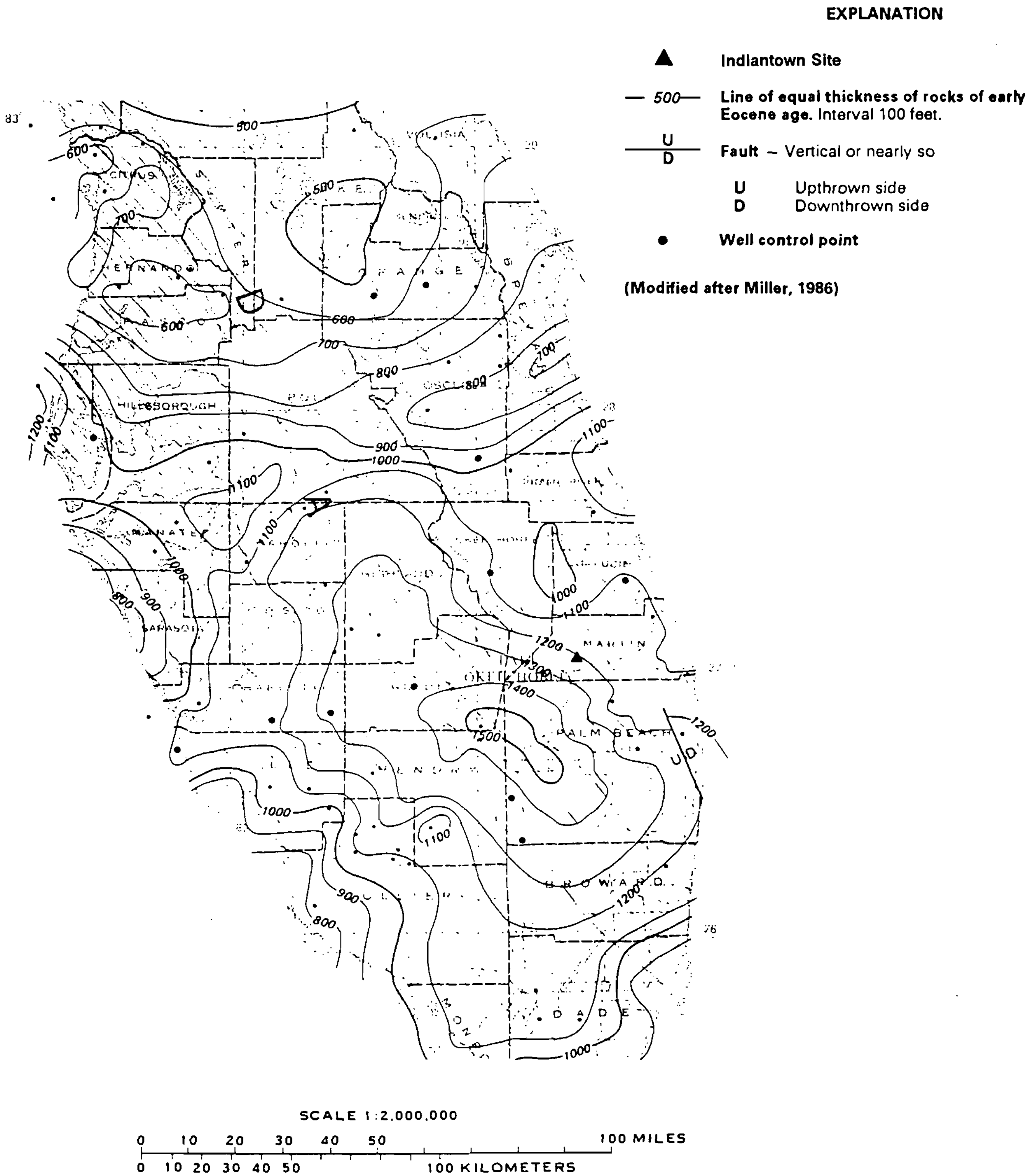

Figure 2.3.1–4

ISOPACH MAP OF EARLY EOCENE AGE STRATA (CORRESPONDS TO OLDSMAR FORMATION IN MARTIN COUNTY)

Source: FPL, 1989

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Lake City and Avon Park Limestones

The Lake City and Avon Park Limestones were initially named by Applin and Applin (1944) to differentiate dolomitic and fossiliferous limestones of Early to Middle Eocene age. The distinction between the two units was based on the presence of a dominant microfauna, Dictyoconus americanus (Shaw and Trost, 1984) and other foraminifera. Based on a larger sampling of deep wells than were available to Applin and Applin, Miller (1986) has proposed to combine the Lake City and Avon Park Limestones into one unit to be called the Avon Park Formation. The premise for this is the similarity of lithologies and the presence of the diagnostic fossil assemblages throughout the total thickness of both units. For the purposes of this discussion, however, the Lake City and Avon Park Limestones will be described separately.

Lake City Limestone

Applin and Applin (1944) named the lower Middle Eocene age Lake City Limestone from the descriptions of alternating beds of dark brown crystalline dolomite and dolomitic limestones, and tan to cream, soft to hard, chalky, fossiliferous limestone encountered in wells drilled at Lake City, Florida. The sequence also contains peat and lignite beds with chert nodules and thin chert layers. Dolomitization of the limestone is highly varied throughout the sequence. In areas where the process has occurred partially or completely, diagnostic fossil assemblages are difficult or impossible to identify. Pore spaces in the limestone are commonly impregnated with anhydrite and gypsum (Stringfield, 1966).

The Lake City Limestone is reported to be in disconformable contact with the Oldsmar Formation because of the presence of marine peats and gypsum and anhydrite nodules near the contact (Stewart, 1966). Other investigators (Vernon, 1951) suggest that the contact may be unconformable.

Avon Park Limestone

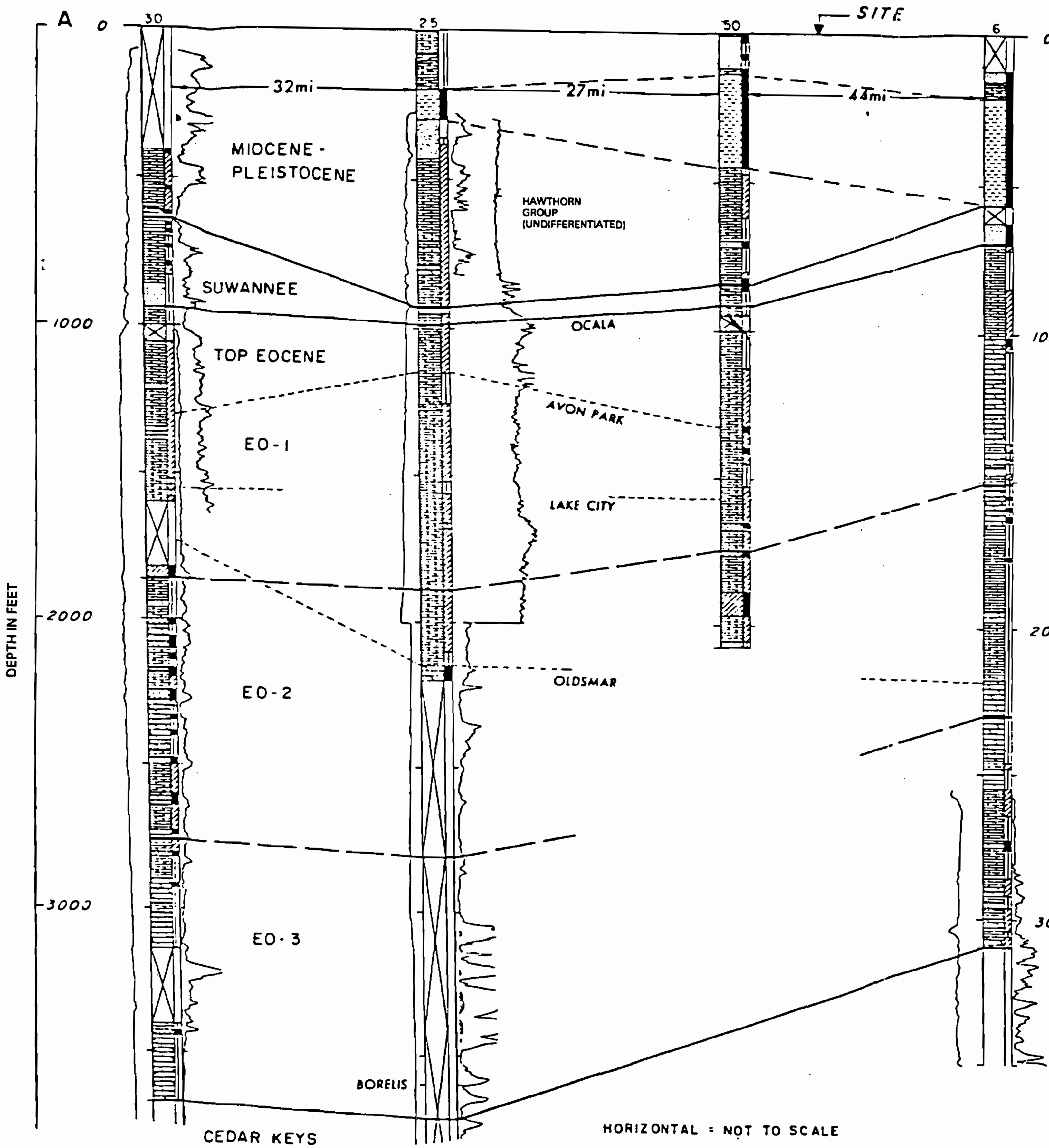
The Avon Park Limestone of Middle Eocene age is described as a cream to dark brown, hard to medium-soft, nearly pure, chalky, crystalline limestone. It is differentiated from the overlying Ocala Group primarily by its fossil content. It exhibits lithologic changes both horizontally and vertically (Lichtler, 1960) with numerous thin, porous, granular, sand-like zones (Stewart, 1966). Lichtler (1960) indicates that the thickness of the Avon Park Limestone outside Martin County is estimated to be at least 400 feet. However, a regional cross section through the vicinity of the ICL site indicates that its thickness in this area may be only about 200 feet (Figure 2.3.1-5). Miller (1986) indicates that the thickness of Middle Eocene age rock strata, including the Lake City and Avon Park Limestones, is about 1,250 feet in the vicinity of the Indiantown site (Figure 2.3.1-6) . The top of the Avon Park Limestone, as shown on Figure 2.3.1-7, is at about El. -800 feet in the site area.

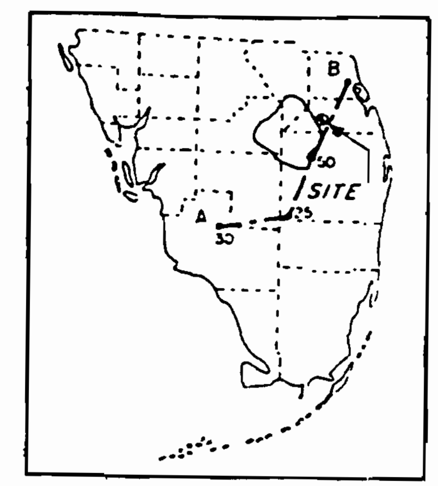
Ocala Limestone

Unconformably overlying the Avon Park Limestone is the Late Eocene age Ocala Limestone. The Ocala in Florida is commonly referred to as a group which includes the Crystal River, Williston, and Inglis Formations. Miller (1986) states that the three formations cannot be distinguished lithogically at their type section or in the subsurface, and refers to all three units as the Ocala Limestone. In Martin County, the group, because of insufficient materials for study and classification, has not been subdivided (Lichtler, 1960). Therefore, the term Ocala Limestone will be used in this discussion.

The Ocala consists chiefly of limestones that are generally granular, white to cream or slightly pink, soft to medium hard, and that contain an abundance of crystalline calcite in some areas. The Ocala also contains occasional beds of foraminiferal coquina.

Figure 2.3.1–5
REGIONAL GEOLOGIC CROSS SECTION





INDEX MAP

WELL NO.	BUREAU OF GEOLOGY ACESSION NO.	LOCATION TWP.	RGE.	SEC.
6	W-4323	36	40	19
50	W-7500	36	37	28
25	W-4661	48	35	2
30	W-10252	48	29	24
	W-2142	48	29	14

LEGEND:

- ANHYDRITE
- DOLOSTONE
- LIMESTONE
- SANDSTONE
- SHALE
- MISSING SAMPLE
- IMPERMEABLE
- HIGH PERMEABILITY
- LOW PERMEABILITY

Source: FPL, 1989

MODIFIED AFTER PURI AND WINSTON, 1974

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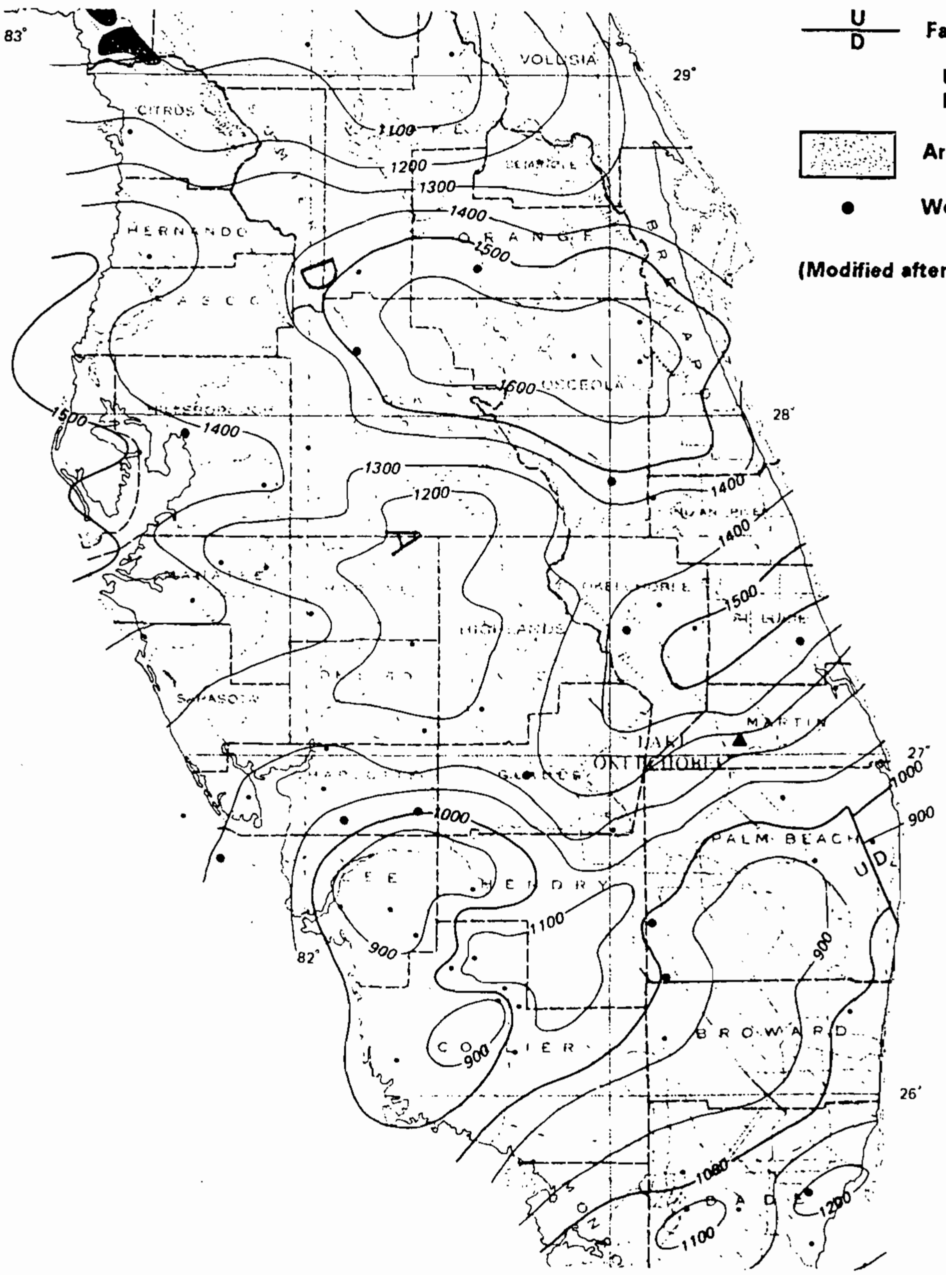

SCALE 1:2,000,000

0 10 20 30 40 50 100 MILES

0 10 20 30 40 50 100 KILOMETERS

EXPLANATION

▲ Indiantown Site

— 500— **Line of equal thickness of rocks of middle Eocene age.** Dashed where approximate. Interval 100 feet.

U/D **Fault**—Vertical or nearly so

U Upthrown side
D Downthrown side

Area of outcrop (or shallow subcrop)

● **Well control point**

(Modified after Miller, 1986)

Figure 2.3.1–6

ISOPACH MAP OF MIDDLE EOCENE AGE STRATA (CORRESPONDS TO AVON PARK LIMESTONE IN MARTIN COUNTY)

Source: FPL, 1989

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G-10/90-1808-7

EXPLANATION

▲ Indiantown Site

— 300— **Structure contour.** Shows altitude of top of rocks of middle Eocene age. Interval 100 feet. Datum is sea level.

U/D **Fault** – Vertical or nearly so

U Upthrown side

D Downthrown side

● **Well control point**

(Modified after Miller, 1980)

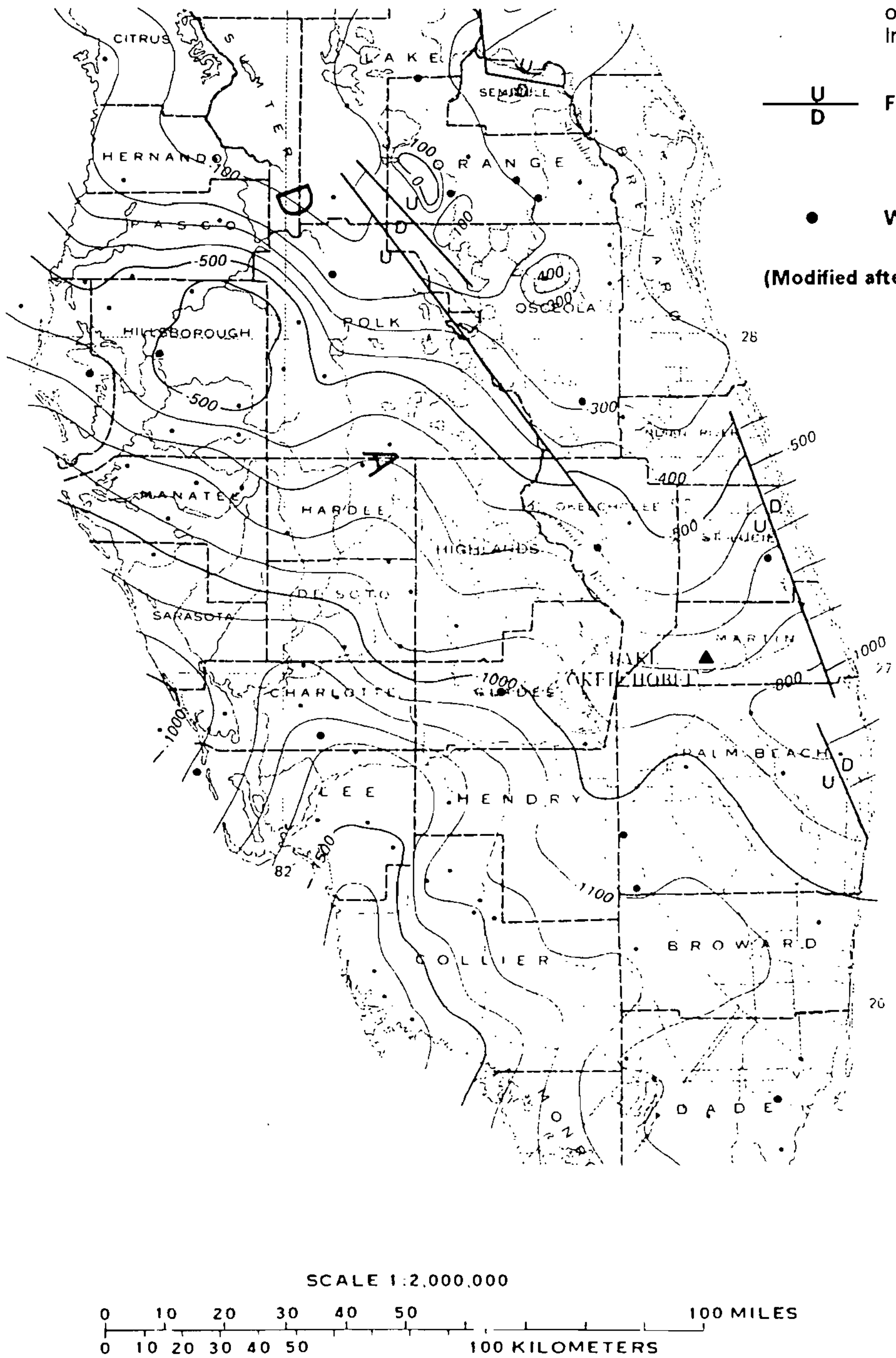

Figure 2.3.1-7.

STRUCTURE CONTOUR ON TOP OF MIDDLE EOCENE AGE STRATA (CORRESPONDS TO AVON PARK LIMESTONE IN MARTIN COUNTY)

Source: FPL, 1989

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Lichtler (1960) states that the Ocala Limestone is generally less than 100 feet thick in Martin County. However, the regional cross section shown on Figure 2.3.1-5 indicates that the Ocala may be on the order of 400 feet thick in the ICL site area. Miller (1986) indicates a thickness for the Ocala Limestone of about 200 feet in the site area (Figure 2.3.1-8). The log of a deep well that penetrates the entire Ocala Limestone at the nearby FPL Martin site shows a thickness of 100 feet (FPL, 1982). The top of the Ocala, at about El. -700 feet based on the logs of wells in the vicinity of the ICL site, is an erosional surface that creates an unconformity with the overlying Oligocene age deposits.

Suwannee Limestone

The only formation known to be of Oligocene age in Martin County is the Suwannee Limestone (Lichtler, 1960). This formation is bounded by unconformities and is described as a cream colored, slightly porous, soft, granular mass of limy particles, many of which seem to be of organic origin.

Lichtler (1960) states that the thickness of the Suwannee in western Martin County ranges from about 20 to 60 feet. The regional cross section shown on Figure 2.3.1-5 indicates a thickness on the order of 80 feet in the vicinity of the site. Miller (1986) suggests that Oligocene age rocks are absent in Martin County except for a thin band east of a northwest trending fault which parallels the east coast through Martin, St. Lucie, and Indian River Counties (Figure 2.3.1-9). Although Miller does not indicate the presence of Oligocene age rocks west of the coastal fault, it is possible that, due to the contour interval used for the mapping (100 feet), identification of these rocks was omitted from the area immediately west of the fault. Based on a larger sampling of wells throughout Martin County, Knapp (1988) indicates a combined thickness for the Tampa Formation and Suwannee Limestone of between 75 and 100 feet. Erosion of the surface of the Suwannee Limestone in western Martin County has produced an unconformity with the overlying Miocene sediments.

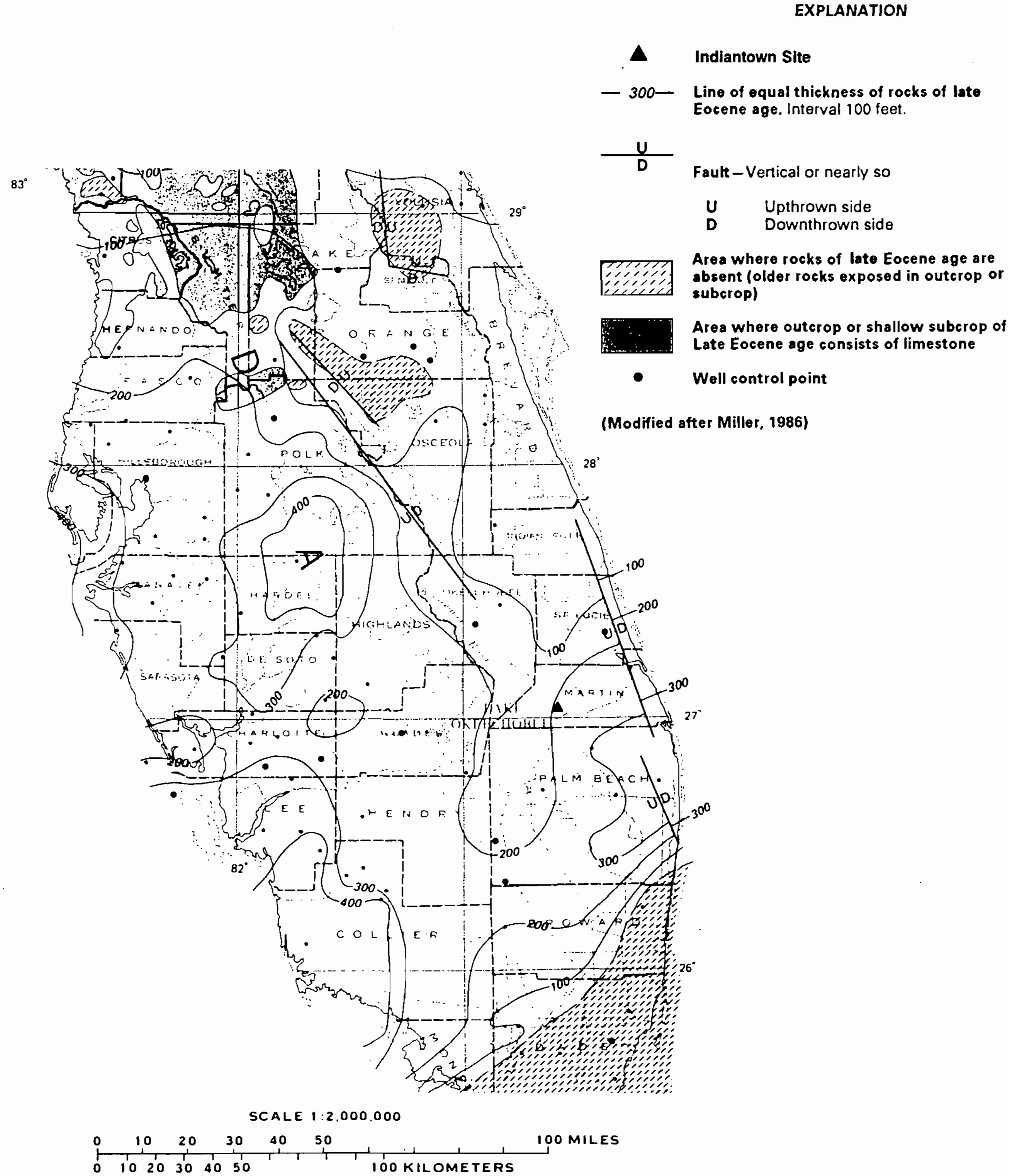

Figure 2.3.1–8

ISOPACH MAP OF LATE EOCENE AGE STRATA (CORRESPONDS TO OCALA LIMESTONE IN MARTIN COUNTY)

Source: FPL, 1989

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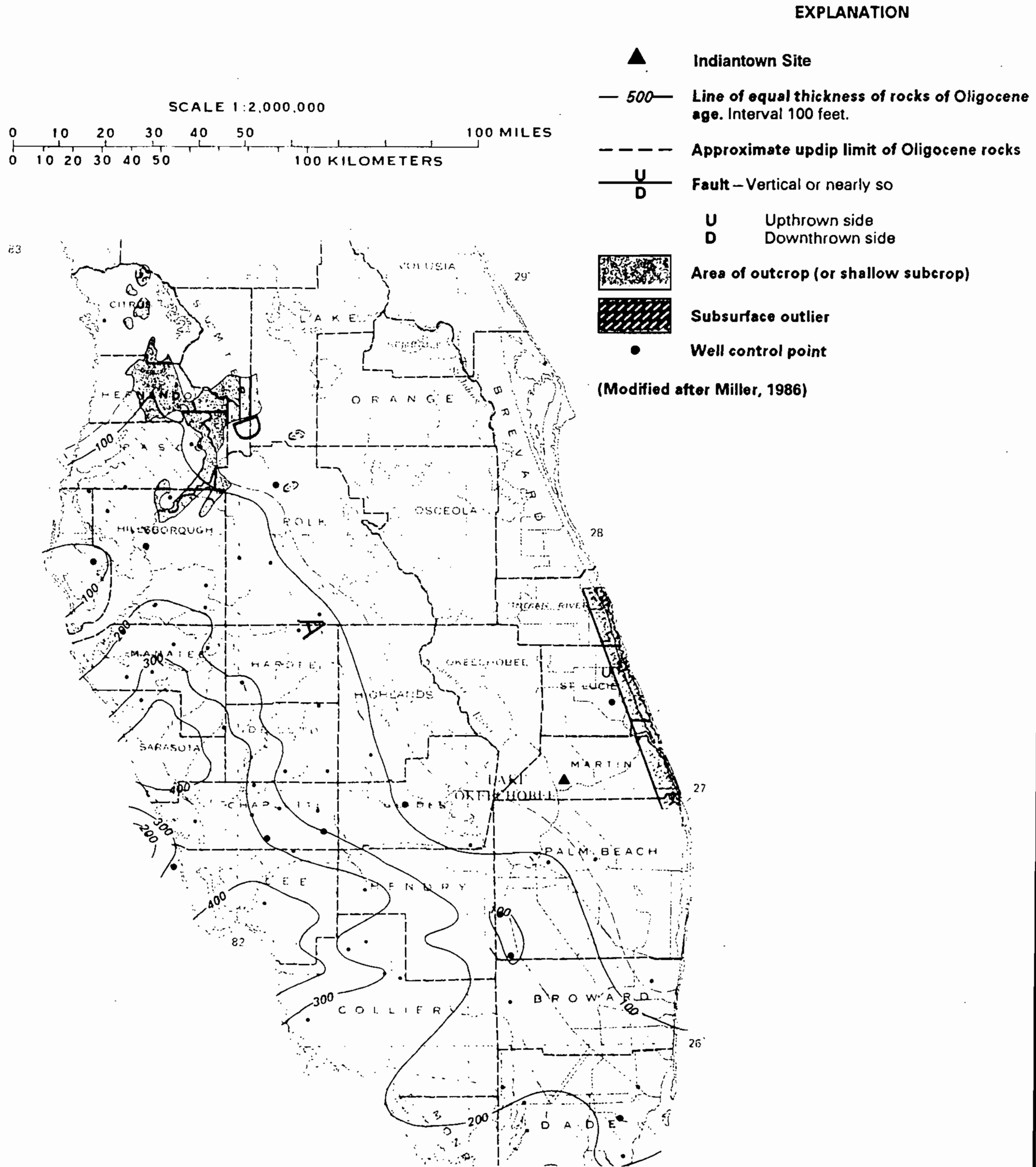

Figure 2.3.1–9

ISOPACH MAP OF OLIGOCENE AGE STRATA (CORRESPONDS TO SUWANNEE LIMESTONE IN MARTIN COUNTY)

Source: FPL, 1989

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Tampa Formation

Lichtler (1960) indicates that the presence of the Tampa Formation has not been definitely established in Martin County, where it is only tentatively identified in 10 to 15 feet of sandy limestone in one well located about 2 miles south of the city of Stuart. This identification is based on a similarity with the type-locality near Tampa. Scott (1988) proposes to reduce the status of the Tampa Formation to a member within the Hawthorn Group due to its limited areal extent, facies changes, and apparent gradational contacts with the units above and below it. The cross section shown on Figure 2.3.1-10 indicates that the Tampa Member of the Hawthorn Group has not been identified east of DeSoto County. In its type-locality near Tampa, the member is described as a fairly hard, dense, white-to-yellowish, variably sandy and clayey limestone (Scott, 1988).

Hawthorn Formation/Group

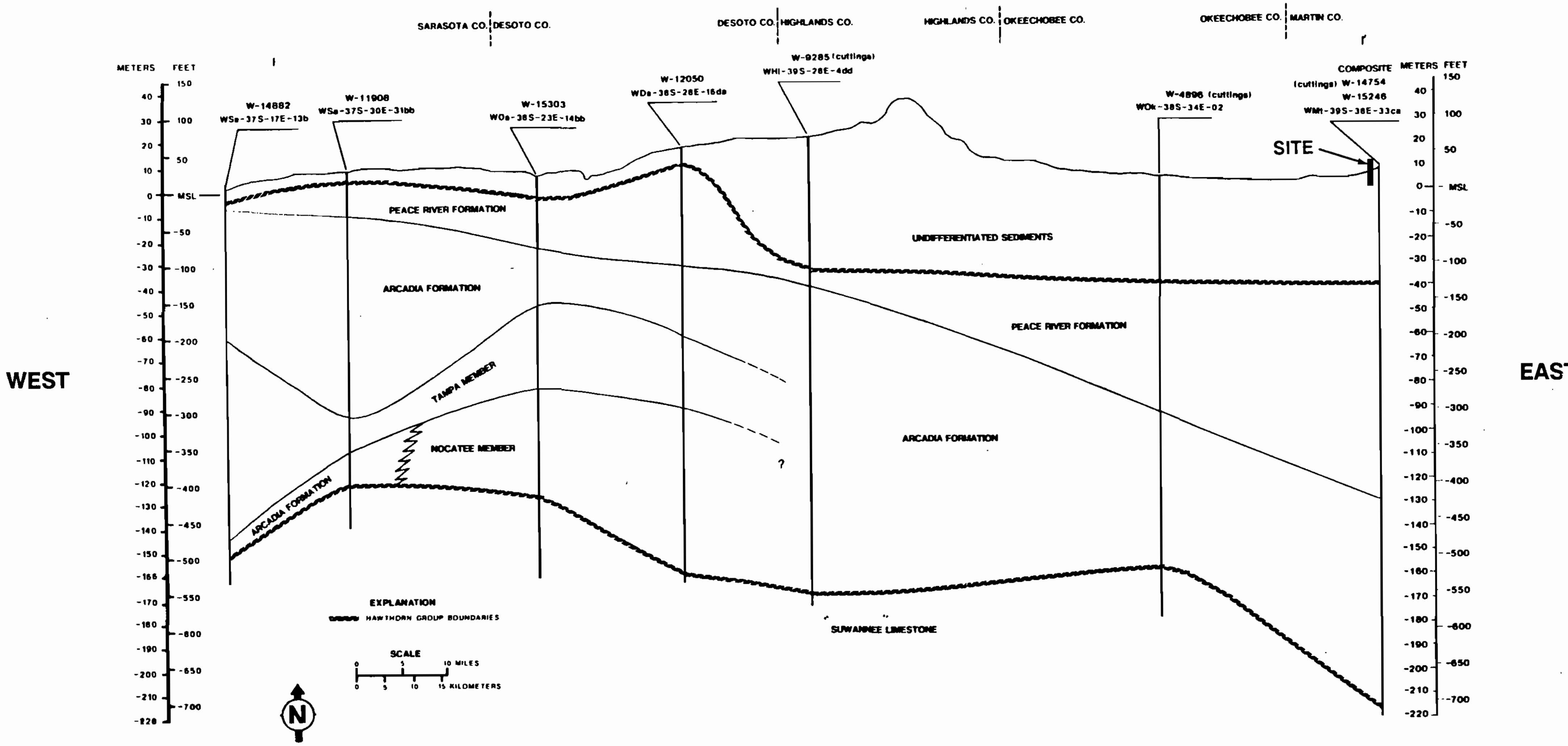
The Hawthorn Formation, as described by Lichtler (1960), conformably overlies the Tampa Formation, where present, or unconformably overlies the Suwannee or older limestones in Martin County. In the site vicinity, the Hawthorn Formation consists of beds of dark green to white phosphatic clay containing silt and quartz sand. The lower part of the formation varies from thin layers of sandy phosphatic limestone and chert to lenses and thin layers of phosphatic sand and abundant shells. Due to this apparent heterogeneity, it has been proposed by Scott (1988) to characterize the Hawthorn as a group by dividing it, based on clastic and carbonate lithologies, into two formations: the Peace River Formation (clastic) in the upper part, and the Arcadia Formation (carbonate) in the lower part.

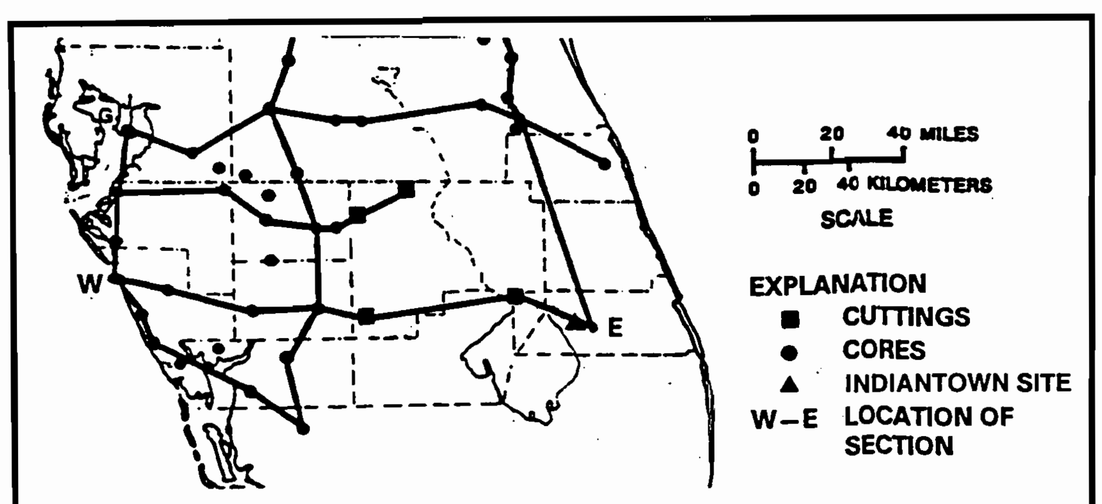
The relationship between the Peace River Formation and the Arcadia Formation in south Florida is shown in the cross section on Figure 2.3.1-10.

The proposed Arcadia Formation in south Florida unconformably overlies either the Ocala Limestone or the Suwannee Limestone. It consists mainly of a yellowish-

Figure 2.3.1-10.

SUBSURFACE CROSS SECTION: WEST-EAST





INDEX MAP

Source: FPL, 1989

(MODIFIED AFTER SCOTT, 1988)

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gray to olive-gray dolostone and white to yellowish-gray limestone. Both the dolostone and limestone are sandy, clayey, finely crystalline, and phosphatic. Recrystallization of the limestones is common. Clay and quartz sand beds less than 5 feet in thickness occur throughout the formation.

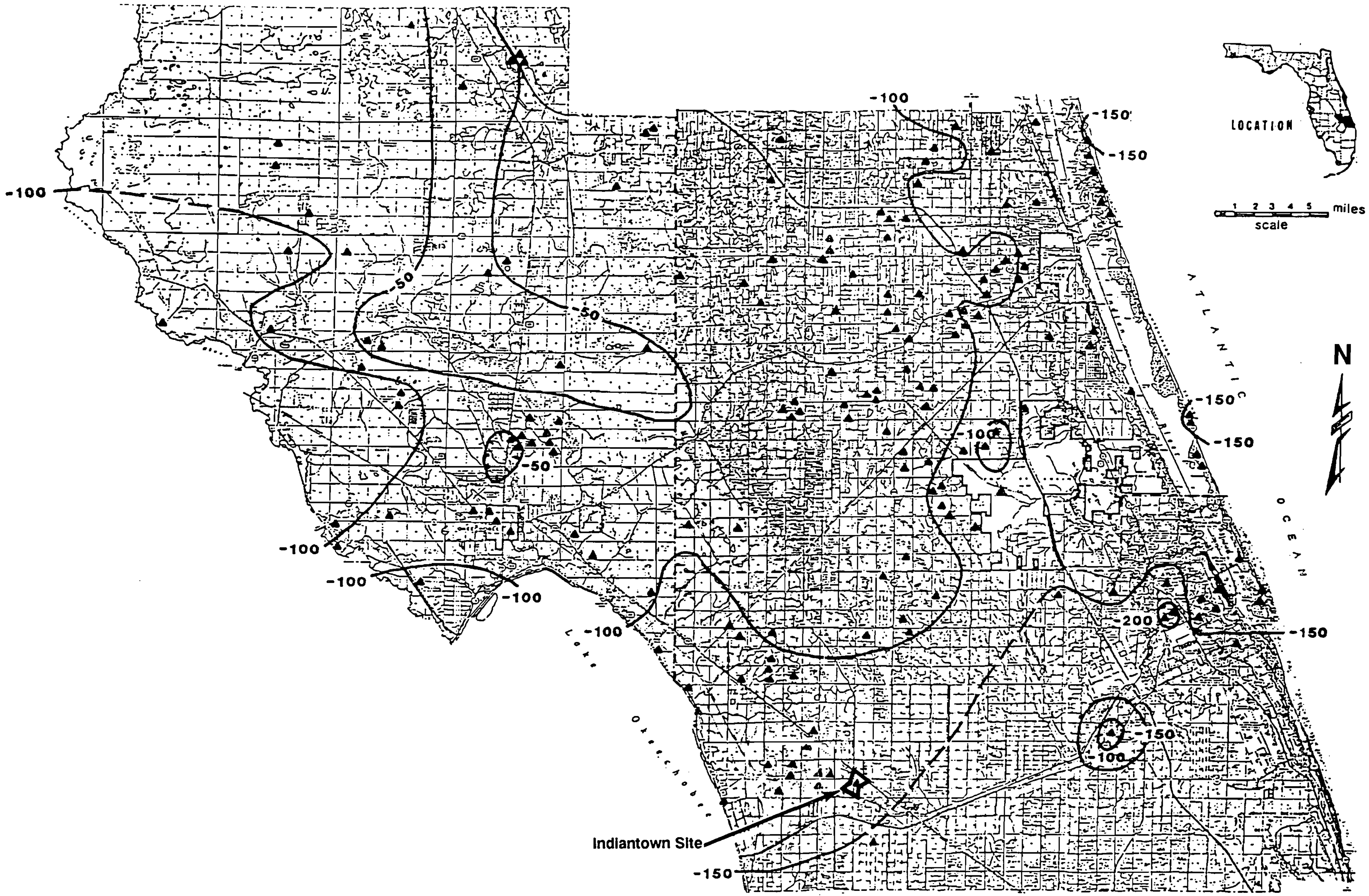
The proposed Peace River Formation is characterized by seams of interbedded light-gray to olive-gray quartz sands, clays, and carbonates consisting of limestone and dolostone. The sands are poorly consolidated, very-fine to medium grained, clayey, and calcareous to dolomitic with a variable phosphate content. The yellowish-gray to olive-gray clays are poorly to moderately indurated, calcareous to dolomitic, and contain quartz sand and silt. The carbonates comprise less than one-third of the formation and vary in color from yellowish-gray to white. They are variably sandy, clayey, and phosphatic and poorly-to-well cemented.

The top of the Hawthorn Group occurs at approximately El. -105 to -150 feet in the vicinity of the ICL site. These elevations are based on the logs of test wells and exploratory borings drilled in the area, and are in general agreement with Miller (1986) and Knapp (1988). Figure 2.3.1-11 shows structure contours on the top of the Hawthorn Group in Martin, St. Lucie, and Okeechobee Counties. The upper portion (5 to 20 feet) of the Hawthorn Group in this area consists predominantly of greenish-gray clay with subordinate amounts of shell, limestone, silt, and sand. The Hawthorn Group is about 550 to 600 feet thick in the site area (Knapp, 1988; Miller, 1986) as shown on Figure 2.3.1-12.

Tamiami Formation

The Tamiami Formation in south Florida has generally been defined as including all deposits of Late Miocene age overlying the Hawthorn Group (Lichtler, 1960). Where no distinct lithologic break occurs between Middle and Late Miocene sediments, the Tamiami can be differentiated from the Hawthorn only by fossil content. Based on lithologic descriptions of materials from exploratory borings

Figure 2.3.1-11
TOP OF THE HAWTHORN GROUP (CONTOUR INTERVAL: 50 FEET)



Source: FPL, 1989
(MODIFIED AFTER KNAPP, 1988)

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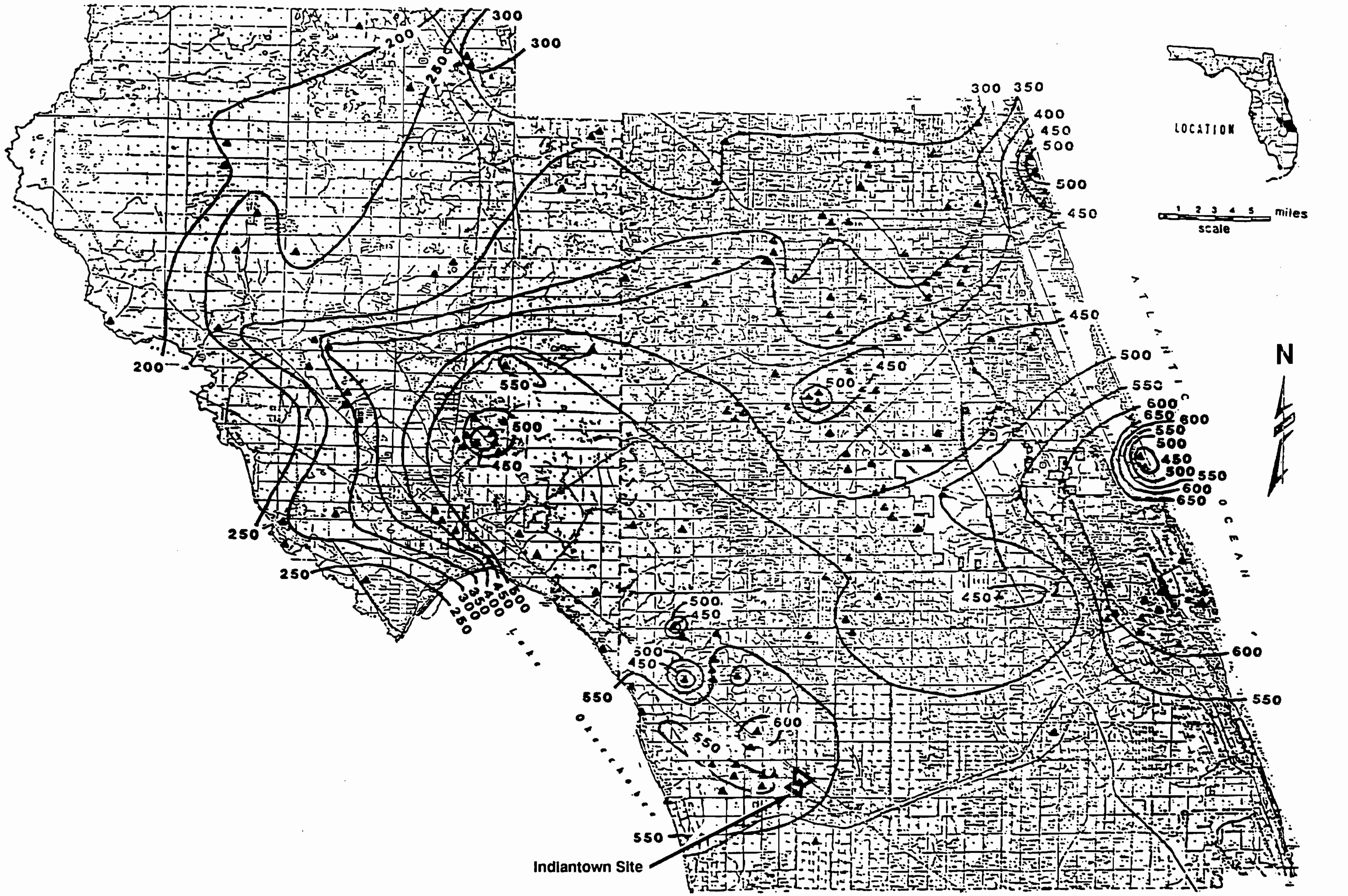

Figure 2.3.1–12
ISOPACH MAP OF THE HAWTHORN GROUP (CONTOUR INTERVAL: 50 FEET)

Source: FPL, 1989
(MODIFIED AFTER KNAPP, 1988)

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Figure 2.3.3-1.

WATER USERS WITHIN FIVE MILE RADIUS OF INDIANTOWN SITE

N

Scale: 1 Inch = 1 Mile

LEGEND:

Site Boundary

• 1 Water User Location. Number Corresponds to the Water User Identification Number Shown in Tables 2.3.3-4 and 2.3.3-6

Sources: SFWMD, USGS, FPL

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drilled at the ICL site, the top of the Tamiami Formation is estimated to occur at about El. -85 feet and is approximately 25 to 30 feet thick.

Caloosahatchee Marl

The only Pliocene age formation present in the site area is the Caloosahatchee Marl, which is composed largely of sand and shells (Lichtler, 1960). The top of this unit at the ICL site occurs at about El. -50 feet and is approximately 35 feet thick.

Anastasia Formation

The Anastasia Formation is the oldest Pleistocene age formation in Martin County. It is estimated to be over 100 feet thick in the eastern part of the county, but presumably thins to the west, where it pinches out or merges with the contemporaneously deposited Fort Thompson Formation west of Martin County (Lichtler, 1960). The Anastasia lies unconformably on the Caloosahatchee Marl or older formations and is, in turn, unconformably overlain by the Pamlico Sand. Although from place to place its composition varies, ranging from coquina to sand, in Martin County it consists primarily of sand, shell beds, and thin, discontinuous layers of sandy limestone or sandstone.

The Anastasia Formation and the overlying Pamlico Sand are the only geologic units exposed in Martin County. In those areas where it is not exposed, the Anastasia Formation is expected to underlie the surficial Pamlico Sand. At the ICL site, the Anastasia Formation extends from near the ground surface to about El. -50 feet.

Pamlico Sand

The Pamlico Sand of Pleistocene age forms a thin veneer, where present, over the Anastasia Formation. Although this unit could not be identified at the ICL site, if present, it is expected to have a maximum thickness of only a few feet.

2.3.1.2 Detailed Site Lithologic Description

A drilling program to evaluate the ICL site lithology was implemented in July and August 1990. The drilling effort consisted of six test borings, designated TB-1 through TB-6; construction of five monitor wells, MW-1 through MW-5; two piezometers, POW-1 and POW-2; and an aquifer test well, PW-1. The six test boring locations (TB-1 through TB-6) are situated at the approximate corners and in the middle of the site (Figure 2.3.1-13). The borings were plugged with neat cement, and monitor wells and piezometers were drilled and installed within 10 feet of each boring.

A separate but concurrent geotechnical investigation was also performed at the site to determine subsurface conditions for preliminary foundation evaluation purposes. The logs of two borings drilled for that investigation (B-102 and B-105) were used to assist in construction of the site geologic cross sections discussed below.

Summary of Drilling and Sampling Methodology

The borings, monitor wells, and piezometers were drilled and constructed by Ardaman and Associates, Inc., West Palm Beach, Florida. The aquifer test well was installed by Drilling Services, Inc., Ft. Pierce, Florida. Technical supervision of the drilling and well construction activities was provided by a hydrogeologist from CH2M HILL of Gainesville, Florida.

All test borings were drilled using mud rotary drilling techniques. A bentonite mud, Quik Gel^R, was used to facilitate drilling of the soil borings. The drilling rig, tools, drill rods, and bits were steam cleaned before drilling a new borehole.

The 4-inch-diameter test borings were drilled to approximately 110 to 150 feet in depth. The deeper borings penetrated the top of the Hawthorn Group sediments at the site. During drilling, the soils were sampled at 5-foot intervals using the standard penetration test (SPT) and a split-barrel sampler (ASTM D 1586). Thin-

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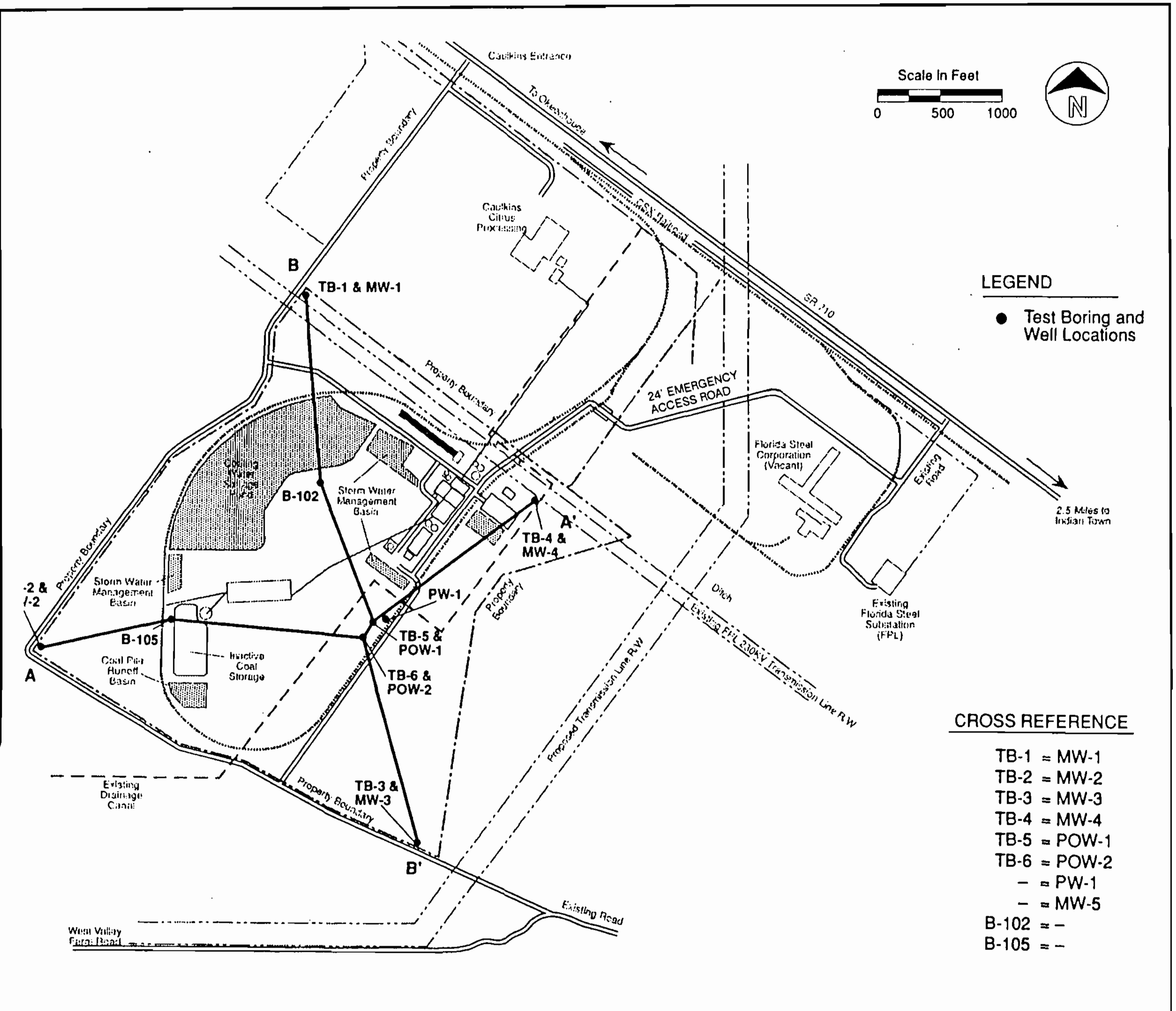
Figure 2.3.1-13. TEST BORING, WELL, AND GEOLOGIC SECTIONS LOCATIONS

Source: CH2M Hill, 1990



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walled tube samples (ASTM D 1587) were obtained at selected depths where low "N" values (blow counts) indicated soft material that would allow the tube to be pushed into the formation. This technique allowed relatively undisturbed samples to be obtained. Both the onsite hydrogeologist and the driller prepared a lithologic description as the boring progressed. The boring logs prepared by CH2M HILL are presented in Section 10.5.1. Representative soil samples (up to ten per borehole) and thin-walled tube samples were obtained from the borings and sent to Ardaman and Associates geotechnical laboratory for analysis. Soil samples were not obtained during the drilling of PW-1 because split-barrel samples were collected at POW-1, 50 feet away.

After the test borings were drilled to their final depth, geophysical logs were run on five of the borings (TB-1 through TB-5). Logs at these locations were determined to be sufficient to characterize the geology at the site. The logs run included mechanical caliper, natural gamma ray, long and short normal (LSN) electric, spontaneous potential (SP), and single-point electric. Copies of the geophysical logs are presented in Section 10.5.1. Following the geophysical logging, each boring was cemented from the bottom of the borehole to the land surface with neat cement. New borings were then drilled using mud-rotary techniques within 10 feet to facilitate installation of the monitor well or piezometer.

Results of Investigations

Boring Logs

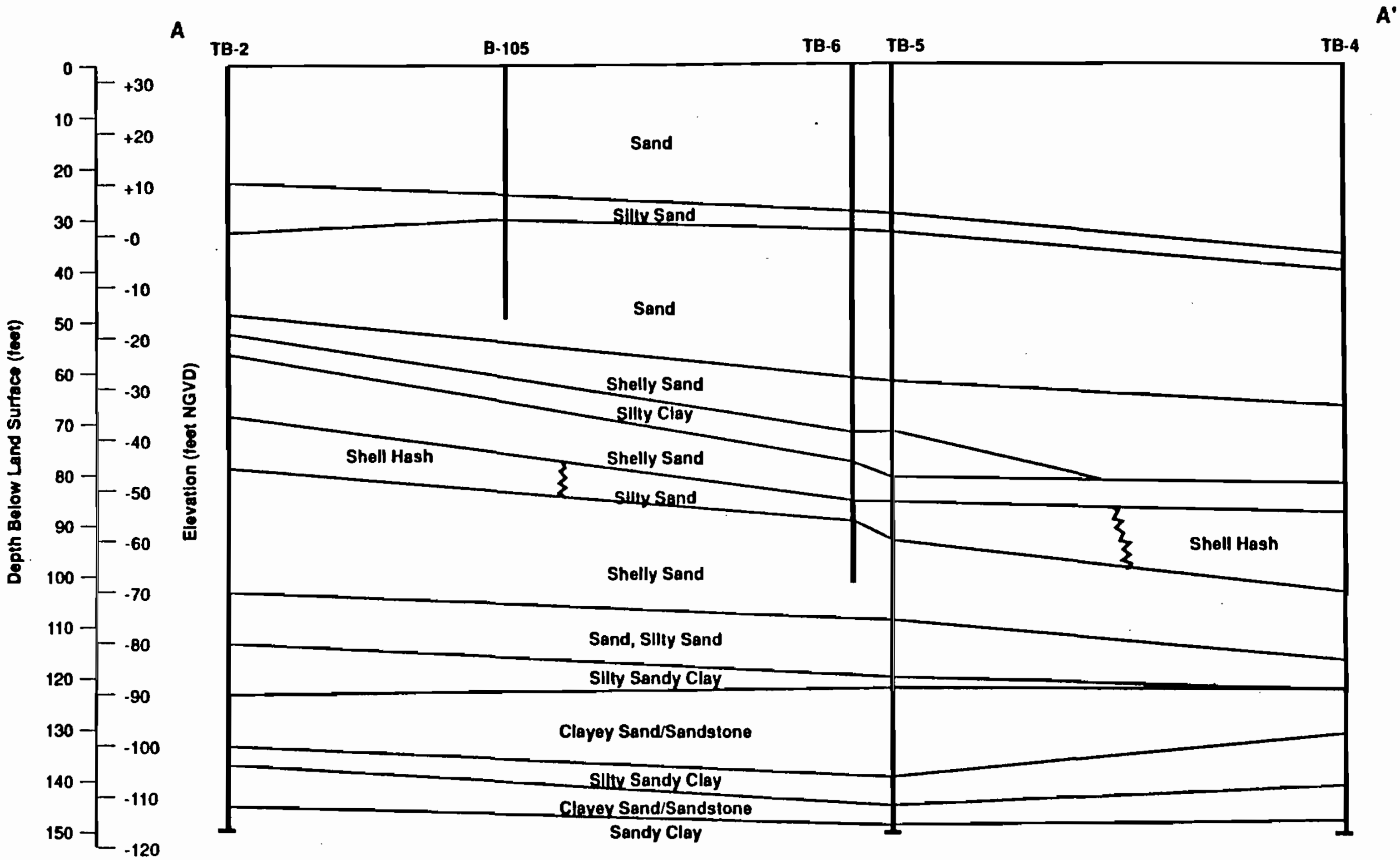
Boring logs were prepared by the site hydrogeologist based on lithologic descriptions of split-barrel samples from each boring. Copies of the boring logs are presented in Section 10.5.1. Figures 2.3.1-14 and 2.3.1-15 are geologic cross sections through the site using the borings shown on Figure 2.3.1-13.

In general, a fine-grained, silica sand unit was encountered from the land surface to a depth of approximately 30 feet below the land surface (bls). A thin "hardpan" layer of organically cemented sand was found in some of the borings within this

Figure 2.3.1-14.

GEOLOGIC CROSS SECTION A-A'

Source: CH2M Hill, 1990



Horizontal Scale in Feet

0 200 400

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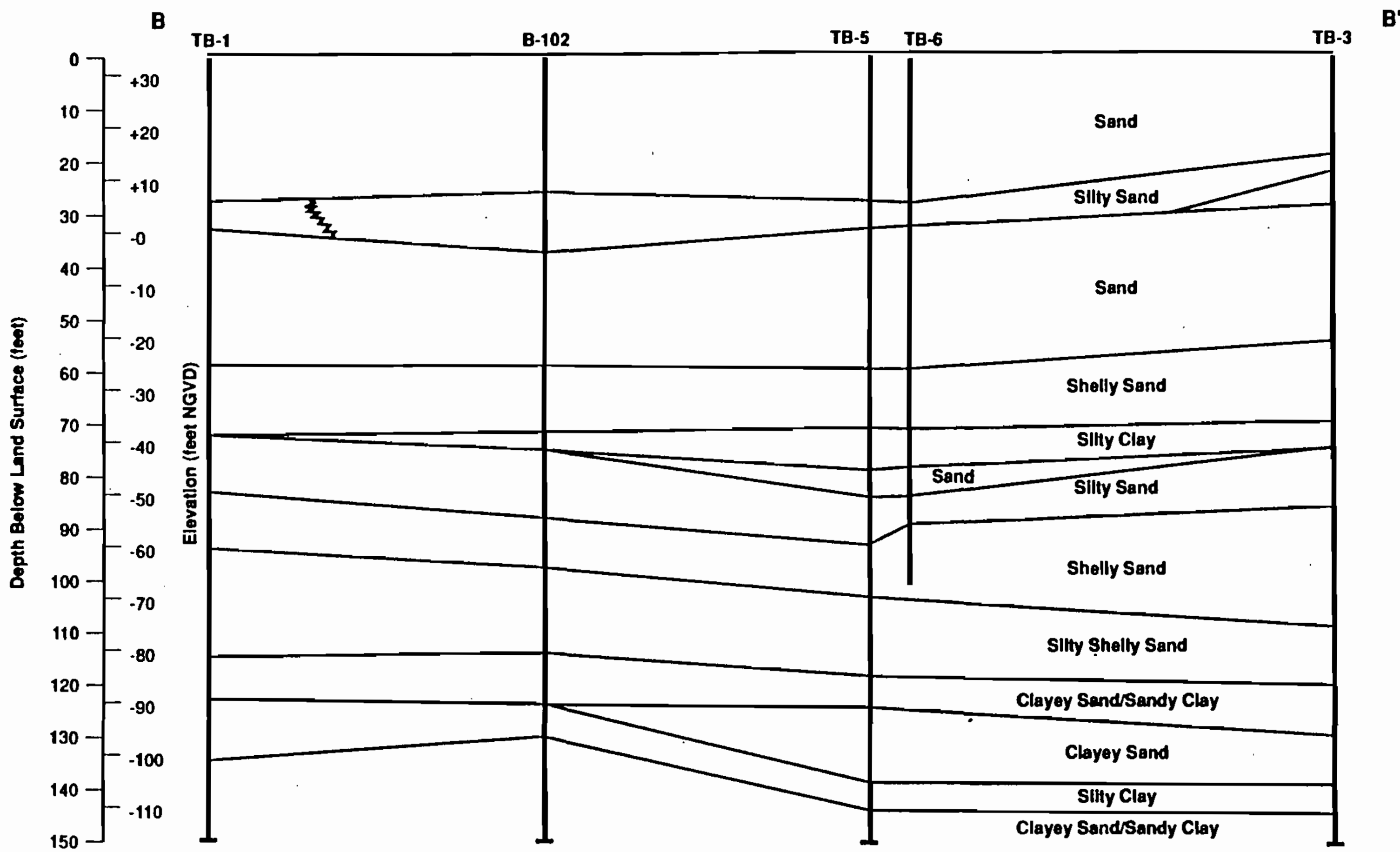
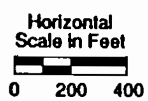
Figure 2.3.1-15.
GEOLOGIC CROSS SECTION B-B'

Source: CH2M Hill, 1990





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sand unit. Below the sand unit is a silty sand layer with an average thickness of 5 feet that grades laterally to cemented sand and limestone at TB-1 and TB-3.

At a depth of approximately 35 feet bls, a very fine-grained, very dense, light olive-gray sand unit was encountered with a thickness of about 20 feet. Below this unit is a fine quartz sand with a significant amount of black phosphorite grains and some shell that extends to a depth of about 70 feet bls. This shelly sand layer grades laterally and downward to a silty clay zone in the center of the site (Figure 2.3.1-15).

A shelly sand unit occurs at a depth of approximately 85 feet bls. This shelly sand unit increases in shell content radially from the center of the site and has alternating silt content throughout. The shelly sand unit grades to a silty sand, which extends to a depth of approximately 120 feet bls. Alternating beds of sandy clay, clayey sand, and poorly cemented clayey sand were encountered from a depth of 120 feet bls to the total depth of the borings ($\pm$150 feet bls).

Sieve Analyses

Sieve analyses were conducted on 47 split-barrel samples from test borings TB-1 through TB-5. The purpose of these analyses was to evaluate the grain size distribution of the geologic units at each boring location. Laboratory test results of the sieve analyses are presented in Section 10.5.1. A review of these grain size curves confirms the fine, silty sandy nature of the soils that predominate throughout the site as indicated on the boring logs.

Porosity and Vertical Hydraulic Conductivity

Thin-walled tube samples were obtained from TB-2, TB-3, TB-4, and TB-5 at depths ranging from 26 to 136 feet bls. The samples were sent to Ardaman and Associates geotechnical laboratory for determination of the vertical hydraulic conductivity and porosity values of these undisturbed samples.

Hydraulic conductivity was determined using a triaxial-type testing cell, while final volumetric and dry weight measurements were used to determine the porosity, with an assumed specific gravity of 2.70 based on the higher percentage of silica sands found at the site. The results of the tests are shown in Table 2.3.1-1. The hydraulic conductivity values range from 1.0 X 10^{-3} cm/sec for fine sands at a depth of 36 feet bls to 1.73 X 10^{-8} cm/sec for silty clay at a depth of 71 feet bls. As expected, coarser-grained materials exhibit higher hydraulic conductivities than the finer, clayey samples. Porosity values vary from 36.1 percent to 57.4 percent and average approximately 40 percent for samples with significant sand content. The 57.4 percent porosity value was obtained from a silty clay sample, which generally has higher porosities than coarser-grained sediments.

Cation Exchange Capacity

The cation exchange capacity (CEC) of a soil is defined by Hem (1989) as the "total number of negative charge sites at which reversible cation adsorption and desorption can occur." This analysis is usually performed on clay-rich sediments and is expressed as the number of milliequivalents (mEq) of cations that can be exchanged per 100 grams dry weight of sample.

CEC analyses were performed on two samples: TB-5 at 71 feet bls and TB-4 at 134 feet bls. Values of 6.6 and 5.95 mEq/100 grams, respectively, were obtained for these two samples. The laboratory test results for these analyses are presented in Section 10.5.1. In general, these CEC values are considered low, but other factors such as pH also control the sorptive capacity of sediments.

Geophysical Logs

Natural gamma ray, single-point electric logs, spontaneous potential (SP), LSN electric logs, and caliper logs were run in selected boreholes. The natural gamma ray and single-point electric geophysical logs were found to be the most useful to delineate individual strata in the geologic column at the site.

Table 2.3.1-1
SUMMARY OF GEOTECHNICAL ANALYTICAL DATA FOR THE ICL SITE

Boring No.	Interval (ft, bls)	Lithologic Description	Hydraulic Conductivity (cm/sec)	Void Ratio	Porosity (%)	Plasticity (%)	Cation Exchange Capacity (mEq/100g)
TB-5	26-29	Very Fine Sand Trace Silt	6.8×10^{-4}	0.688	40.8	NA	NA
	71-74	Gray Silty Clay	1.73×10^{-8}	1.349	57.4	51	6.6
	36-38.5	Gray Fine Sand	1.0×10^{-3}	0.64	39.0	NA	NA
TB-4	96-98.6	Silty Shell Hash	8.0×10^{-6}	0.61	37.9	NA	NA
	134-136	Gray Silty Sand	9.6×10^{-5}	0.77	43.5	1	5.95
TB-3	71-73.5	Silty Shelly Clay	4.5×10^{-6}	0.565	36.1	0	NA
TB-2	26-29	Gray Silty Sand	9×10^{-6}	0.589	37.0	NA	NA

bls = below land surface
mEq = milliequivalents
NA = not applicable

Note: All analyses performed by Ardaman and Associates, Inc.

Source: CH2M Hill, 1990

Four major lithologic units can be distinguished based on the gamma ray and electric logs. These units correspond well to lithologic units identified from the samples collected during drilling. A shallow unit of relatively clean sands occurs to a depth of 30 feet bls, which is distinguished on the gamma ray logs by a relatively low gamma count rate, with little vertical variability. At a depth of 30 feet bls, a high gamma peak is noted, which corresponds to the silty sand layer identified from the samples collected at this depth. At TB-3, a high gamma peak occurs at a depth of 21 feet bls, correlating to a sandy limestone unit noted on the boring log.

A distinctive unit of much higher gamma ray counts occurs over the interval from about 30 feet to a depth of about 80 feet bls. The count rate changes sharply over short vertical intervals, giving the log a characteristic "jagged" appearance. The higher gamma ray activity in this interval is attributed to the uranium content of the phosphorite grains noted on the boring logs. In TB-1, TB-3, and TB-4, the highest gamma ray counts correspond to fine-grained or silty sands, with 20 to 25 percent black, very fine grained phosphorite. In TB-5, the gamma peak at 69 feet bls correlates with a silty clay unit noted on the boring log. In TB-2, the gamma peak correlates with thin clay lenses encountered by the boring at a depth of 60 feet bls.

The top of the third unit at a depth of about 80 feet bls is marked by a substantial decrease in gamma ray activity to a level intermediate between the first two units, and by a corresponding lower resistivity on the electric logs. This level of gamma ray activity continues until a peak is encountered at the base of each borehole. The intermediate gamma ray activity in this interval corresponds to interbedded, shelly sand; silty shelly sand; clayey sand; and silty clay layers to depths of about 140 to 145 feet bls. The amount of phosphorite grains in this interval varies from trace quantities to 10 to 20 percent of the sample. Within this third unit, the lowest gamma ray count corresponds to a shelly sand bed occurring at a depth of approximately 90 to 110 feet bls.

The fourth major unit distinguishable on the gamma ray logs is the top of the Hawthorn Group. The sharp increase in gamma ray activity seen at the base of each borehole is consistent with the geophysical signature of the top of the Hawthorn Group sediments. These sediments are typically rich in clays and phosphates, which produce high gamma counts.

On some of the single-point electric logs, a 5- to 10-foot-thick clay bed is indicated by a sharp deflection to the left. The feature is noted in TB-1, TB-3, and TB-5, and has a corresponding gamma ray peak at the same depth. The deflection occurs in TB-1 at a depth of 74 to 80 feet, and corresponds to a sandy, shelly clay on the boring log. In TB-5, the feature is a more subdued peak in the interval between 65 and 75 feet, and corresponds to a silty clay. The silty, shelly clay in TB-3 appears as a sharp peak in the interval between 65 and 70 feet bls on the electric log. Gamma peaks, in general, correspond to clay layers encountered in the borings.

The spontaneous potential log also provided some useful information when delineating formation contacts. In TB-2, a gradual increase in resistivity beginning at a depth of 113 feet bls correlates with the occurrence of a clayey, shelly sand unit. This increase in SP response occurs from 113 to 145 feet bls and correlates with the interbedded clayey sands and sandy clays on the boring log of TB-2. In TB-3, a gradual decrease in SP response from 75 to 115 feet bls corresponds to the shelly sand unit noted on the TB-3 boring log. In TB-4, a sharp decrease in SP response at 30 feet bls delineates the bottom of the fine silica sand unit noted on the boring log. Also, an increase in SP response at 120 feet bls denotes the beginning of interbedded clayey sands and clays. Lastly, a low resistivity spike at 85 feet bls in TB-5 denotes the beginning of shelly sands.

Geologic Formations at ICL Site

The stratigraphic nomenclature discussed below corresponds to that used by Lichtler (1960) and Scott (1988). Because lithology varies both laterally and vertically in shallow marine depositional environments, the formation names assigned to the various site lithologic units is considered arbitrary.

Pamlico Sand

The Pamlico Sand is identified as a thin veneer of fine silica sand that unconformably overlies the Anastasia Formation. Lichtler (1960) notes that these marine terrace sediments may not be present on the Orlando Ridge, a subdivision of the Eastern Flatlands physiographic region in which the Indiantown site is located, because this land may not have been covered by the sea during Pamlico time. If present at the site, this unit is only a few feet thick.

Anastasia Formation

At the site, the Anastasia Formation, which extends from near the land surface to a depth of about 85 feet, consists mostly of fine silica sand with variable quantities of shell and phosphate. Thin, discontinuous layers of silty sand, clay, and sandy limestone also are present within this formation.

Caloosahatchee Marl

The Caloosahatchee Marl is composed largely of sand and sandy shell beds (Nealon et al., 1987). At the site, this formation extends from approximately 85 to 120 feet bls, and is characterized by increasing silt content with depth.

Tamiami Formation

The Tamiami Formation consists of alternating layers of silty sand, sandy clay, and indurated clayey sand at the site. This formation is encountered at a depth of approximately 120 feet bls and extends to a depth of approximately 145 feet bls. The top of the Hawthorn Group sediments occurs at this depth, based on the gamma logs.

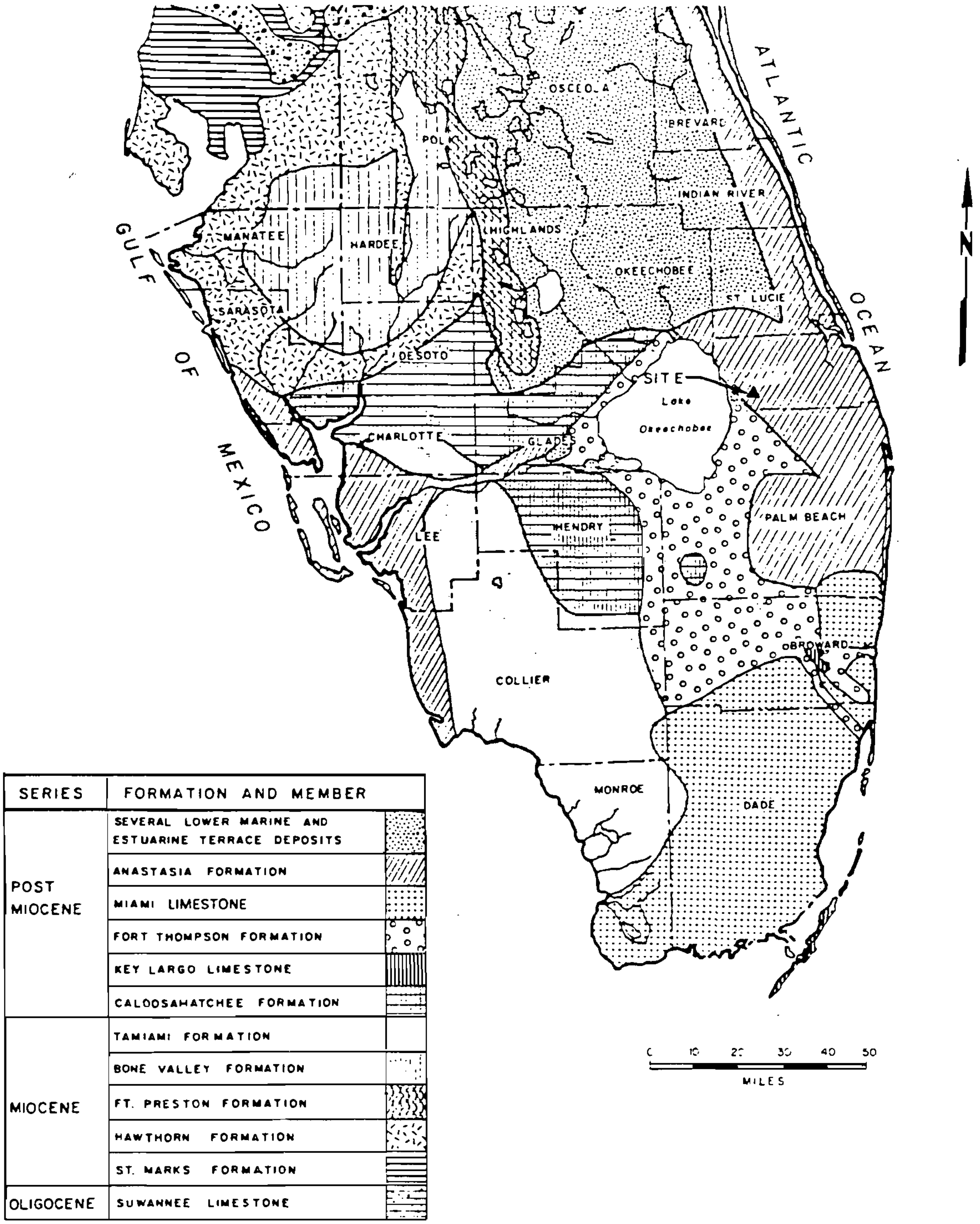
2.3.1.3 Geologic Maps

The near-surface sediments at the ICL site consist of Pleistocene age deposits of the Pamlico Sand and Anastasia Formation. A regional geologic map showing the surficial geology of south Florida is presented on Figure 2.3.1-16. The Pamlico Sand, where present at the ICL site, is estimated to have a maximum thickness of only a few feet. The description of sediments encountered by exploratory borings drilled at the site indicates that the Anastasia Formation extends to a depth of approximately 85 feet.

A review of the site surficial soil classification (USDA, 1981) indicates that the majority of the northern half of the site consists of Basinger fine sand, while the southern half of the site consists mainly of Waveland sand (Figure 2.3.1-17). The third largest area, near the center of the site, is covered by the Lawnwood fine sand. The remaining minor soil types include Lawnwood fine sand, depressional; Waveland sand, depressional; Basinger fine sand, depressional; Placid sand; Sanibel muck; and Tequesta Variant muck.

The three main soil types covering most of the site are all characterized as poorly drained, nearly flat-lying soils. The Basinger fine sand is characterized by very high permeability values throughout the soil profile, while the Waveland sand and the Lawnwood fine sand have high permeability values in the surface and subsurface layers, and low to very low permeability values in the subsoil.

Figure 2.3.1-13 shows the locations of two cross sections through the site. The sections are presented on Figures 2.3.1-14 and 2.3.1-15, and are based on exploratory drill hole data from a recent site investigation. They show the materials encountered in the borings from the ground surface to a depth of about 150 feet. These sections show that the site is generally underlain by layers of sand, silty sand, and shelly sand to the base of the Anastasia Formation. However, occasional zones of sandy or silty clay were encountered within this interval by



MODIFIED AFTER: VERNON AND PURI, 1964

Figure 2.3.1-16.

REGIONAL GEOLOGIC MAP

Source: FPL, 1989

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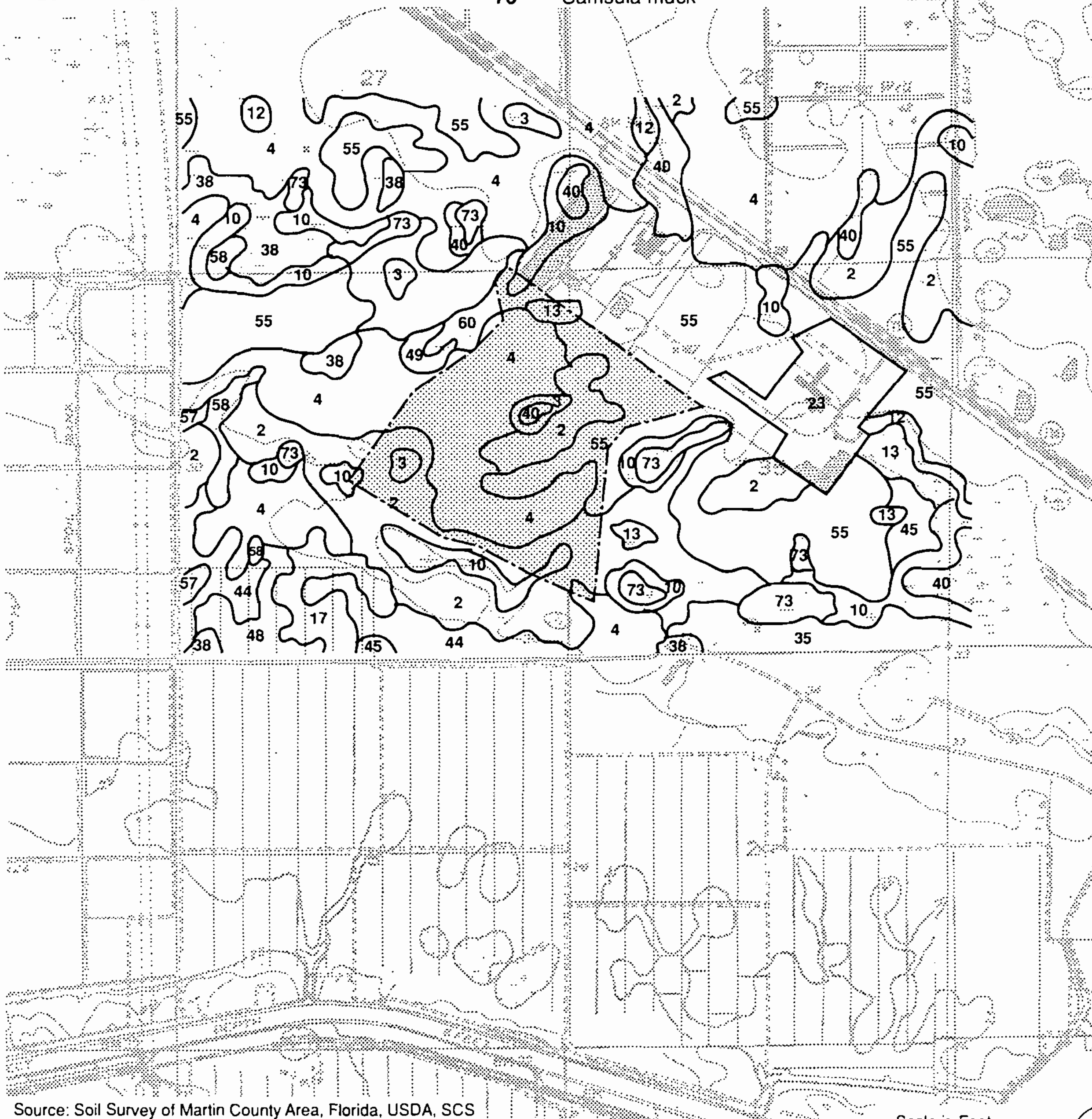
LEGEND

-·—·-	Property Boundary
2	Lawnwood fine sand
3	Lawnwood fine sand, depressional
4	Waveland sand
5	Waveland sand, depressional
10	Basinger fine sand, depressional
12	St. Johns Variant sand
13	Placid sand
17	Wabasso sand
23	Urban sand
35	Salerno sand
38	Floridana fine sand, depressional
40	Sanibel muck
44	Boca fine sand
45	Hilolo fine sand
49	Riviera fine sand, depressional
55	Basinger fine sand
57	Chobee loamy sand
58	Gator muck
60	Tequesta Variant muck
73	Samsula muck



Source: Soil Survey of Martin County Area, Florida, USDA, SCS

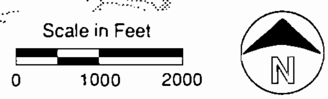


Figure 2.3.1-17

SOIL SURVEY OF THE SITE

Source: CH2M Hill, 1990

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some of the borings, indicating the presence of discontinuous layers of finer-grained material.

2.3.1.4 Bearing Strength

For satisfactory performance, the foundation of any structure must meet two independent design criteria. First, it must have an acceptable factor of safety against bearing failure in the foundation soils. Second, settlements during the life of the structure must not be of a magnitude that will cause structural damage, endanger piping connections, or otherwise impair the operational efficiency of the facility. In order to assess these two criteria, a preliminary subsurface exploration was conducted.

The subsurface exploration was made during July 1990, by Ardaman & Associates, under the technical direction of a Bechtel geotechnical engineer. This exploration consisted of eight Standard Penetration Test borings drilled to depths ranging from 30 to 150 feet, and eight Cone Penetration Test soundings to depths ranging from 30 to 48 feet. The borings were widely spaced over the site, to generally cover areas where structures and facilities are proposed. Ardaman drilled the test borings with a CME 45 truck-mounted drilling rig, and made cone soundings with a truck-mounted Dutch cone probe. Generally, test borings were drilled to the depth of interest appropriate for the structures proposed in the boring's vicinity (i.e., 150-foot depth borings in the vicinity of heavily loaded proposed structures, usually power block structures, and 50-foot depth borings near lightly loaded structures). Cone soundings were made to refusal depth, the depth at which the equipment could no longer advance the test probe. Boring logs and cone test data are presented in Section 10.5.1.

The results of the subsurface exploration indicate a soil profile consisting predominantly of sands. The sands are generally loose near the surface (approximately the top 5 feet), with density increasing with depth, as shown in Figure 2.3.1-18. Analysis and experience indicate that bearing capacity or strength

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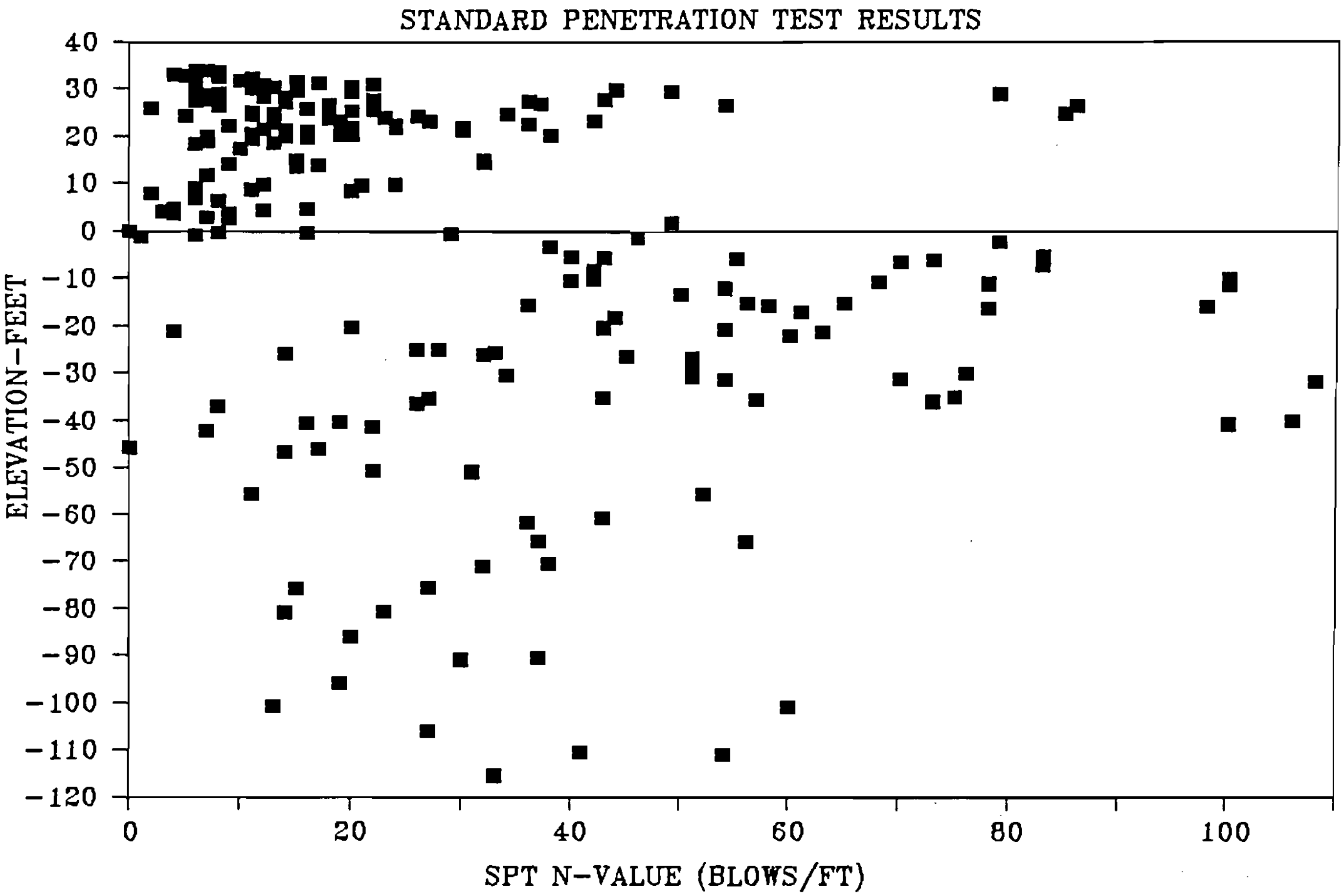

Figure 2.3.1-18.

SPT VALUES VS. DEPTH

Source: Bechtel, 1990

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is almost never a controlling design criterion when foundations are placed on sands. Rather, foundation settlement usually governs foundation design. For the cogeneration plant and related facilities planned, light to medium foundation loads will be accommodated using shallow, spread foundations. Heavily loaded structures will be placed on either a thick mat foundation (after removing the loose upper soils, and replacing them with compacted backfill), or on deep foundations, bypassing the upper, loose soils.

2.3.2 SUBSURFACE HYDROLOGY

2.3.2.1 Subsurface Hydrologic Data for the Site

The hydrogeologic framework beneath the Indiantown, Florida, site can be divided into three main parts. From shallow to deep, they are: the Surficial aquifer system; the relatively impermeable sediments of the Hawthorn Group; and the Floridan aquifer system.

A field testing effort was performed to characterize the hydrogeologic conditions within the Surficial aquifer system at the site. This field effort included drilling and split-barrel sampling of five 150-foot soil borings. Thin-walled tube samples were obtained at various depths in four of the borings and were analyzed for vertical hydraulic conductivity and porosity by Ardaman and Associates, Inc. Four 30-foot monitor wells and one aquifer test well were constructed near the soil boring locations. Two deep piezometers and one shallow monitor well were constructed to obtain water levels during a 72-hour pumping test that was conducted to determine aquifer characteristics at the site.

Summary of Drilling and Sampling Methodology

Eight wells were constructed to characterize the hydrogeology of the ICL site. An 8-inch-diameter test well (PW-1) was completed to a depth of 120 feet by Drilling Services, Inc., Ft. Pierce, Florida. Two 110-foot-deep piezometers (POW-1 and POW-2) were installed within 50 and 200 feet of PW-1. A shallow (16-foot deep) monitor well, MW-5, was constructed approximately 200 feet from PW-1 to monitor the water level in the upper portion of the Surficial aquifer. The remaining four monitor wells (MW-1 through MW-4) are located at the approximate corners of the site (Figure 2.3.2-1). The purpose of the monitor wells is to determine the direction of groundwater flow and to characterize groundwater quality in the Surficial aquifer system at the site.

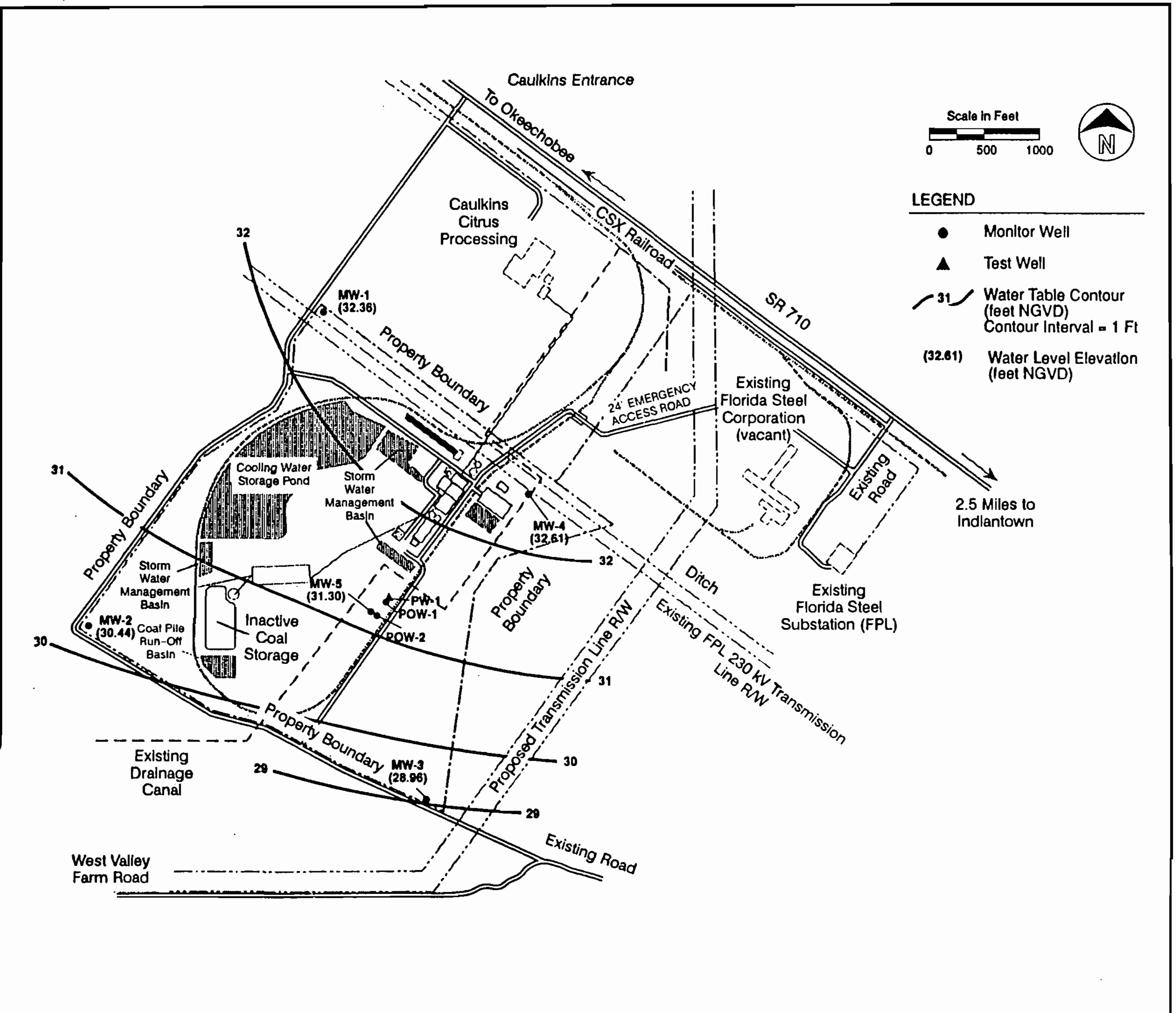

Figure 2.3.2-1.
MONITOR WELL, TEST WELL, AND GEOLOGIC SECTION LOCATIONS

Source: CH2M Hill, 1990

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All wells were constructed using mud rotary drilling techniques. A bentonite mud, Quik Gel[R], was used on PW-1, and either Vari-Flo[R] or Poly-Sal[R], both biodegradable muds, were used to drill the other well borings. The drilling rig and all tools, drill rods, and bits were steam-cleaned before drilling each borehole.

All wells were constructed with Schedule 40 polyvinylchloride (PVC) casing. Except for a 40-foot length of 0.030-inch slot, PVC wire-wrapped screen at PW-1, all wells were completed with a Schedule 40 PVC, 0.020-inch slot screen. Well construction diagrams are provided in Section 10.5.3.

Screens were sand packed with 8/20 silica sand in all wells except PW-1. PW-1 was packed with 6/20 silica sand. The monitor wells (MW-1 through MW-5) had a 2-foot cap of bentonite pellets emplaced above the sand pack.

The tremie method was used to fill the annulus above either the sand pack or the bentonite cap with Portland Type II neat cement, with variable amounts of bentonite added. The cement top was tagged, and the cement brought to the land surface. A steel protective casing and cement pad were emplaced around the well casings to complete the well installation.

PW-1 was developed using the air lift method, but all other wells were developed by pumping. The development time varied from about 1/2 hour at MW-5 to approximately 8 hours over a 2-day period at PW-1. Wells were developed until the water produced was reasonably sediment-free.

<u>Characterization of the Surficial Aquifer System</u>

Relationship of Aquifer to Local Geology

The results of the field investigation indicate that the Surficial aquifer system is comprised of two zones of relatively high permeability separated by a unit of lower permeability. The upper zone is unconfined and bounded above by the water table and below by a thin, somewhat discontinuous, silty layer at a depth of approximately 30 feet below the land surface (bls). Monitor wells MW-1 through MW-4 are screened from approximately 20 to 30 feet bls. Lithologically, the upper zone consists of fine-to-medium sands, with a discontinuous hardpan layer near the land surface (Figure 2.3.2-2).

Below the silty layer is approximately 55 feet of very dense, very fine grained sand, with interbedded clay lenses that provide additional confinement of the lower zone.

At a depth of approximately 85 feet bls, a sandy shell layer with a thickness of approximately 30 to 40 feet is encountered (Figure 2.3.2-2). This is the lower zone of the Surficial aquifer system, within which the aquifer test well (PW-1) and deep piezometers (POW-1 and POW-2) are completed. The lower zone is generally regarded as the most productive of the two zones of the Surficial aquifer system. Lichtler (1960) notes that a shell bed at a depth of 95 feet bls is the principal production zone in the Indiantown area.

At a depth of approximately 120 feet bls, a light olive-gray, silty clay formation thought to be the Tamiami Formation is encountered, which forms the base of the Surficial aquifer system.

Water Table

The water table configuration at the site was determined from water level measurements obtained from recently installed monitor wells and piezometers. Table 2.3.2-1 summarizes the well construction details and groundwater elevations in the Surficial aquifer system at the site. In general, the depth to water from the land surface is only a few feet. The groundwater contours based on water level measurements obtained on August 17, 1990, are shown on Figure 2.3.2-3.

In addition to water level measurements obtained at the site, Figures 2.3.2-4 and 2.3.2-5 show wet and dry season water table contours throughout Martin County during 1974 (Miller, 1978). These figures indicate that the water table can be

Figure 2.3.2-2.
HYDROGEOLOGIC CROSS SECTION

Source: CH2M Hill, 1990

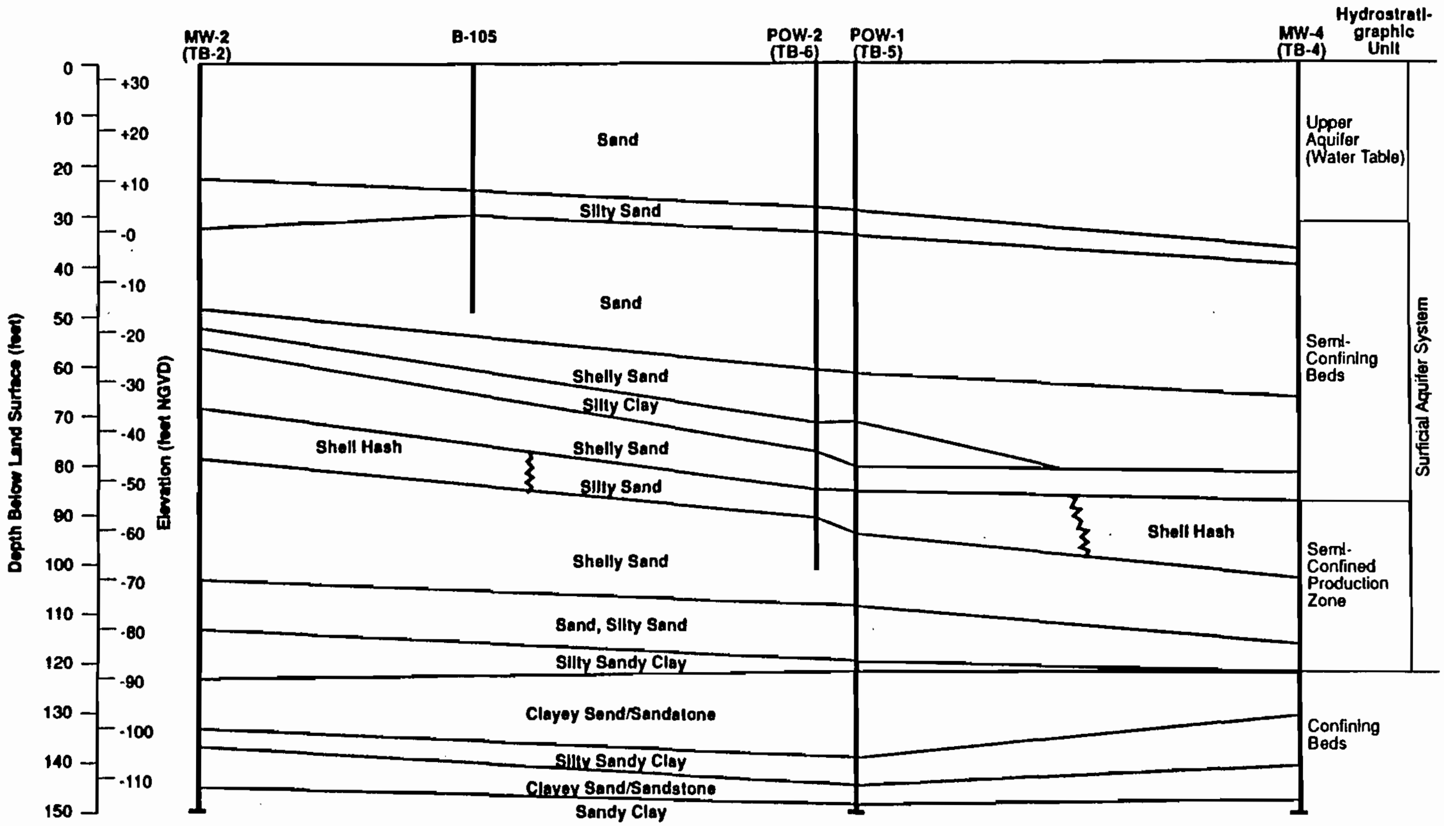

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Figure 2.3.2-3.
GENERAL CONFIGURATION OF THE SURFICIAL AQUIFER WATER TABLE, AUGUST 17, 1990

Source: CH2M Hill, 1990

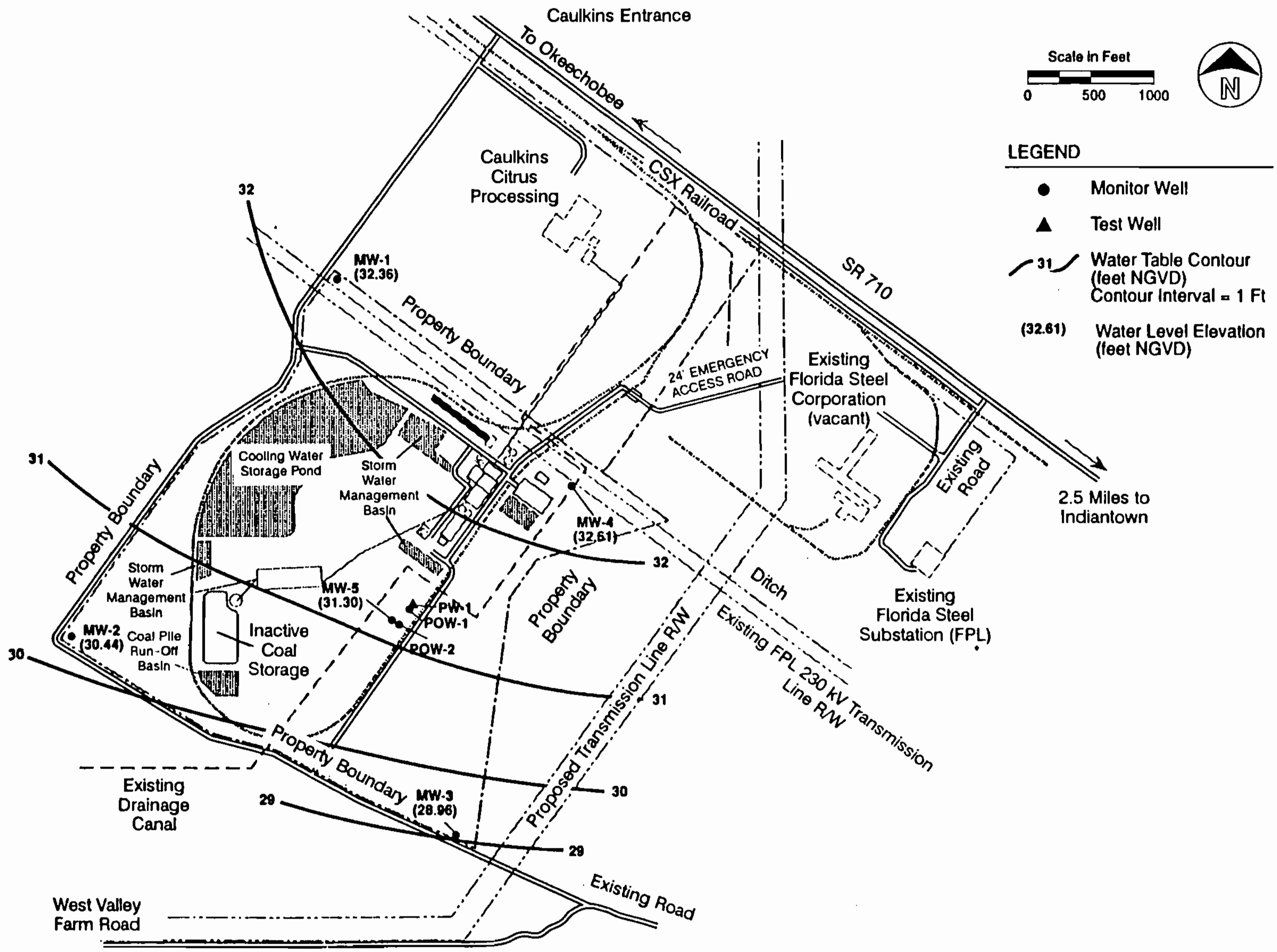

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Figure 2.3.2-4.
WET SEASON WATER TABLE CONTOURS IN MARTIN COUNTY, OCTOBER 1974

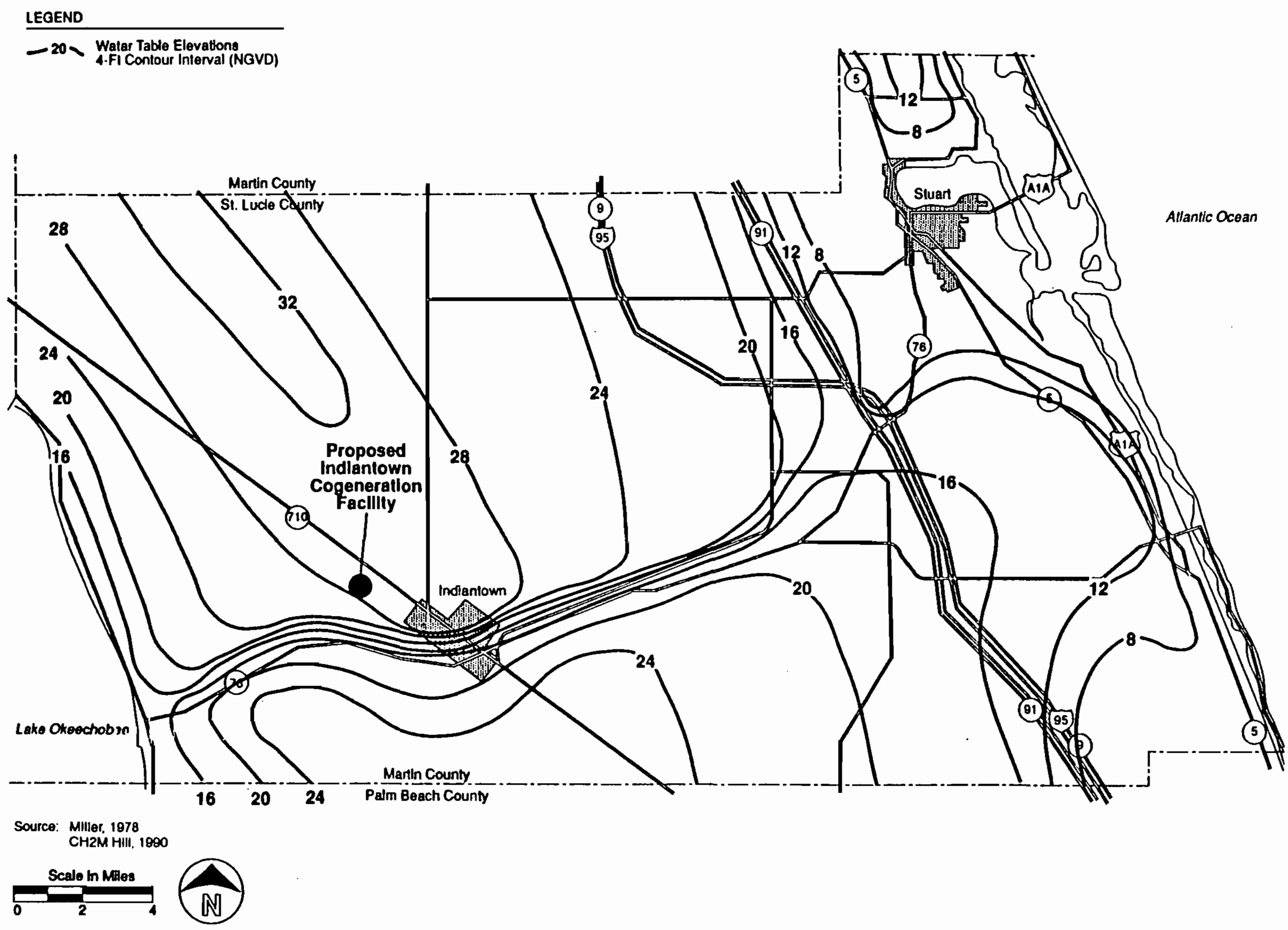

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Figure 2.3.2-5.
DRY SEASON WATER TABLE CONTOURS IN MARTIN COUNTY, MAY 1974

Source: CH2M Hill, 1990

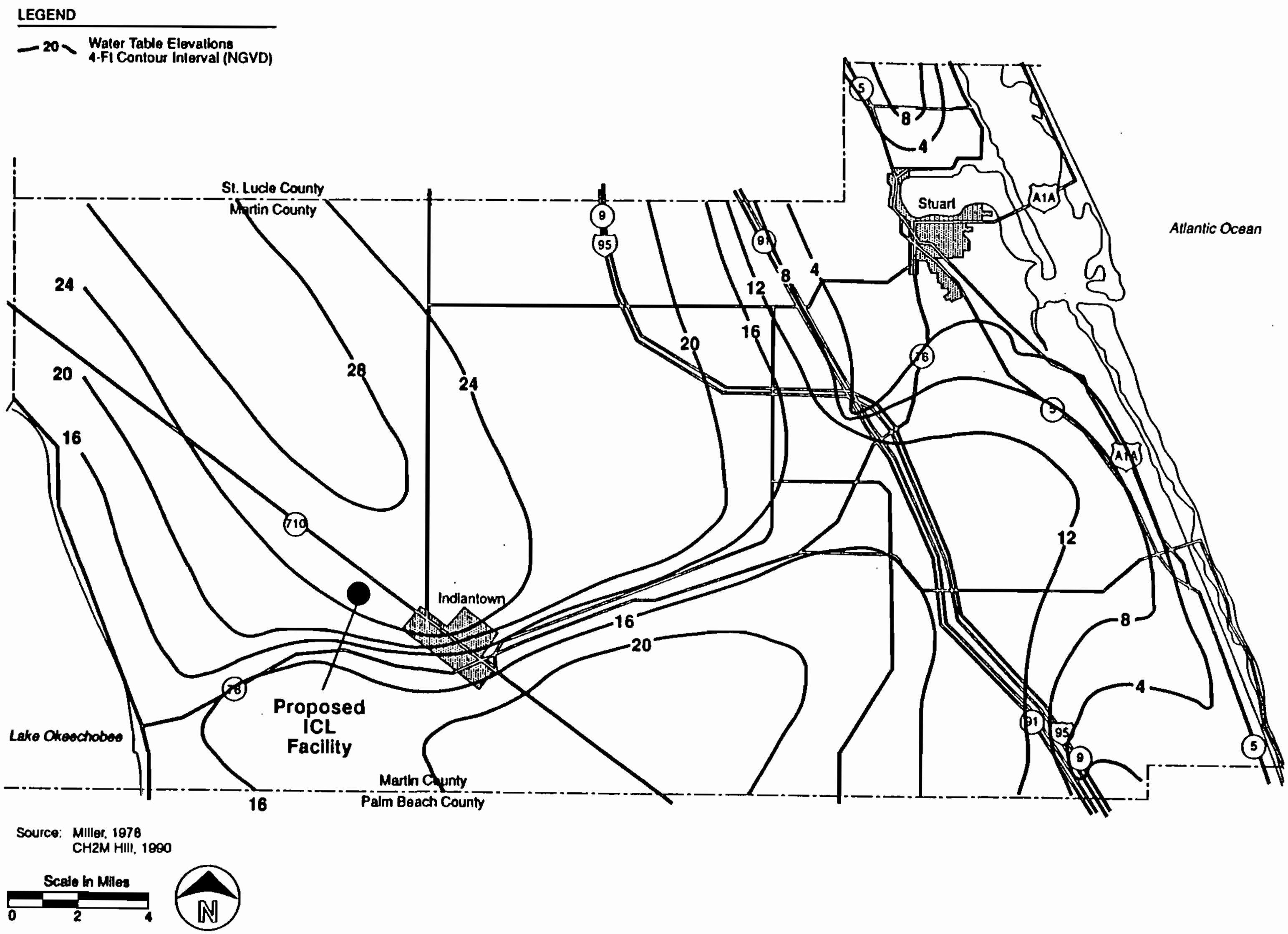

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Table 2.3.2-1
SUMMARY OF GROUNDWATER ELEVATIONS AND WELL CONSTRUCTION DETAILS AT THE ICL SITE
AUGUST 1990

Well Number	Screened Interval (feet)	Well Diameter (inches)	Top of Casing Elevation (feet)	Depth to Water (feet)	Water Level Elevation (feet)
MW-1	20 - 30	4	37.72	5.36	32.36
MW-2	15 - 25	4	34.02	3.58	30.44
MW-3	20 - 30	4	33.69	4.73	28.96
MW-4	20 - 30	4	38.21	5.60	32.61
MW-5	10 - 15	2	35.86	4.56	31.30
PW-1	80 - 120	8	35.38	5.45	29.93
POW-1	92 - 112	2	35.41	5.53	29.88
POW-2	90 - 110	2	35.87	6.31	29.56

Notes:
- Top-of-casing and water level elevations referenced to National Geodetic Vertical Datum (NGVD).
- Water level measurements obtained on August 17, 1990.
- Screened interval referenced in feet below land surface.
- Depth to water referenced from top-of-casing.
- All wells installed by Ardaman and Associates, except PW-1, installed by Drilling Services, Inc.

Source: CH2M Hill, 1990

expected to fluctuate a few feet between the wet and dry seasons. Also, the shape of the water table appears to mimic the topography, in that topographic highs correspond to higher water levels.

Groundwater Flow

In general, the water table slopes gently to the south-southwest with a horizontal hydraulic gradient of approximately 1.0 X 10^{-3} feet per foot (ft/ft). This gradient is similar to that obtained from wells completed in the lower producing zone (PW-1, POW-1, and POW-2) of the Surficial aquifer system. The groundwater flows southwesterly and discharges to the St. Lucie Canal, located approximately 2 miles south of the site (Figure 2.3.2-4).

Vertical hydraulic gradients between the upper and lower zones of the Surficial aquifer system were determined by comparing water level elevations from wells completed in these two zones. The vertical hydraulic gradient between these zones is probably affected by the thickness and areal continuity of the semi-confining unit between them. The water levels summarized in Table 2.3.2-1 indicate that, where wells are completed in both zones around the test well, the upper aquifer has a head about 1.7 feet higher than the lower aquifer. This is a 0.03-ft/ft downward gradient across the 55 feet of low permeability material from approximately 30 feet to 85 feet in depth.

Aquifer Characteristics

A 72-hour pumping test was conducted to determine aquifer characteristics at the site. The pumping test began on August 13, 1990, at 10:15 a.m. A submersible pump was installed in PW-1 and connected to a 4-inch-diameter discharge line emptying into a nearby drainage ditch. The well was pumped at a constant rate of 150 gallons per minute (gpm). Flow measurements were obtained with a manometer tube and a 4-inch by 3-inch orifice plate at the end of the discharge piping.

PW-1 was pumped and POW-1, POW-2, and MW-5 were used as observation wells from which water levels were obtained throughout the test. Water level readings were also obtained at perimeter monitor wells MW-2, MW-3, and MW-4, and at observation wells OW-101, OW-102, and OW-115. The observation wells, installed as part of the preliminary foundation evaluation at the site, are screened from approximately 20 feet to 30 feet bls. A data logger was used to obtain water level data at regular, timed intervals in POW-1 and POW-2. Two pressure transducers (30 and 10 pounds per square inch [psi]) were used in POW-1 and POW-2, respectively. The data logger was programmed to record water levels at logarithmic intervals so that readings were obtained frequently at the beginning of the test and less frequently as the test progressed. Manual water level measurements also were taken with an electrical water level indicator (M-scope) or steel tape as backup data. Field data sheets and data logger output for the pumping test are contained in Section 10.5.1.

Following 72 hours of operation, the pump was shut off, and the water levels were allowed to recover. Water levels were measured during recovery at PW-1, POW-1, POW-2, and MW-5.

Two days of background water level data were obtained prior to the test by using the data logger on POW-2. Water level data also were obtained at POW-2 following the 72-hour pumping test. These data show that the naturally occuring water level in POW-2 was essentially the same before and after the pumping test. Therefore, adjustments to the drawdown data were not required.

The data were evaluated using the following three techniques:

- Walton (1962)
- Cooper-Jacob (1946)
- Theis recovery method

The drawdown data from POW-1 and POW-2 were evaluated using the Walton method, which applies to unsteady state flow in semi-confined (leaky) aquifers and assumes no storage within the semi-confining bed. Transmissivity (T), storativity (S), and leakance (K'/b') were estimated for the aquifer at POW-1 and POW-2 by plotting drawdown versus time on log-log paper and by superimposing type curves. The calculations to determine these parameters are presented in Section 10.5.1.

Second, the data were evaluated using the Cooper and Jacob (1946) "straight-line" method. For this analysis, a semi-log graph of drawdown versus time was developed for POW-1 and POW-2. These graphs are also contained in Section 10.5.1. Finally, recovery data from PW-1, POW-1, and POW-2 were evaluated using the Theis recovery method to determine transmissivity. Graphs of residual drawdown versus a time ratio (t/t') were plotted on semi-log paper to determine T values. Storativity was not determined because of inherent limitations of the Theis recovery method.

The Surficial aquifer system in Martin County is regionally regarded as being unconfined (Lichtler, 1960). However, analysis of the pumping test data at the project site indicates semi-confined (leaky) conditions. A summary of aquifer coefficients determined from the pumping test analyses is provided in Table 2.3.2-2. The Walton method assumes unsteady state flow in leaky aquifers. However, the straight-line method (Cooper and Jacob, 1946) and the Theis recovery method both assume perfectly confined aquifers; this limiting assumption tends to yield slightly higher T values for these methods because leakance is not taken into account. Data at POW-2 illustrate this concept (e.g., the Walton method yielded a T value of 4,775 gpd/ft, while Cooper-Jacob and Theis recovery methods yielded T values of 6,286 and 6,397 gpd/ft, respectively). Thus, the Walton method, which assumes leaky aquifer conditions, appears to yield results most representative of the field conditions.

Table 2.3.2-2
AQUIFER COEFFICIENTS DERIVED FROM
72-HOUR PUMPING TEST
AUGUST 1990

Well No.	Method	Transmissivity (gpd/ft)	Storativity (Dimensionless)	Leakance (gpd/ft^3)
POW-1	Walton	5,372	1.40×10^{-4}	1.3×10^{-3}
	Cooper-Jacob	5,657	1.32×10^{-4}	NA
	Theis-Recovery	5,306	NA	NA
POW-2	Walton	4,775	1.33×10^{-4}	2.7×10^{-3}
	Cooper-Jacob	6,286	1.11×10^{-4}	NA
	Theis-Recovery	6,397	NA	NA
PW-1	Theis-Recovery	5,236	NA	NA
	Average	5,600	1.3×10^{-4}	2.0×10^{-3}

Note: NA = Not applicable

Source: CM2M Hill, 1990

As stated previously, water level data also were obtained in perimeter monitor wells and observation wells completed in the upper 30 feet of the Surficial aquifer system at the site (Section 10.5.1). Water levels in these wells varied randomly, with no apparent response to pumping the aquifer at PW-1.

Groundwater velocity beneath the site was calculated according to the following equation:

$$v = Ki/n \qquad \text{(Heath, 1983)}$$

where:

- v = average groundwater velocity in feet per day (ft/day)
- K = hydraulic conductivity (ft/day)
- i = hydraulic gradient (ft/ft)
- n = effective porosity (dimensionless)

Using an average T value of 5,600 gpd/ft, an aquifer thickness of 40 feet for the lower producing zone, and the relation T = Kb, a K value of 140 gpd/ft^2 (18.7 ft/day) was calculated. Assuming an effective porosity of 0.35 (based on the laboratory test result on a sample collected from the pumping zone), and the calculated hydraulic gradient of 1×10^{-3} ft/ft, a groundwater velocity of 5.3×10^{-2} ft/day was determined.

Water Quality

Water quality samples were obtained from PW-1 at the end of the pumping test and from MW-1 through MW-4 to determine background water quality. Water quality samples were obtained directly from the pump discharge piping at the end of the pumping test at PW-1. Before sampling the monitor wells, a minimum of three well volumes were purged from each well to ensure that native formation water was obtained. Once the temperature, conductivity, and pH of the water had stabilized, a clean Teflon® bailer was lowered into each well to collect the groundwater sample. The pump and intake hose used to purge the well and bailer were cleaned between wells with an isopropanol rinse, followed by rinsing with deionized water to avoid cross-contamination. Quality assurance samples (travel blanks) also were submitted to the laboratory for analysis.

Water quality samples were analyzed for general inorganic parameters, metals, ethylene dibromide (EDB), pesticides, herbicides, and Environmental Protection Agency (EPA) Methods 601/602 parameters. Laboratory analytical data for the water quality samples are contained in Section 10.5.1 and represent the first of four quarterly sampling events to be performed at the site. Additional sampling will be performed to determine if any seasonal fluctuations in water quality occur. The results of selected inorganic parameter analyses are summarized in Table 2.3.2-3.

For EPA Methods 601/602, EDB, pesticides, and herbides analyses, no parameters had values reported above the detection limit. Samples from MW-1 through MW-4 exceeded drinking water standards for three parameters -- color, turbidity, and iron (Section 10.5.1). Samples from MW-1, MW-2, and MW-4 exceeded the pH standard as well. Also, MW-3 slightly exceeded drinking water standards for total dissolved solids (TDS) with a value of 562 mg/l.

The metals analyses were essentially below the detection limit except for two metals in MW-3 and MW-4. Copper was noted in MW-3 at 0.02 mg/l and at 0.03 mg/l in MW-4, while lead was detected in MW-4 at 0.003 mg/l. However, it should be noted that lead was present in the travel blank at 0.011 mg/l. Boron was detected in all samples and ranged from 0.025 mg/l to 0.039 mg/l. The highest value was reported in MW-3.

The selected inorganic parameters presented in Table 2.3.2-3 are grouped to show the differences and similarities in water quality. The range of values for MW-1, MW-2, and MW-4 is presented in one column because the results were so similar. This water is slightly acidic, moderately colored with some turbidity, and contains moderate concentrations of chloride and sulfate.

Table 2.3.2-3
SUMMARY OF BACKGROUND WATER QUALITY
AUGUST 17, 1990

Parameter[a]	MCL[b]	MW-1, -2, & -4	MW-3	PW-1
pH (standard units)	6.5 - 8.5	4.85 - 6.40	6.95	7.15
Alkalinity, Total (as $CaCO_3$)	--	<1.0 - 88.0	280	280
Color (APHA)	15	50 - 90	50	10
Conductivity (μmhos/cm)	--	125 - 370	783	567
Hardness, Total (as $CaCO_3$)	--	30 - 122	336	340
Turbidity (NTU)	1	5.7 - 16.3	12.6	<0.2
TDS	500	168 - 334	562	392
Calcium	--	1.9 - 35.0	124	85
Copper	1	<0.02 - 0.03	0.02	<0.02
Iron	0.3	0.96 - 2.0	2.7	<0.02
Lead	0.05	<0.002 - 0.003	<0.002	<0.002
Potassium	--	0.31 - 1.30	0.79	1.66
Silica	--	8.2 - 9.1	10.6	17.2
Sodium	160	15.8 - 23.4	28.7	11.9
Boron	--	0.025 - 0.029	0.039	0.025
Chloride	250	29.1 - 32.1	72.0	18.3
Fluoride	4.0	0.03 - 0.05	0.34	0.12
Sulfate	250	3.9 - 5.3	1.2	<1.0
Ammonia	--	0.19 - 0.86	1.89	0.52
Total Phosphorus	--	0.09 - 0.18	1.18	0.35

[a]Values are mg/l as substance unless otherwise stated.
[b]MCL = Maximum Contaminant Level per Ch. 17-550 F.A.C.

Source: CH2M Hill, 1990

By contrast, the data from MW-3 and PW-1 are more similar to each other than to the other monitor wells. These samples have higher values for pH, alkalinity, conductivity, hardness, TDS, calcium, and fluoride. Differences in water quality between MW-3 and the other Surficial monitor wells may be due to the lithology screened by the well. Inspection of the boring logs (Section 10.5.1) indicates that MW-1, MW-2, and MW-4 are screened within fine sands, but MW-3 is screened within a sandy limestone unit.

Other Potentially Impacted Aquifers

The lower Floridan aquifer (Boulder Zone of the Floridan aquifer system) will be utilized for wastewater disposal, and the upper Floridan aquifer will be used as the alternative water supply purposes by the ICL facility. The Floridan aquifer system is a regional carbonate aquifer underlying Florida, south Georgia, and portions of Alabama and South Carolina. The rock units comprising the aquifer system range in age from Paleocene to early Miocene (Miller, 1986). A description of the geologic units in the study area is provided in Section 2.3.1.1.

The limestones and dolomites comprising the aquifer system vary from highly permeable zones to moderately permeable zones. Meyer (1989) divides the Floridan aquifer system into three hydrogeologic units based on geology, hydrochemistry, and hydraulics. The upper Floridan aquifer and middle confining unit contain brackish water, and the lower Floridan aquifer contains water similar to seawater (Meyer, 1989). Based on field data in the vicinity of the site, the upper Floridan aquifer may be further divided into an upper and lower unit (CH2M HILL, 1985 and 1989; Florida Power and Light, 1990).

The upper Floridan aquifer will be impacted by the operation of the ICL facility because it is proposed to be used as an alternative source of cooling tower makeup water and plant process water. Production wells constructed in the lower portion of the upper Floridan aquifer are expected to withdraw a maximum of 6.2 million gallons per day (mgd) for up to 90 days during years of severe drought.

The wellfield will consist of two wells constructed into the upper unit of the upper Floridan aquifer and four wells constructed into the lower unit. The proposed locations of these wells, essentially at the four corners of the site, are shown on Figure 3.1.1-1 in Section 3.1. Each of the two wells in the upper unit will be designed to supply 300 gpm of water for plant process use, with one well used for backup purposes. The four wells into the lower unit will be designed to supply 1,000 gpm each for cooling tower makeup water.

Upper Floridan Aquifer

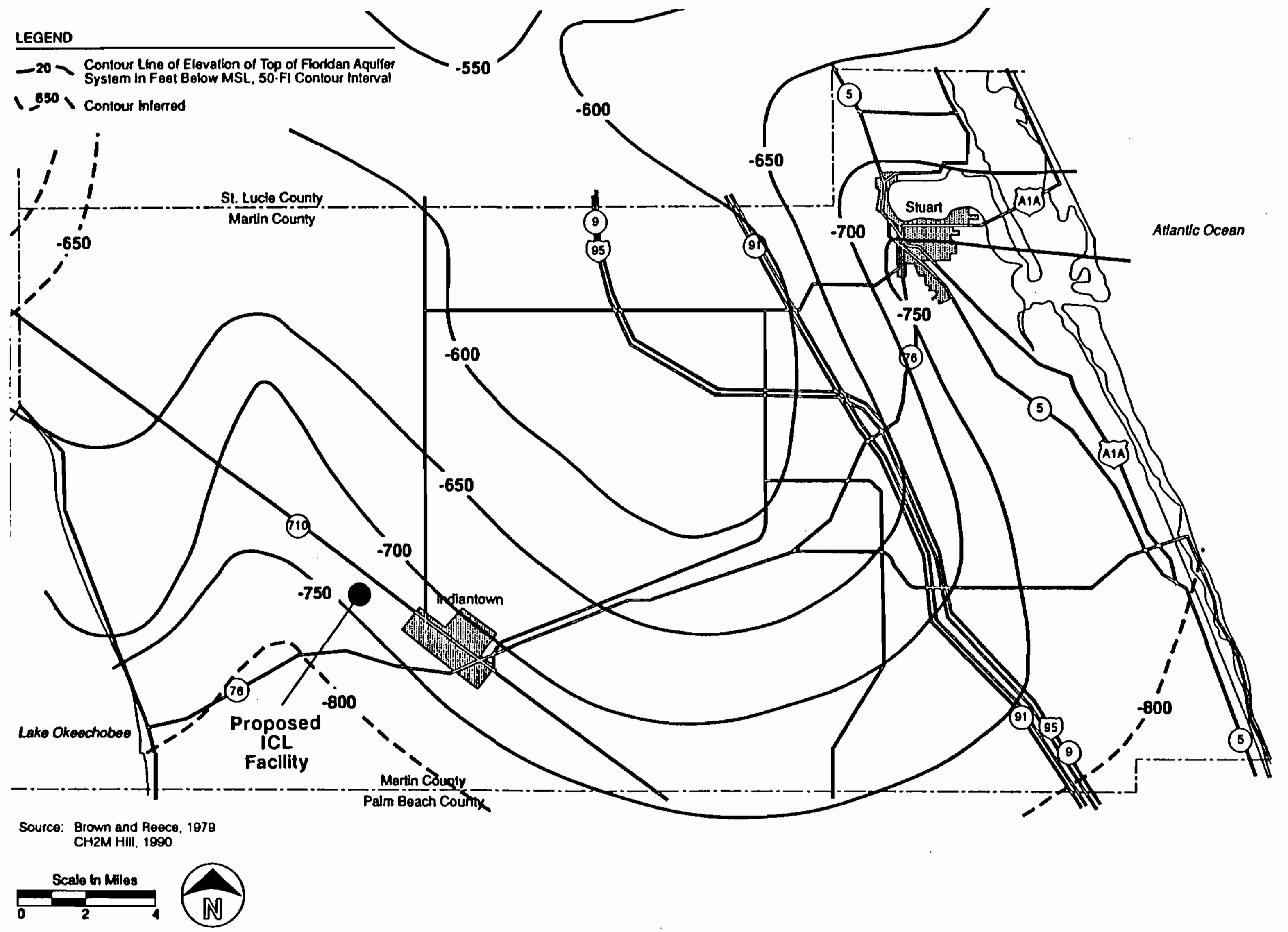
The upper Floridan aquifer is defined according to its permeability characteristics (Miller, 1986). In general, the upper Floridan aquifer in south Florida is composed of permeable portions of the Tampa, Suwannee, and Ocala Limestones and permeable portions of the upper part of the Avon Park Formation (Meyer, 1989), which range in age from Oligocene to Middle Eocene. According to Brown and Reece (1979), the elevation of the top of the Floridan aquifer system in Martin and St. Lucie Counties ranges from approximately 600 to 800 feet below mean sea level. Figure 2.3.2-6 shows the configuration of the top of the upper Floridan aquifer.

A discrepancy exists between the hydrogeologic section that Miller (1986) describes (Plates 25 through 33) in his report, in terms of the water-transmitting characteristics of various intervals, and the results of aquifer testing at sites in the vicinity of the proposed ICL facility. Miller indicates in Plate 30 that the interval between approximately 1,000 and 1,500 feet in depth is assigned to the middle confining Unit I. However, aquifer testing data from the Lake Okeechobee Aquifer Storage Recovery (ASR) site (CH2M HILL, 1989), Pratt and Whitney (CH2M HILL, 1985), and Florida Power and Light's (FPL) Martin plant (FPL, 1990) indicate that approximately the lower 200 feet of this interval is highly transmissive.

An ASR demonstration project was performed by CH2M HILL (1989) for the South Florida Water Management District at a site located about 23 miles northwest of the ICL facility. The ASR test well was completed to a depth of 1,700 feet, with the

Figure 2.3.2-6.
ELEVATION OF THE TOP OF FLORIDAN AQUIFER SYSTEM, MARTIN COUNTY

Source: CH2M Hill, 1990



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final casing set to 1,268 feet in depth. The well is completed in a fractured, dolomitic unit with calculated transmissivity values ranging from about 4.4 to 5.7 X 10^6 gpd/ft.

A similar zone of high transmissivity was identified at the Pratt and Whitney plant (CH2M HILL, 1985), located about 9 miles from the ICL facility. Beginning at about 1,390 feet bls, Middle Eocene age strata consisting of highly sucrosic and honey-combed dolomite persist to a depth of approximately 1,750 feet. This zone was found to be highly permeable and was difficult to drill through because of extensive fractures and solution cavities.

A high transmissivity value was determined for the lower zone of a Floridan aquifer well (LFM-1) located approximately 3.5 miles northwest of the ICL facility at the FPL Martin site. A transmissivity of 2.5 X 10^6 gpd/ft was determined for the interval from about 1,350 to 1,450 feet (FPL, 1990). A log of this well indicates that this zone contains a "somewhat vesicular dolostone with high to moderate visible porosity".

Potentiometric Surface - In general, the potentiometric surface of the Floridan aquifer system in Martin County is above the water table surface, but has undergone a gradual lowering in the last three decades (Nealon et. al., 1987). Except for some topographically high sandhills in the eastern part of the county, the potentiometric surface is above the land surface in Martin County (Lichtler, 1960).

The most recent published map available showing the potentiometric surface of the Floridan aquifer system is found in Nealon et. al. (1987), and provides a dry season potentiometric surface from May 1984. The most recent published wet season potentiometric map available is found in Brown and Reece (1979), and shows the potentiometric surface from September 1977. Both these maps are reproduced here as Figures 2.3.2-7 and 2.3.2-8.

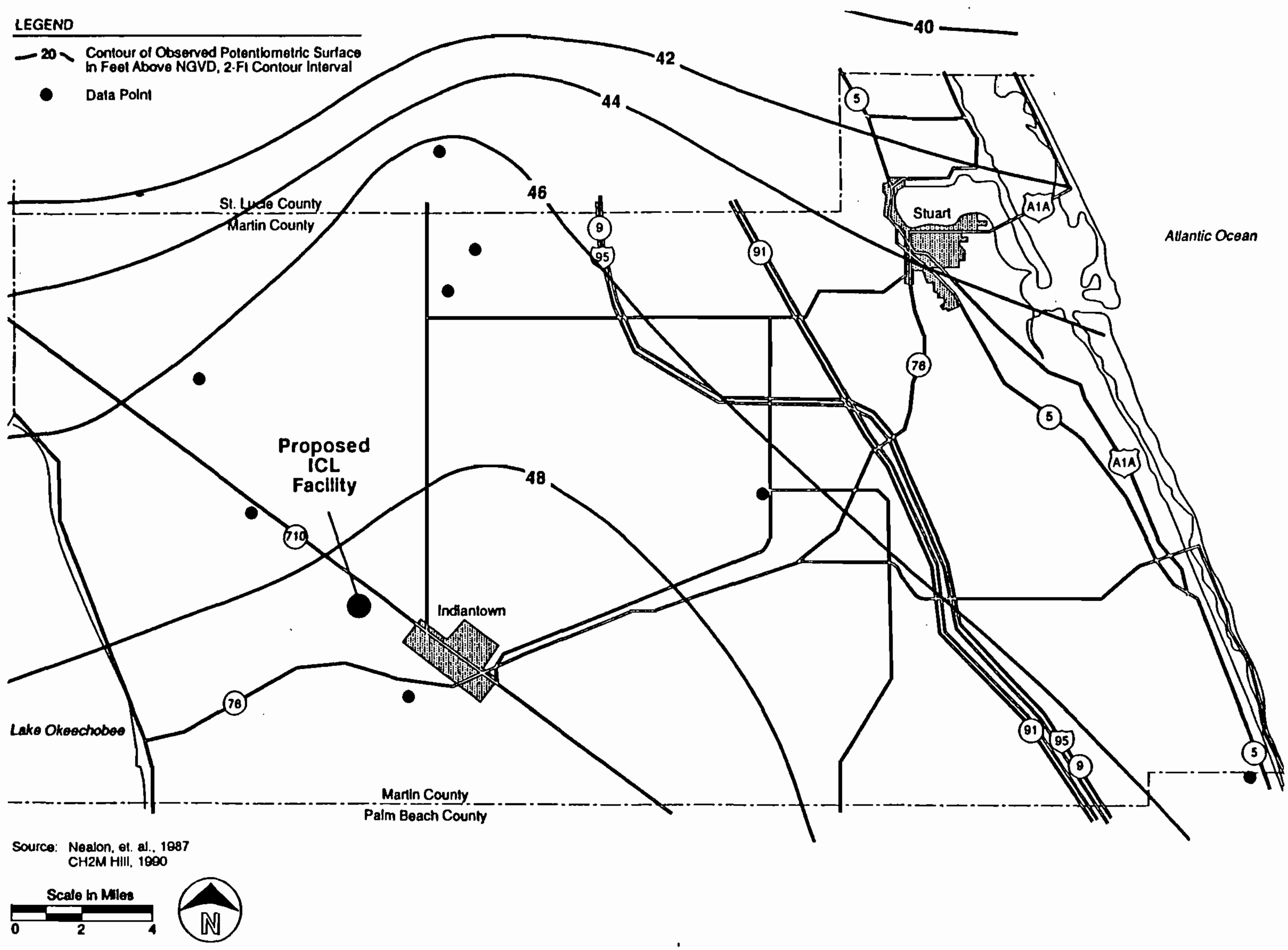

Figure 2.3.2-7.
POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER SYSTEM IN MARTIN COUNTY, MAY 1984

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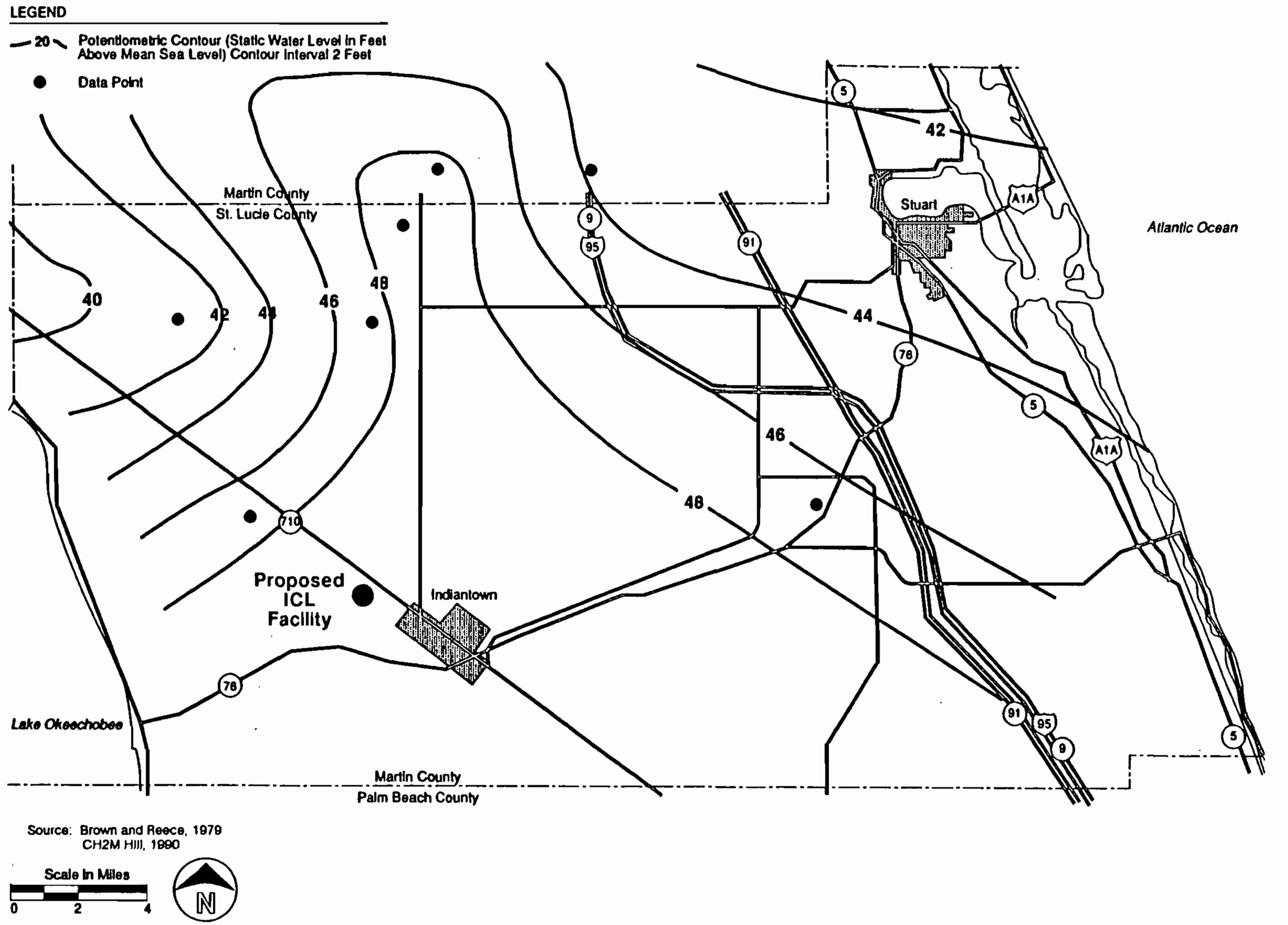
Figure 2.3.2-8.
POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER SYSTEM IN MARTIN COUNTY, SEPTEMBER 1977

Source: CH2M Hill, 1990



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Lichtler (1960) reports that in December 1957 the potentiometric surface ranged from 48 to 53 feet above mean sea level, and that it sloped in an east-southeast direction in Martin County. By May 1984, the gradient had changed to a north-northeast direction, and the surface elevations ranged from 41 feet above mean sea level in the northeast part of the county to 48 feet in the southwest part (Nealon et. al., 1987). The general configuration of the potentiometric contours is the same at the end of the wet season for September 1977, but the elevations are up to 2 feet higher. Nealon et. al. (1987) attributes the lowering of the potentiometric surface and the change in groundwater flow direction to irrigation withdrawals from the aquifer system.

Groundwater Flow - The regional direction of groundwater flow is illustrated on Figure 2.3.2-9, as adopted from Meyer (1989). Meyer indicates that groundwater movement is generally southward from the Polk County potentiometric surface high shown on Figure 2.3.2-9. Groundwater then flows from the groundwater divide to the Atlantic Ocean and the Gulf of Mexico. Flow in Martin County, as indicated by lines perpendicular to the potentiometric contours, is generally to the northeast.

Meyer (1989) attempted to assess the rate of flow in the upper Floridan aquifer from the Polk County high southward by calculating velocities and transit times along segments of the flow lines shown on Figure 2.3.2-9 from estimated pre-development (late 1800s to early 1900s) hydraulic gradients. The velocities ranged from a minimum of 0.5 feet per year to a maximum of 93.0 feet per year along the selected flow segments.

Hydraulic gradients were measured in Martin County from the May 1984 potentiometric map, and averaged 0.42 feet per mile. Meyer (1989) reports that the predevelopment potentiometric surface in south Florida was probably 5 to 10 feet higher than it is now. Water use practices north of Lake Okeechobee may have lowered the potentiometric surface high, resulting in reduced hydraulic gradients in south Florida.

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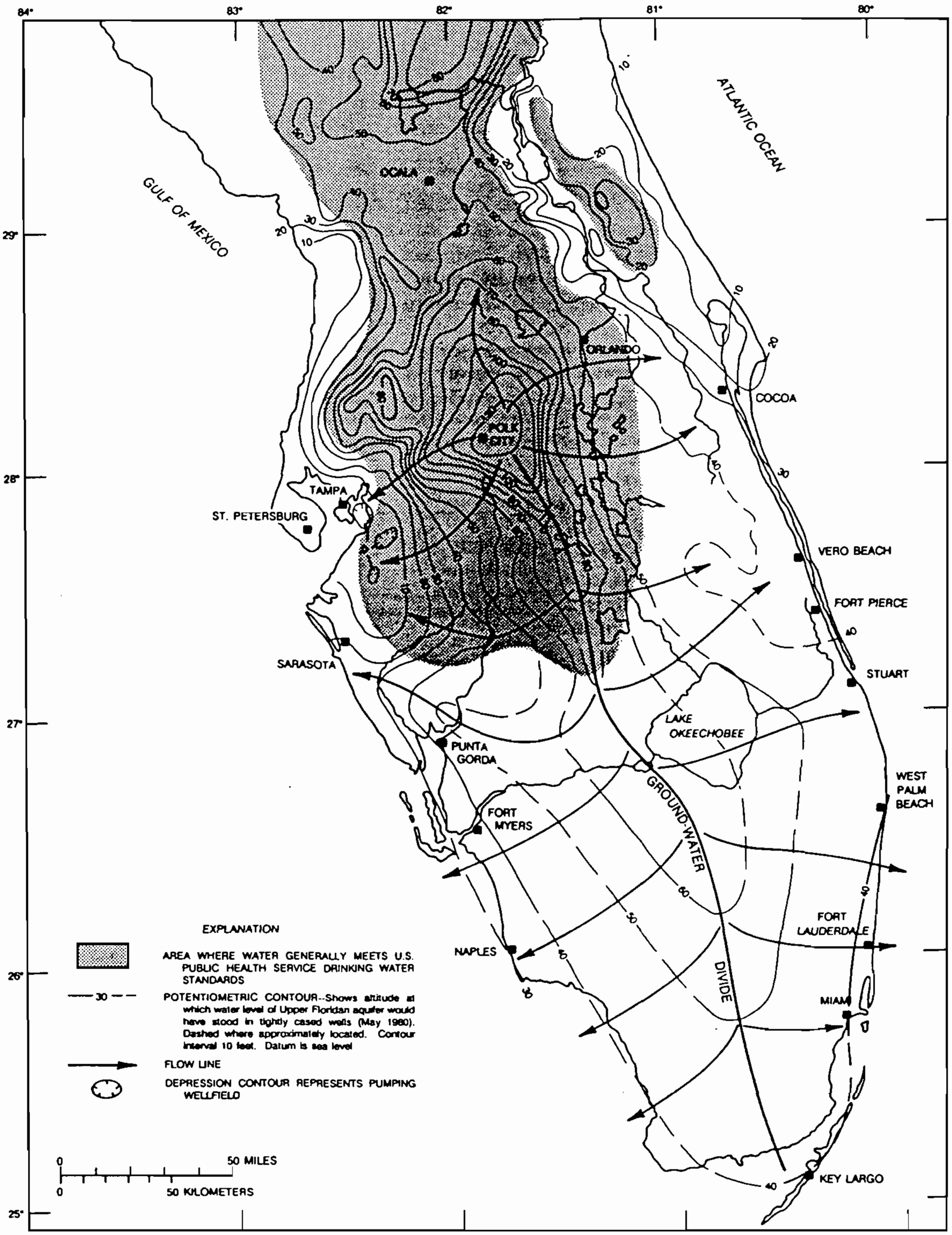

Figure 2.3.2-9.

POTENTIOMETRIC SURFACE OF UPPER FLORIDAN AQUIFER. PENINSULAR FLORIDA IN MAY 1980

Source: CH2M Hill, 1990; Meyer, 1989

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All of south Florida is a discharge area for the upper Floridan aquifer. Lichtler (1960) indicates that there are no known springs in Martin County. Johnston and Bush (1988) estimate that discharge from the upper Floridan aquifer in south Florida was entirely from diffuse upward leakage under predevelopment conditions. Aucott (1988) indicates that this diffuse upward leakage is less than 1 inch per year. All other water flowing through the aquifer system in Martin County is eventually discharged into the ocean (Nealon et. al., 1987).

Aquifer Characteristics - Plate 28 of Miller (1986) shows the thickness of the upper Floridan aquifer throughout the state. In Martin County, the thickness varies from approximately 400 feet in the western part of the county to 700 feet in the eastern part, and is estimated to be about 500 feet at the site.

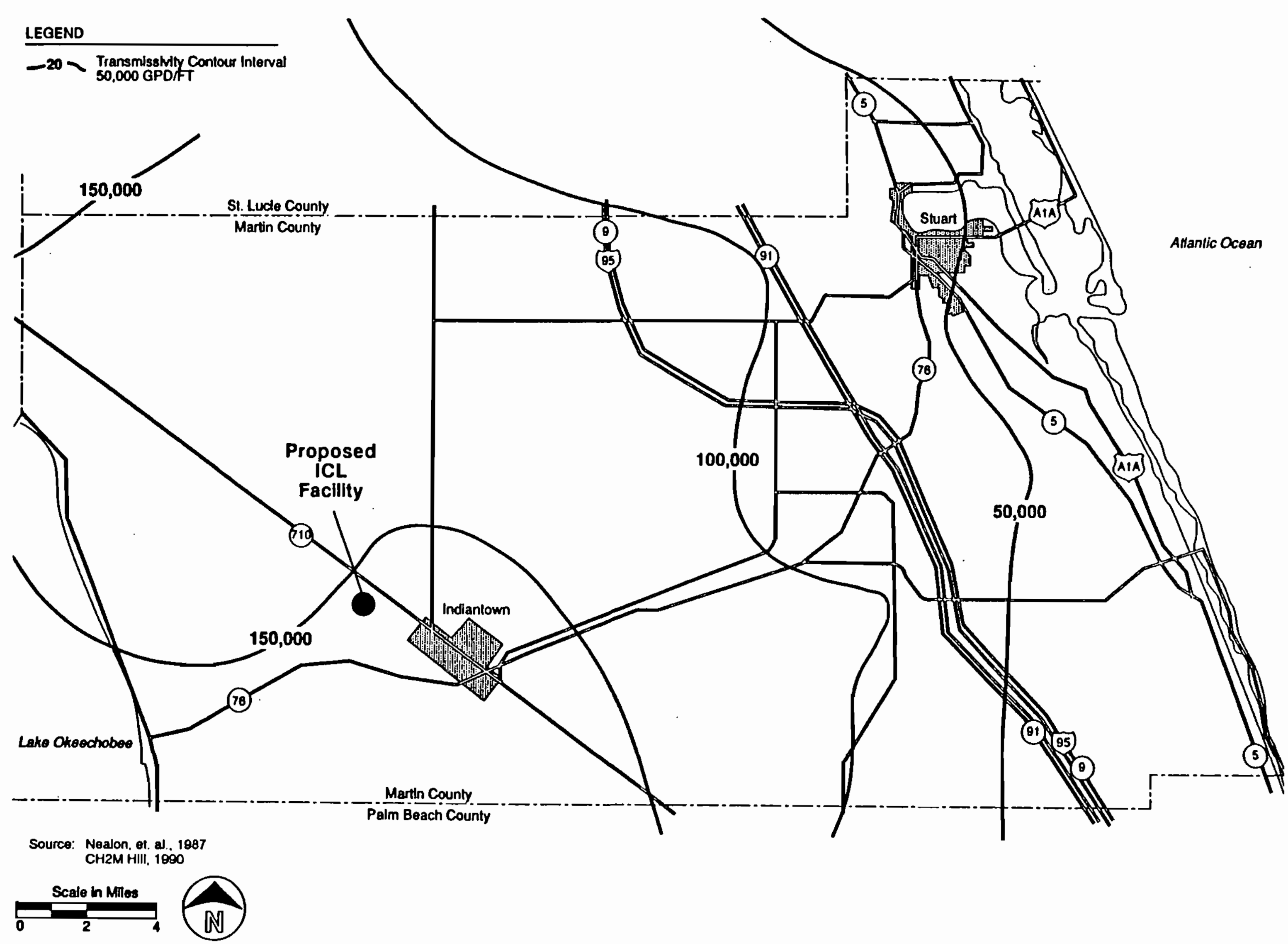
Values of transmissivity contained in the literature on the upper Floridan aquifer indicate that the western half of the county has a higher transmissivity than the eastern half. Nealon et. al. (1987) report a transmissivity ranging from less than 50,000 to over 150,000 gpd/ft, with a distribution as shown on Figure 2.3.2-10. Johnston and Bush (1988) provide a range in the storage coefficient of the upper Floridan aquifer from 1.0×10^{-5} to 2.0×10^{-2}, with the most common values in the 10^{-3} to 10^{-4} range.

A deep well at the FPL Martin site (MF-23) is completed within the upper unit of the upper Floridan aquifer. Aquifer testing in this well yielded a transmissivity of 100,000 gpd/ft, which is consistent with published data for irrigation wells in the area (FPL, 1990).

Water Quality and Utilization - Water from the upper Floridan aquifer is generally suitable only for irrigation and other non-potable purposes. Irrigation use occurs principally in the west and north parts of the county. Johnston and Bush (1988) estimate that 5 to 20 mgd of water is withdrawn from the Floridan aquifer system in Martin County. Brown and Reece (1979) report chloride values in the Floridan aquifer system ranging from 200 to 1,400 milligrams per liter (mg/l) in

Figure 2.3.2-10

TRANSMISSIVITY OF THE UPPER FLORIDAN AQUIFER, MARTIN COUNTY



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September 1977, with the contoured distribution as shown on Figure 2.3.2-11. Sprinkle (1989) reports chloride values from 250 to 1,000 mg/l in the western one-fourth of the county, and less than 1,000 mg/l in the eastern three-fourths of the county. Groundwater samples from LFM-1, representing the highly transmissive zone of the upper Floridan aquifer, yielded a chloride concentration of 2,488 mg/l and a TDS value of 4,735 mg/l (FPL, 1990). Comparison of this data with that from MF-23 indicates that the highly transmissive zone has higher chloride concentrations than that of the upper part of the lower transmissivity zone.

Brown and Reece (1979) report TDS concentrations ranging from 500 to over 3,000 mg/l for September 1977 (Figure 2.3.2-12). By comparing the TDS values from three wells that were sampled by Lichtler in 1957, Brown and Reece concluded that the TDS of the Floridan aquifer in Martin County has not significantly changed in the last 20 years. Meyer (1989) provides a contour map of the dissolved solids in the upper Floridan aquifer that shows a similar range in concentrations from 1,000 to over 3,000 mg/l of TDS.

Water samples obtained from reverse-air drilling and packer pumping tests at the ASR well (CH2M HILL, 1989) were analyzed in the field and laboratory. A water quality change was noted at approximately 1,300 feet bls. Above 1,300 feet, water quality analyses identified concentrations of 564 mg/l of TDS, 115 mg/l of chlorides, and 920 μmhos/cm of conductivity. Below 1,300 feet, these concentrations increased progressively to 6,040 mg/l of TDS; 2,920 mg/l of chlorides; and 10,360 μmhos/cm of conductivity at 1,619 feet in depth.

Four reverse osmosis plants currently exist in Martin County (Nealon et. al., 1987) that use the Floridan aquifer as a raw water source. These plants provide potable public water supplies on the barrier islands. The upper Floridan aquifer was identified in that report as a potential alternative supply that could augment the Surficial aquifer supply.

Figure 2.3.2-11
CHLORIDE CONCENTRATION OF FLORIDAN AQUIFER SYSTEM IN MARTIN COUNTY, SEPTEMBER 1977

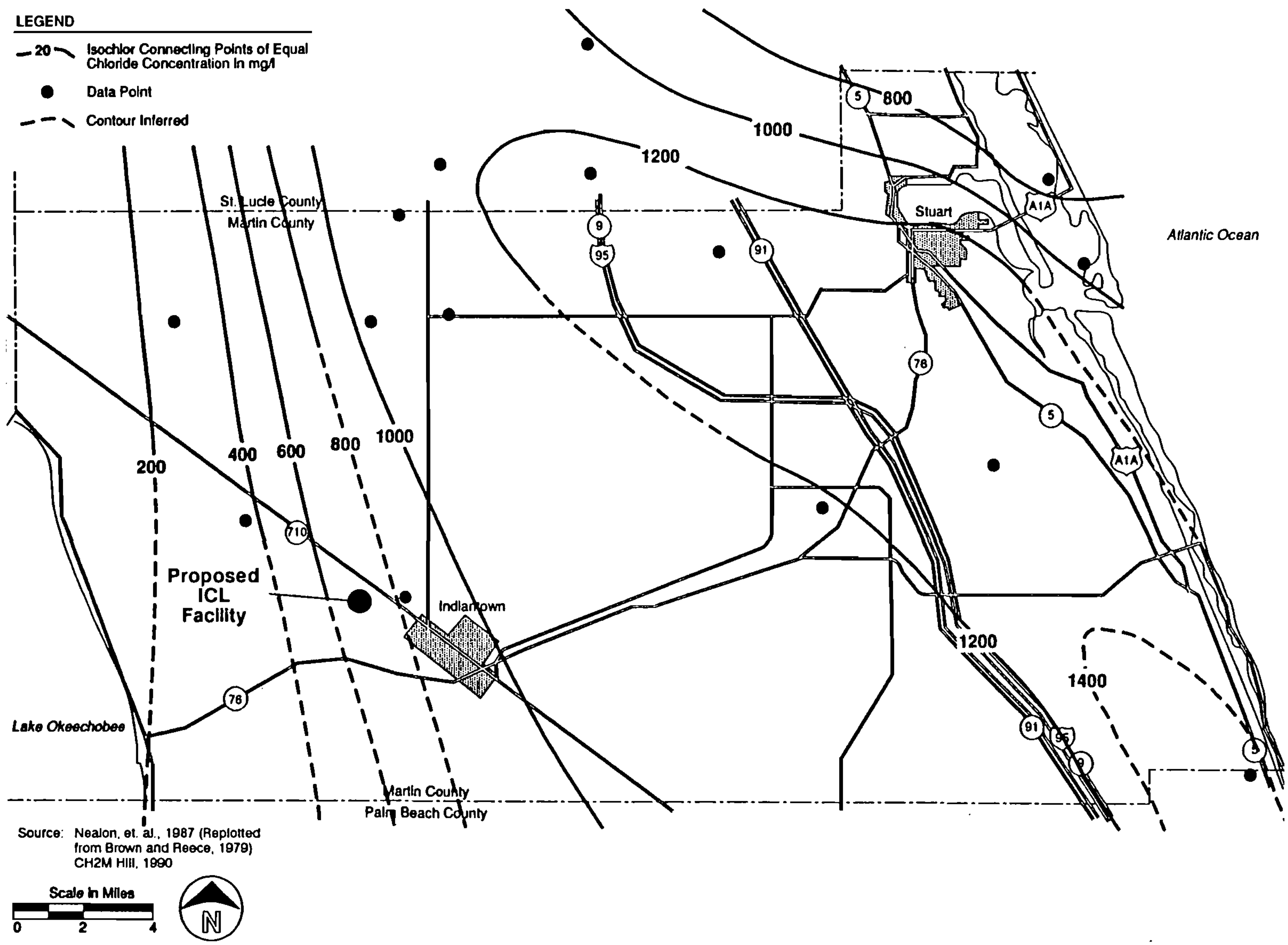

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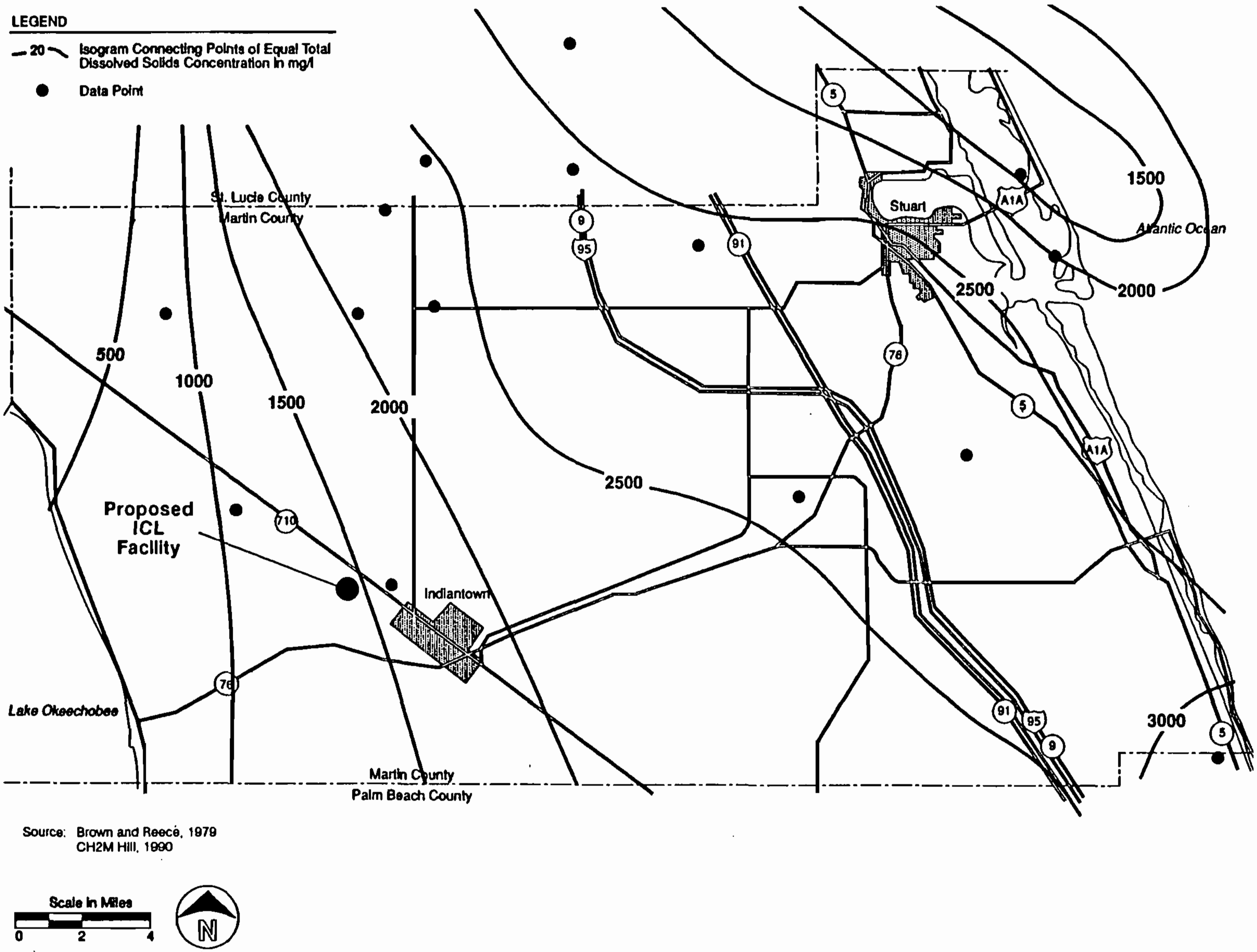
Figure 2.3.2-12.
TOTAL DISSOLVED SOLIDS OF FLORIDAN AQUIFER SYSTEM IN MARTIN COUNTY, SEPTEMBER 1977



Source: Brown and Reecé, 1979
CH2M Hill, 1990

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Lower Floridan Aquifer Boulder Zone

The lower Floridan aquifer consists of the Oldsmar Formation of Early Eocene age and may include the upper part of the Late Paleocene age Cedar Keys Formation (Meyer, 1989). The Lower Floridan contains sub-zones of low and high permeability that have a subregional extent (Miller, 1986). The Boulder Zone of south Florida is such a sub-zone with a high transmissivity. The Boulder Zone is the portion of the lower Floridan aquifer that may be impacted by the operation of the ICL facility because it will receive injected wastewater.

Potentiometric Surface - No potentiometric surface map of the lower Floridan aquifer was found in the literature.

Groundwater Flow - Meyer (1989) calculated hydraulic gradients and velocity for the Boulder Zone in south Florida based on water level measurements and radiocarbon dating. His findings are duplicated in Table 2.3.2-4. Meyer's Site 9 is in Fort Lauderdale and Site 10 is 44.5 miles west of Site 9. Meyer calculates an inland hydraulic gradient of 8.5×10^{-7} feet per foot, compared with a gradient of 3.8×10^{-7} based on transit time from radiocarbon dating. The velocities between the two sites range from 59.7 to 29.8 feet per year based on calculations and assumptions (such as porosity ranging from 0.2 to 0.4), compared with 17 feet per year based on radiocarbon dating.

Aquifer Characteristics - The thickness of the lower Floridan aquifer is mapped for the state on Plate 32 of Miller (1986). For Martin County, the thickness ranges from less than 1,900 feet in the northwest corner of the county to greater than 2,500 feet in the south-southeast portion of the county.

Transmissivity values for the Boulder Zone of the lower Floridan aquifer range from 3.2×10^{-6} ft^2/day to 2.4×10^{-7} ft^2/day (Meyer, 1989). Meyer (1989) used a transmissivity value of 2.5×10^{-7} ft^2/day for the calculations found in Table 2.3.2-4. No storage coefficient values for the lower Floridan aquifer were found in the literature.

Table 2.3.2-4
ESTIMATED HYDRAULIC GRADIENTS AND RELATED HYDRAULIC DATA BASED ON MEASURED WATER LEVELS AND RADIOCARBON DATING BOULDER ZONE OF THE LOWER FLORIDAN AQUIFER

Measurement No.	Referenced Segment	Distance (miles)	Head Difference (feet)	Hydraulic Gradient (feet per foot)	Average Velocity (feet per year)	Transit Time (years)
1	Site 9 to Site 10[a]	44.5	0.20	8.5×10^{-7}	39.0	6,025
2	Site 9 to Site 10[b]	44.5	0.28	1.2×10^{-6}	54.6	4,300
3	Subsea outcrop to Site 9[b]	10.5	0.21	3.8×10^{-7}	17.3	3,200
4	Subsea outcrop to Site 10[b]	55.0	0.24	8.4×10^{-7}	38.7	7,500

Note: Based on transmissivity of 2.46×10^7 ft^2/day, thickness of 650 feet, and porosity of 0.30.

[a]Calculation based on fluid density, water-level measurements, and assumed aquifer characteristics.

[b]Calculation based on radiocarbon age and assumed aquifer characteristics.

Source: Adapted from Meyer, 1989.
CH2M Hill, 1990

Water Quality - The water quality of the Boulder Zone is similar in chemical composition to that of sea water. Background water quality analyses are presented in Table 2.3.2-5 for an injection well completed into the Boulder Zone and located about 24 miles southeast of the ICL facility. Background water quality is also available from several other injection wells within a 25-mile radius, but the water quality is so similar that results from one site are considered to be representative of the water quality in this zone.

Sprinkle (1989) indicates that the chloride and dissolved solids concentrations of the waters from the lower Floridan aquifer in south Florida exceed 10,000 mg/l. Thus, the most beneficial use of this zone is for waste disposal because it has no potential for water supply.

Confining Unit Between the Surficial and Upper Floridan Aquifers

Lichtler (1960) describes the Hawthorn Formation in Martin County as consisting of low-permeability strata of Miocene age, primarily consisting of phosphatic clay with silt and quartz sand, and thin layers of sandy, phosphatic limestone and chert. The Hawthorn Group (Scott, 1988) provides confinement between the Surficial aquifer system and the upper Floridan aquifer.

Lichtler (1960) reports that the Hawthorn Formation is 350 to 550 feet thick in Martin County. Nealon et. al. (1987) report that a thickness of 450 to 650 feet of phosphatic clay, dolosilts, and quartz sand are attributable to the Hawthorn Group. Miller (1986) identifies the confining unit between the Surficial aquifer system and the upper Floridan aquifer as the "upper confining unit." Miller (1986) in Plate 25 shows that the upper confining unit ranges from less than 500 feet to greater than 650 feet in thickness in Martin County. Scott (1988) shows an isopach map of the Hawthorn Group, with the thickness ranging from less than 550 feet in the northwest corner of the county to greater than 600 feet in the southeast corner of the county.

Table 2.3.2-5
TYPICAL WATER QUALITY LOWER FLORIDAN AQUIFER (BOULDER ZONE)

Parameter	Value
pH (Laboratory)	7.35
Conductivity (μmhos/cm @ 25°C)	45,200
Total Dissolved Solids (@ 180°C)	38,200 mg/l
Chloride	19,400 mg/l
Fluoride	0.62 mg/l
Iron	0.76 mg/l[a]
Calcium	2,800 mg/l
Magnesium	3,670 mg/l
Sulfate	2,680 mg/l
Carbon Dioxide	8.7 mg/l
Alkalinity, Total	100 mg/l
Bicarbonates	122 mg/l
Carbonates	<0.1 mg/l
Total Hardness	6,470 mg/l
Carbonate Hardness	100 mg/l
Hydroxides	<0.1 mg/l

[a]By Method of Standard Addition

Note: Analysis from 3,320-foot-deep injection well at Pratt and Whitney, approximately 24 miles from ICL facility.

Source: CH2M Hill, 1990

Miller (1986) attributes a lack of knowledge about the hydraulic characteristics of the upper confining unit to the variability in its lithology, interbedding of the unit, and its generally low permeability. He identifies a range of vertical hydraulic conductivity values for the clays within the Hawthorn Group ranging from 1.5 X 10^{-2} feet per day (ft/d) to 7.8 X 10^{-7} ft/d. The upper confining unit at the site is expected to be at the lower end of this range.

The hydraulic head at the top of the confining unit is the same as the water level in the Surficial aquifer system. Some variation in this level exists between the wet and dry seasons, with the levels ranging from approximately 25 to 30 feet National Geodetic Vertical Datum (NGVD). The hydraulic head at the base of the confining unit is the potentiometric surface of the upper Floridan aquifer, or about 48 feet NGVD. The upward hydraulic gradient across the thickness of the confining unit (approximately 550 feet) is calculated to be 0.042 ft/ft during the dry season.

The upward leakage rate across the confining unit may be approximated by using the hydraulic gradient of 0.042 ft/ft and the vertical hydraulic conductivity values that Miller (1986) provided. The leakage rates range from 6.2 X 10^{-4} ft/day to 3.2 X 10^{-8} ft/day.

The continuity of the confining unit throughout the site and the general area is well documented in numerous literature sources. The statewide isopach map of the Hawthorn Group that Scott (1988) presents clearly shows that, for at least the southern half of the state, the Hawthorn Group is continuous and thickens to the south.

Confining Unit Between Upper and Lower Floridan Aquifers

Miller (1986) identifies the confining unit between the upper and lower Floridan aquifers as the middle confining Unit I. The thickness of the middle confining Unit I is generally 400 feet throughout Martin County, but approaches 500 feet in thickness in the southeast and northwest portions of the county. Miller (1986) reports that the lithologies of the middle confining unit and the permeable units above and below are relatively similar.

Some data are available from the injection well drilling and testing in adjacent Palm Beach County. Geraghty & Miller (1986) report that the vertical hydraulic conductivity of the confining zone, as defined by the lithologic cores taken in the interval between 2,300 and 2,900 feet bls, ranged from 7.52×10^{-7} to 4.87×10^{-5} centimeters per second (cm/sec). For the Pratt and Whitney injection well, CH2M HILL (1985) reports permeability results from cores in the 2,000- to 2,400-foot interval of approximately 1.7×10^{-6} cm/sec.

Information on the hydraulic head at the top and bottom of the middle confining Unit I is not available. Miller (1986) states that limited hydraulic data show a range of head differences between the upper and lower Floridan aquifers, with larger differences associated with greater confinement.

The middle confining Unit I occurs throughout the eastern half of Florida to South Carolina (Miller, 1986; Figure 11). In Florida, it thickens from the central axis of the state eastward to a maximum of 600 feet along the coast.

2.3.2.2 Karst Hydrogeology

The ICL site lies outside that portion of Florida where extensive historical subsidence has occurred due to the solution of carbonate and other rocks which results in the formation of karst terrain (Davies, et al., 1984). The site area is underlain by unconsolidated sediments of sufficient thickness above soluble rock strata so as to virtually preclude the development of karst conditions that would impact operation of the proposed plant. The exploratory borings drilled at the site did not encounter any significant shallow rock strata that could be subjected to solutioning as a result of the movement of groundwater or lowering of the water table. Therefore, evidence for the movement of shallow groundwater through sinkholes, caves, springs, and fractures or joints, characteristic of karst terrain, is not present in the Indiantown area.

As further evidence for the lack of potential karst development at the site, data were reviewed related to a regional screening study conducted by FPL (1979) of a 25-county area in central and south Florida that addressed the presence of karstic (solution cavity/sinkhole) features. The FPL study, which included Martin County, was based on a review of topographic maps of the area, published reports on the local geology and groundwater resources, analysis of satellite imagery, and regional reports of sinkhole occurrence. It concluded that favorable conditions for karst development were not present in Martin County. Studies conducted by others (NSS, 1973, 1974) of local depressions at the nearby FPL Martin site, however, presented evidence for the existence of buried karst in the limestone layers of the Pliocene age Caloosahatchee Marl.

For the regional screening study (FPL, 1979), criteria were developed to delineate areas of karstic conditions or conditions that could be favorable for karst development. On a regional basis, the development of karstic features in Florida is most common in areas where:

- Pre-Miocene age carbonate rocks are at or near the ground surface
- Recharge occurs to the Floridan aquifer
- There is a high density of lakes per unit area
- Reports of sinkhole occurrences are persistent

With respect to the near-surface occurrence of carbonate rocks, local experience generally shows that post-Miocene (Pleistocene) age carbonates do not pose the same potential for karstic development as do older carbonates in Florida, nor do they show the same correlation of occurrence with a high density of lakes, as do the pre-Miocene carbonates. Figure 2.3.2-13 shows the extent of near-surface pre-Miocene age limestones in central and south Florida, and indicates that none exist from Lake Okeechobee southward. The closest pre-Miocene limestones in the near-surface are approximately 140 miles northwest of the site. Major pre-Miocene age limestone formations that experience solutioning and cavity development occur at a depth of over 740 feet at the ICL site and are overlain by thick, impervious strata. The solutioning of these limestones has resulted in the development of the highly transmissive zones of the Floridan aquifer.

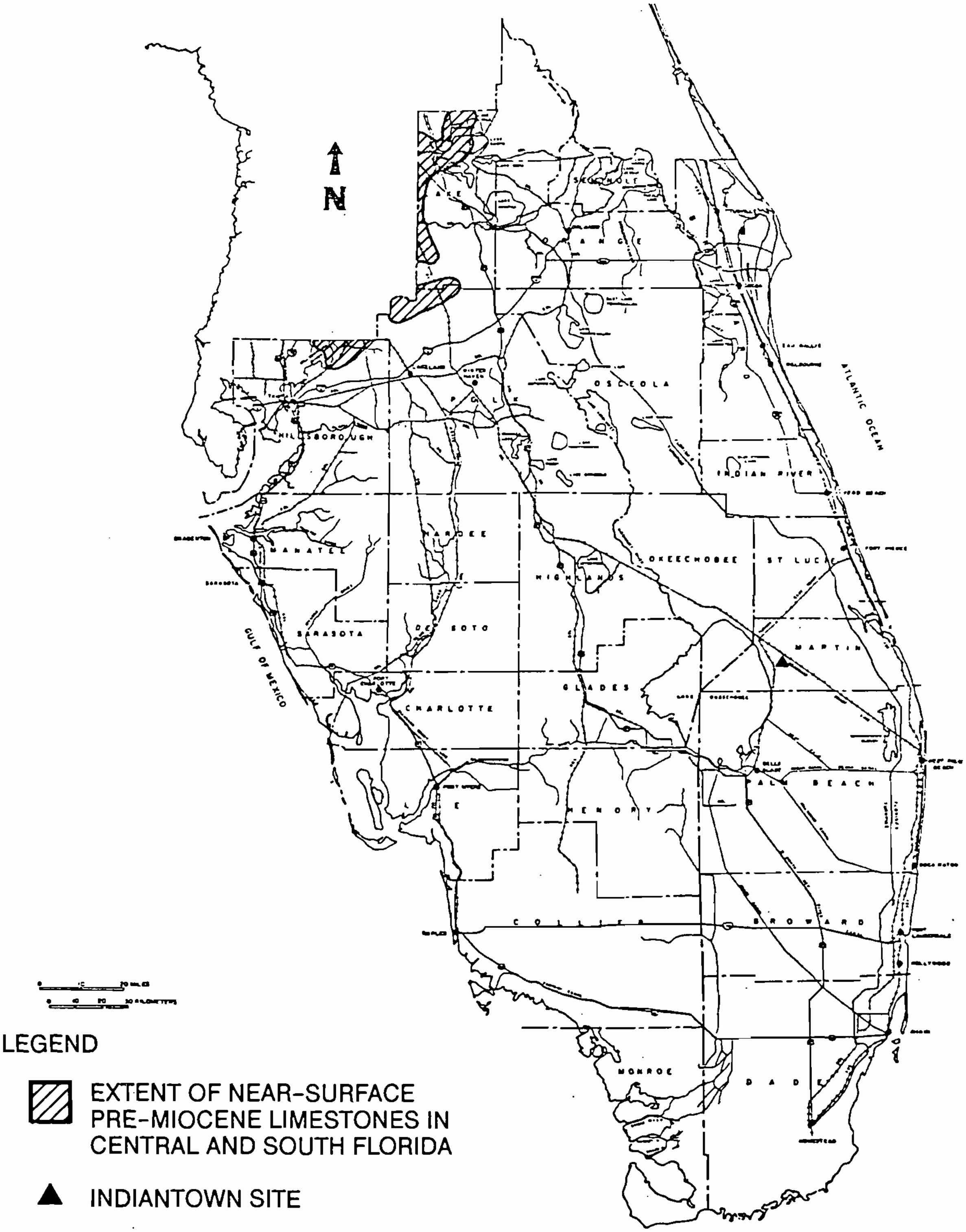
Recharge to the Floridan aquifer system in central Florida occurs through sinkholes, sinkhole-related lakes, or precipitation that is transmitted directly to the aquifer from Polk County northward where the pre-Miocene limestones are near the surface. Figure 2.3.2-14 shows the southern portion of the recharge area for the Floridan aquifer system.

The qualitative interpretation of a false-color infrared satellite image of Florida by Dames and Moore, as part of the 1979 FPL regional screening study, is the basis for Figure 2.3.2-15. This figure shows areas containing a high density of lakes relative to surrounding areas. The interpretation is based upon the sensitivity of the imagery to areas containing greater or lesser amounts of moisture.

Areas that have exhibited persistent collapse because of sinkholes are shown on Figure 2.3.2-16, based upon a map of Florida published by the U.S. Geological Survey.

A correlation of the features shown on Figures 2.3.2-13 through 2.3.2-16 resulted in the development of Figure 2.3.2-17 (FPL, 1979) showing the potential for the development of karst in portions of central and south Florida.

The FPL Siting Study (1979) relied on published information and the lack of surficial expressions of karst development to identify areas not susceptible to the formation of karst. No subsurface investigations to identify buried karst conditions



LEGEND

EXTENT OF NEAR-SURFACE PRE-MIOCENE LIMESTONES IN CENTRAL AND SOUTH FLORIDA

▲ INDIANTOWN SITE

REFERENCE: VERNON AND PURI, 1964
Source: FPL, 1989

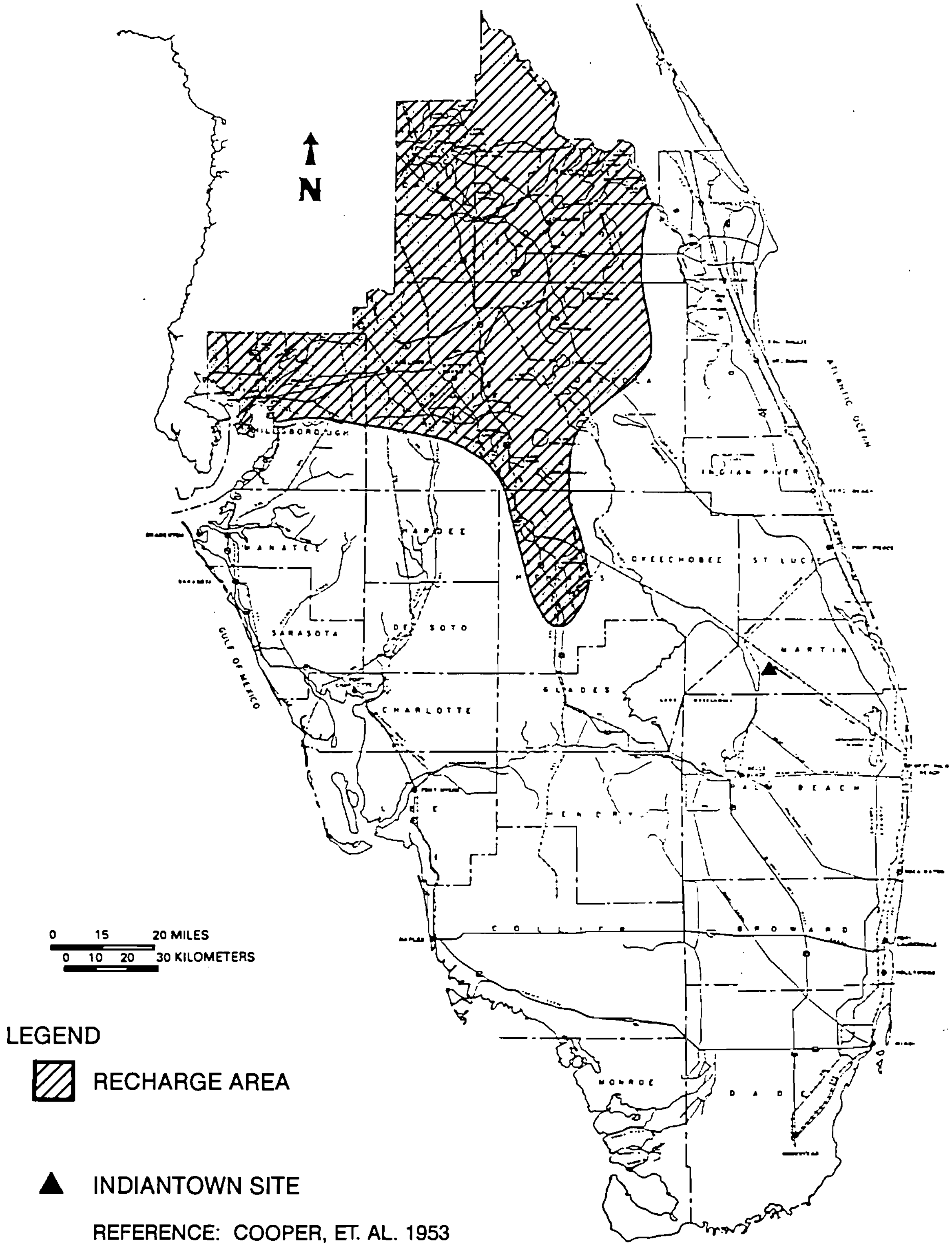
Figure 2.3.2-13.

LOCATION OF NEAR-SURFACE PRE-MIOCENE LIMESTONES

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

G-10/90-1808-16



REFERENCE: COOPER, ET. AL. 1953
Source: FPL, 1989

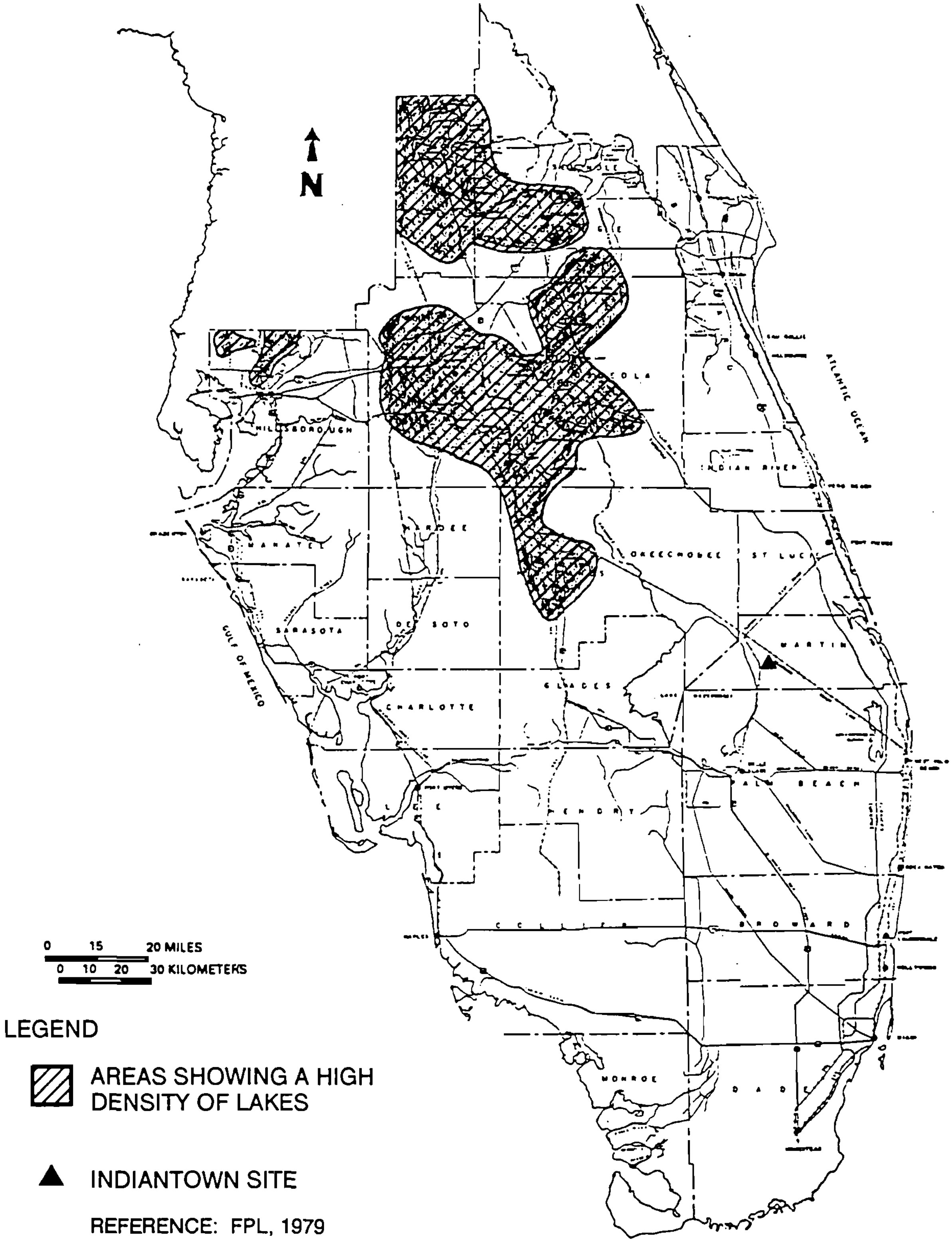
Figure 2.3.2-14.

FLORIDAN AQUIFER RECHARGE AREA

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

G-10/90-1808-17



REFERENCE: FPL, 1979
Source: FPL, 1989

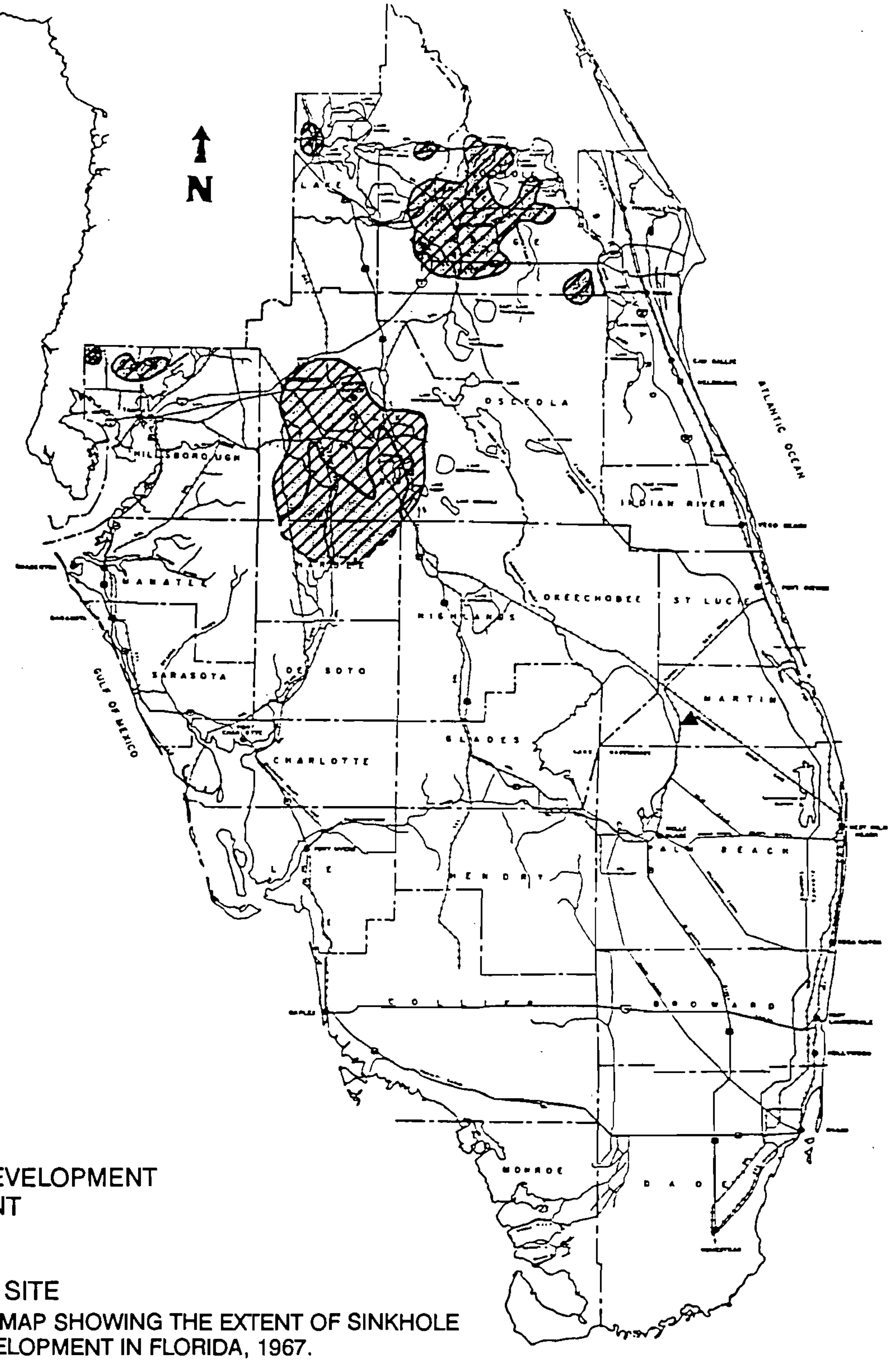
Figure 2.3.2-15.

AREAS WITH A HIGH DENSITY OF LAKES

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

G-10/90-1808-18



0 15 20 MILES
0 10 20 30 KILOMETERS

LEGEND

SINKHOLE DEVELOPMENT IS PERSISTENT

▲ INDIANTOWN SITE

REFERENCE: USGS, MAP SHOWING THE EXTENT OF SINKHOLE AND/OR KARST DEVELOPMENT IN FLORIDA, 1967.
Source: FPL, 1989

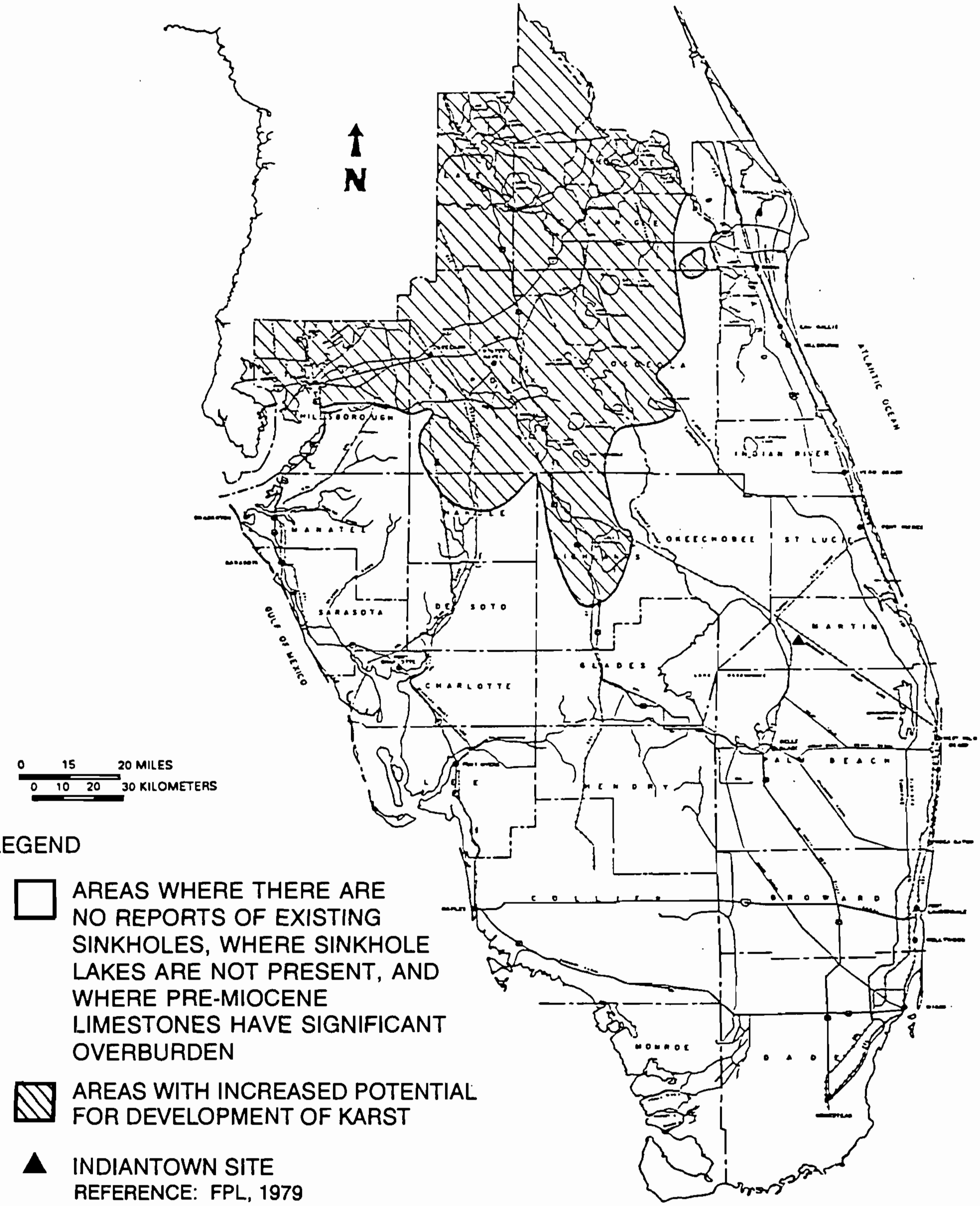
Figure 2.3.2-16.

AREAS OF PERSISTENT SINKHOLE COLLAPSE

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

G-10/90-1808-19



LEGEND

☐ AREAS WHERE THERE ARE NO REPORTS OF EXISTING SINKHOLES, WHERE SINKHOLE LAKES ARE NOT PRESENT, AND WHERE PRE-MIOCENE LIMESTONES HAVE SIGNIFICANT OVERBURDEN

▨ AREAS WITH INCREASED POTENTIAL FOR DEVELOPMENT OF KARST

▲ INDIANTOWN SITE

REFERENCE: FPL, 1979

Source: FPL, 1989

Figure 2.3.2-17.

ASSESSMENT OF KARST DEVELOPMENT

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

G-10/90-1808-20

(paleokarst) were performed as part of the study. However, previous investigations conducted at the nearby FPL Martin site by NSS (1973, 1974) did include studies to determine the origin of numerous shallow, closed depressions occurring throughout the area.

Based on the studies of these shallow depressions, including drill hole information, it was concluded by NSS that they were caused by the solutioning of calcite and aragonite in the shallow Pleistocene age Pamlico and Anastasia sands and possibly in the upper zones of a lenticular limestone of the Pliocene age Caloosahatchee Marl.

These studies indicated that development of the paleokarst features occurred during the Pleistocene epoch when the sea level was lower than it is now. Lower groundwater levels and increased rates of vertical and lateral percolation during the Pleistocene resulted in increased solution activity. NSS (1974) therefore concluded that current solution activity is negligible because of shallow groundwater levels and low rates of infiltration.

2.3.3 SITE WATER BUDGET AND AREA USES

This section presents a summary of the sources and characteristics of surface water in the vicinity of the ICL site. The information is based on historical data collected at several gauging stations near the site by federal, state, and local agencies. These data encompass surface water flow, precipitation, evaporation, and other meteorological information.

This section also presents a summary of the groundwater resources and users of both surface and groundwater in the vicinity of the Indiantown site. The SFWMD water use permit allocations presented herein reflect the maximum total amounts of both surface and groundwater available for use by each permitted user. No information is available to account for the exact amounts of water actually withdrawn from the individual wells and/or surface water sources covered by each permit.

2.3.3.1 Site Water Budget

Climatic Condition

The ICL site is located in the east central segment of Florida, which has a mild subtropical climate. The nearest Class I weather station is West Palm Beach, Florida. Historical data shows an average monthly temperature of 65.6 °F in January and 82.7 °F in August. The daily maximum and minimum, and monthly mean averages for the period of 1939 to 1987 are shown in Table 2.3.3-1. During this period, the extreme high temperature of 101 °F was recorded in July and extreme minimum of 27 °F was recorded in January.

The mean monthly precipitation was measured at Port Mayaca, Florida, which is about 10 miles southwest of the ICL site. Based on these historic data, the average annual rainfall is 47.2 inches. Maximum and minimum recorded annual rainfall were 60.65 inches and 26.03 inches, respectively. Table 2.3.3-2 presents

Table 2.3.3-1
NORMAL MEAN AND EXTREME TEMPERATURES (°F)
AT
WEST PALM BEACH*, FLORIDA 1939 - 1987

Month	Extreme Maximum	Extreme Minimum	Mean Monthly
January	89	27	65.6
February	90	32	66.7
March	94	30	70.1
April	99	43	73.8
May	96	53	77.7
June	98	61	80.8
July	101	66	82.4
August	98	65	82.7
September	97	66	81.5
October	95	46	77.7
November	91	36	72.1
December	90	30	67.8
Annual			74.9

*Location: West Palm Beach is approximately 30 miles SE of the ICL site.

Source: NOAA, Local Climatological Data, Annual Summaries, 1987, Part II Southern Region

Table 2.3.3-2
MONTHLY PRECIPITATION (INCHES)
AT
PORT MAYACA, FLORIDA 1951 - 1982

Month	Maximum Monthly	Minimum	Average
January	7.06	0.00	1.70
February	5.79	0.14	2.04
March	14.65	0.09	2.59
April	6.88	0.03	2.19
May	10.27	0.45	4.99
June	14.75	1.95	7.14
July	13.48	0.98	6.52
August	10.22	1.65	5.93
September	10.36	1.15	6.52
October	11.15	0.84	4.83
November	5.33	0.06	1.24
December	5.69	0.02	1.52
Annual			47.21

Note: Port Mayaca is approximately 10 miles west of the ICL site.

Source: NOAA, Environmental Services, Monthly Precipitation Data of Florida, 1951-1982 monthly precipitation data at Port Mayaca (U.S. Department of Commerce, 1951-1982).

The main source for the plant cooling water makeup is from Taylor Creek/Nubbin Slough at a location 1.1 miles upstream of the S-191 control structure. This location is about 19 miles northwest of the ICL site.

Precipitation data were measured at Raulerson-3 Station in Okeechobee County. This station is located in the Taylor Creek watershed about 32 miles northwest of the ICL site. For the period from 1957 to 1984, the mean annual precipitation is 48.8 inches, and maximum and minimum annual precipitation are 66.63 and 28.49 inches, respectively. Table 2.3.3-3 shows maximum, minimum, and monthly average precipitation at this station. Comparison of the precipitation data in Tables 2.3.3-2 and 2.3.3-3 shows nearly identical distribution at both stations.

Pan evaporation was measured at Raulerson-3 Station in Okeechobee County. These data showed mean annual pan evaporation of 59.4 inches. Pan evaporation is converted to lake evaporation through the use of the pan coefficient for the area. Using a pan coefficient of 0.73, (NOAA, 1982) and the pan evaporation of 59.4 inches, the estimated mean annual lake evaporation is approximately 43.4 inches. Pan evaporation in Belle Glade, Florida from 1940 to 1979 (NOAA, 1982) showed an annual mean of 62.2 inches. The corresponding lake evaporation is 45.4 inches.

The South Florida Water Management District estimated monthly evapotranspiration rates for various land uses (SFWMD, 1987). The annual values are shown in the following table.

Land Use	Annual Evapotranspiration (Inches)
Urban	23.91
Agricultural	48.44
Swamp	56.24
Vacant Land	42.55

Table 2.3.3-3
MONTHLY PRECIPITATION (INCHES)
AT
RAULERSON-3 STATION 1957 - 1984

Month	Maximum Monthly	Minimum Monthly	Average
January	6.83	0.11	1.84
February	7.08	0.53	2.58
March	9.27	0.05	3.30
April	5.78	0.00	1.98
May	11.25	0.00	4.41
June	17.73	1.23	7.80
July	13.21	1.61	6.78
August	11.13	2.06	6.56
September	20.00	0.58	6.60
October	10.94	0.40	3.71
November	4.40	0.07	1.61
December	4.14	0.10	1.63
Annual			48.80

Note: Raulerson - 3 is in Okeechobee County, about 32 miles northwest of the plant and 12 miles northwest of S-191 structure.

Source: South Florida Water Management District, Data Management Division, Department of Research and Evaluation

The maximum evapotranspiration occurs during April through September.

For the ICL Project, a mean annual evaporation of 45.4 inches is estimated from the above data for use in the water budget of the storage pond on the site.

Surface Water Resources

The cooling water and process water for the plant will be obtained from the proposed intake structure to be located on the Taylor Creek/Nubbin Slough at the intersection of C-59, L-63N, and L-63S Canals. Additional makeup water to meet the plant water requirements during drought periods (when water from the Taylor Creek/Nubbin Slough is not adequate) will be withdrawn from wells withdrawing water from the Floridian aquifer located on the plant site.

Groundwater Resources

The two major sources of groundwater (aquifers) in Martin County are recharged from different areas and are separated by a thick layer of sand and clay of low permeability known as the Hawthorn Formation (Lichtler, 1960). The Surficial (non-artesian) aquifer, extending from the water table to a depth of approximately 120 feet below the ground surface, is recharged by rainfall within Martin County. A small amount of recharge to the Surficial aquifer also results from the downward percolation of water used for agricultural irrigation. Recharge rates to the Surficial aquifer of 6 to 9 inches/year have been estimated as being "typical" (Ruskauff et al., 1989).

The upper Floridan (artesian) aquifer, extending from a depth of about 740 feet to an estimated depth of 1,450 feet below the ICL site, is recharged by rainfall occurring to the north and northwest in areas where the aquifer is in an unconfined or semiconfined condition (Bush and Johnston, 1988). These areas are generally found as topographically high outcrops and central inland regions occurring from Polk County northward. In those areas where the aquifer is unconfined or semiconfined, recharge is estimated to average 10 to 20 inches/year. However, recharge to the regional Floridan Aquifer system has been estimated to average about 5 inches/year over the long term. No recharge to the upper Floridan Aquifer occurs within Martin County due to the thickness of the overlying strata. Natural discharge from the aquifer in Martin County occurs almost exclusively as diffuse upward leakage through the overlying strata at less than 1 inch per year (Aucott, 1988).

2.3.3.2 Area Water Users

Surface and groundwater use in the vicinity of the ICL site is regulated by the SFWMD. Water use permits have been issued by SFWMD for many years. However, a program of well construction permitting was only established by SFWMD in 1985. Information obtained from SFWMD (1989), USGS, and local users (CH2M Hill, 1990) was used to prepare this summary of water uses near the site. It should be noted that there is a possibility of some additional (unpermitted, but legal) potable water wells in the vicinity of the site, but their presence has not been confirmed because they have not been permitted or otherwise reported to SFWMD.

The list of all surface and groundwater users in the 5-mile radius of the plant site is summarized on Table 2.3.3-4 and their location is shown on Figure 2.3.3-1. As shown on Table 2.3.3-4, most of the surface water and groundwater used within 5 miles of the plant site is for industrial purposes, agricultural irrigation, and potable water use. Sources of water used for these purposes include St. Lucie Canal (C-44), the shallow water aquifer, and the Floridan aquifer.

Taylor Creek/Nubbin Slough Water Users

The Taylor Creek/Nubbin Slough water is basically used for agriculture use. The existing surface water users are from Taylor Creek and are summarized on

Table 2.3.3-4
EXISTING WATER USERS WITHIN A 5-MILE RADIUS OF THE ICL SITE

IDENTIFICATION NO.*	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE
1	43-00022	300	**Florida Power & Light Corporation, GW[1] use.** 6-wells of 175 gpm capacity.
2	43-00025	1105.2	**Metropolitan Life Insurance Co., SW[2] use.** 18,000 gpm capacity and 14,000 gpm from C-44 canal.
3	43-00028	28.52	**Byron Grant/Grant Citrus Grove, GW use.** One well of 1,000 gpm capacity.
4	43,00034	118.54	**Thomas M. Chastain, SW use.** Via culvert from C-44 canal.
5	43-00038	2,992.17	**Mayaca Land Corp., SW use.** 25,000 gpm and 17,000 gpm capacity withdrawal from C-44 canal.
6	43-00047	16,290	**Florida Power & Light Corporation, SW use.** 4-pumps of 90,000 gpm capacity withdrawal from C-44 canal.
7	43-00071	57.49	**Joseph D. Farish, GW use.** One well.
8	43-00072	4,641.35	**St. Lucie River Company, SW use.** 2 withdrawals, one of 10,000 gpm capacity and other of 14,000 gpm capacity from C-44 canal.
9	43-00084	432.29	**Indiantown Water Control District, SW use.** 11,000 gpm from C-44 canal.
10	43-00094	4,230.71	**Coca Cola Company, SW use.** 12 withdraws of 18,000 gpm capacity, 8 withdraws of 2,400 gpm and 2 withdraws of 1,200 gpm capacity from Troup - Indiantown Canal.

IDENTIFICATION NO.*	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE
11	43-00095	7,033	**Troup Indiantown WCD, SW use.** 4 withdraws, 2 - of 25,000 gpm, one of 35,000 gpm and one of 20,000 gpm from C-44 canal.
12	43-00112	625.54	**Talquin Corp., SW use.** 2 withdraws, one of 10,000 gpm and one of 6,000 gpm from C-44 canal.
13	43-00122	3,099.97	**Caulkins Land, SW & GW use.** 4 surface water withdraws, 2 of 20,000 gpm capacity and 2 of 25,000 gpm from C-44. 8 wells with 1-800 gpm, 2-850 gpm, 1-975 gpm, 1-1,050 gpm, 1-1,275 gpm, 1-1,450 gpm and 1-1,500 gpm.
14	43-00159	49.21	**Sullivan & Huffman, GW use.** One well of 720 gpm.
15	43-00172	73.59	**T & T Enterprises, GW use.** One wells of 800 gpm capacity.
16	43-00206	18.4	**Blood's Hammock Groves, Inc., GW use.** One well of 300 gpm capacity.
17	43-00217	12.0	**Caulkins Indiantown Citrus (Wastewater), GW use.** One well 200 gpm using reclaimed water from citrus processing.
18	43-00229	15.64	**Greene, Mccarthy, Abbot & Whittler (Shanalli Groves), GW use.** One well of 60 gpm capacity.
19	43-00231	15.64	**Greene, Mccarthy, Abbot & Whittler (Shanalli Groves), GW use.** One well of 60 gpm capacity.
20	43-00247	34.5	**Agri + Lan, SW use.** One withdrawal of 800 gpm capacity.

IDENTIFICATION NO.*	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE
21	43-00260	89.89	**Indianwood Assoc., Inc., SW & GW use.** 3 SW withdraws from on site lakes, two of 400 gpm capacity and one of 200 gpm capacity. One GW withdrawal of 800 gpm capacity.
22	43-00351	63.57	**Walter J. Hatcher, GW use.** Two wells of 525 gpm capacity.
23	43-00362	50.0	**Caulkins Indiantown Citrus Company, GW use.** 3 wells, two of 60 gpm and one of 300 gpm capacity.
24	43-00418	35.42	**S.N. & Stephen Knight & S. Carpenter, GW use.** One well of 500 gpm capacity.
25	43-00424	745.21	**Norman F. Hales, GW use.** 5 wells of 600 gpm capacity.
26	43-00436	2,446.4	**Armstrong Properties, SW use.** One 10,000 gpm surface water withdrawal capacity from C-44 canal.
27	43-00445	8.74	**F. Ray Daniels (Daniels Grove), GW use.** One well of 300 gpm capacity.
28	43-00501	15.27	**Fennel 43 Acre Grove, GW use.** One well of 310 gpm capacity.
29	43-00503	11.29	**Fennel 35 Acre Grove, GW use.** One well of 230 gpm capacity.
30	43-00516	35.03	**J. Bargas (Go For Broke, Inc.), GW use.** 2 Wells of 55 gpm capacity.
31	43-00522	3,162	**Indianwood (Golf Course Facility), GW use.** 2 wells of 14 gpm capacity.
32	43-00540	55,140	**V.B.Q. Tree Farm, GW use.** One well of 120 gpm capacity.

IDENTIFICATION NO.*	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE
33	43-00541	55.19	**C. B. Myers III, GW use.** Two wells, 275 gpm capacity.
34	43-00544	1,000	**Stuart Hatteras, GW use.** One well of 20 gpm capacity.
35	82-393	100,000[3] gpd	**J. Phares (Block 18A Farm), GW use.** One well of 45 gpm capacity.
36	82-394	100,000 gpd	**Harry Green (Block 16A Farm), GW use.** One well of 45 gpm capacity.
37	83-55	10,000 gpd	**Indianwood (Pro Shop & Maint. Bldg.), GW use.** One well 50 gpm capacity.
38	87-185	500 gpd	**VFW Post 6023, GW use.** One well 15 gpm capacity.
39	87-372	90,875 gpd	**Indiantown Egg Prod. Facility, GW use.** 4 wells of 150 gpm capacity each.
40	43-00270	--	**Bay State Milling Company, GW use.** One well, 3" dia., casing 105' depth
41	87-451	50,000 gpd	**Florida Steel (Indiantown Mill), GW use.** 3 wells, two of 50 gpm capacity and one of 600 gpm capacity.
42	USGS M-191[4]		**Norman Hales, GW use.** One well, 125 gpm capacity. Location: SW 1/4 NE 1/4 Sec 36, T39S R38E
43	USGS M-192[4]		**Norman Hales, GW use.** One well, 220 gpm capacity. Location: NE 1/4 NW 1/4 Sec 36, T39S R38E
44	USGS M-923[4]		**Norman Hales, GW use.** One well, 300 gpm capacity. Location: NW 1/4 SW 1/4 Sec 25, T39S R38E

IDENTIFICATION NO.*	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE
45	USGS M-30[4]		**Norman Hales, GW use.** One well, 75 gpm capacity. Location: NW 1/4 SE 1/4 Sec 26, T39S R38E
46	USGS M-31[4]		**Norman Hales, GW use.** One well, 200 gpm capacity. Location: NE 1/4 SE 1/4 Sec 36, T39S R38E
47	USGS M-32[4]		**Norman Hales, GW use.** One well, 70 gpm capacity. Location: NE 1/4 SE 1/4 Sec 26, T39S R38E
48	USGS M-33[4]		**Norman Hales, GW use.** One well, 45 gpm capacity. Location: SE 1/4 NE 1/4 Sec 26, T39S R38E
49	USGS M-34[4]		**Norman Hales, GW use.** One well, 400 gpm capacity. Location: NW 1/4 NW 1/4 Sec 36, T39S R38E
50	USGS M-172[4]		**Mr. Quinn, GW use.** One well, 400 gpm capacity. Location: SE 1/4 SW 1/4 Sec 23, T39S R38E
51	USGS M-915[4]		**Mr. Quinn, GW use.** One well, 160 gpm capacity. Location: NE 1/4 NW 1/4 Sec 26, T39S R38E
52	USGS M-2030[4]		**Palmer Tudhill, GW Use.** One well, 6" Dia. Casing 1220' depth. Location: NE 1/4 NW 1/4 Sec 33, T39S R38E
53	USGS M-2036[4]		**Holdbrook, GW use.** One well, 2" Dia. Casing 105' depth. Location: SE 1/4 SW 1/4 Sec 22, T39S R38E

IDENTIFICATION NO.*	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE
54			**Tropical Fruits, GW use.** One well, 3" Dia. Casing 50' depth. Location: SW 1/4 NW 1/4 Sec 2, T40S R38E
55			**Bud Slay, GW use.** One Well, 2" Dia. Casing 105' depth. Location: NE 1/4 NE 1/4 Sec 2, T40S R38E
56			**Chick Gaskin, GW use.** One well, 2" Dia. Casing 105' depth. Location: NE 1/4 NE 1/4 Sec 2, T40S R38E
57			**Wilda Copeland, GW use.** One well, 2" Dia. Casing 105' depth. Location: NE 1/4 NE 1/4 Sec 2, T40S R38E
58			**Holdbrook, GW use.** One well, 2" Dia. Casing 105' depth. Location: NW 1/4 NE 1/4 Sec 4, T40S R38E
59			**Owner unknown, GW use.** One well, 2" Dia. Casing 105' depth. Location: NW 1/4 SE 1/4 Sec 27, T39S R38E
60			**Jim Roberts, GW use.** One well, 2" Dia. Casing 105' depth. Location: NE 1/4 NE 1/4 Sec 2, T40S R38E
61			**Bar-Nel Tree Farm, GW use.** One well, 2" Dia. Casing 105' depth. Location: NW 1/4 NW 1/4 Sec 26, T39S R38E
62			**Roland Cope, GW use.** One well, 30' depth. Location: SW 1/4 SW 1/4 Sec 35, T39S R38E

IDENTIFICATION NO.*	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE
63			**James Slay, GW use.** One well, 100' depth. Location: SE 1/4 SW 1/4 Sec 35, T39S R38E
64	BTW-1, 2, 3, 4		**Florida Power and Light Corp., GW use.** 4 aquifer test wells, depth 145-168 ft.
65			**Florida Power and Light Corp., GW use.** Water supply well.
66	MF-23[5]		**Florida Power & Light Corp., GW use.** SFWMD monitoring well, depth 1,119 ft. Location SW 1/4, SW 1/4 Sec 17, 739S, R38E
67	LFM-1		**Florida Power & Light Corp., GW use.** Aquifer test well, depth 1,648 ft. Location NW 1/4, NW 1/4 Sec 20, T39S, R38E
68	MF-25[5]		**Florida Power & Light Corp., GW use.** SFWMD monitoring well, depth 1,220 ft. Location NW 1/4, SW 1/4, NW 1/4, Sec 33, T39S, R38E
69	MF-37[5]		**Caulkins Indiantown Groves, GW use.** SFWMD monitoring well, depth 1,260 Location SW 1/4, NW 1/4, NW 1/4, Sec 35, T39S, R38E
70	43-00233		**Jack Phares, GW use.** One well in Surficial aquifer for agricultural use.
71	43-00232		**J&R, GW use.** One well in Surficial aquifer for agricultural use.

*See Figure 2.3.3-1 for location of corresponding number.

IDENTIFICATION NO.*	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE

1. GW - Groundwater Use
2. SW - Surface Water Use
3. Maximum Daily Allowance for General Use Permits
4. U.S. Geological Survey Well Number
5. SFWMD Well Number

Source: Bechtel, 1990
SFMMD
USGS
FPL, 1989

Table 2.3.3-5. The information shown on the table is based on the permit summary printout obtained from the SFWMD (1989b).

As seen from the table, two of the users are on the old section of Taylor Creek which is connected to Lake Okeechobee. One potential user is on Canal L-63N (see Section 5.3.1.4). Primary water use from the Taylor Creek/Nubbin Slough is for agriculture use and no public water supply is obtained from this source.

Groundwater Users

A total of 31 wells are located within approximately 1 mile of the site, and are described in more detail in Table 2.2.3-6. A well canvas was performed to verify and supplement the information available on public record regarding these wells. This canvas consisted of an attempt to contact the appropriate well owner, both by telephone and by a site visit. If the owner could not be contacted after several attempts, the term "no access" is shown in the comments column on Table 2.3.3-6. A local well driller responsible for drilling many of the wells in the area was able to provide information on some of the wells.

Twelve of the wells nearest the site were identified as potable water wells. These wells are reported to be typically 2 inches in diameter and 105 feet deep. Fourteen of the remaining wells are Floridan Aquifer wells that extend to depths of 1,000 to 1,400 feet and are primarily used for agricultural irrigation. Two industrial wells and one test well were also identified.

Table 2.3.3-5
TAYLOR CREEK/NUBBIN SLOUGH WATER USERS

IDENTIFICATION NO.	PERMIT/ REF. NO.	ANNUAL WATER ALLOCATION (mil. gals)	DESCRIPTION OF USER AND WATER SOURCE
1	47-00020-W	46.0	**Q.J. Hazellieff/Citrus Grove, SW & GW use.** Agriculture use. Location: T37S R35E Sec. 24 & 25.
2	47-00024-W	93.75	**Martin Brown & Donald Brown, SW use.** Agriculture use. Location: T37S R35E Sec. 27
3	47-00042-W	482.08	**Norman Stokes, SW use.** Agriculture use. Location: T37S R35E Sec. 23.

Source: SFWMD, 1989b

Table 2.3.3-6
1-MILE RADIUS WELL INVENTORY

Well No.[1]	Location	Permit/ Ref. No.	Owner	Use	Casing Diameter	Casing Depth	Well Depth	Casing Material	Production Rate	Active	Comments
49	NW 1/4 NW 1/4 Sec 36 T39S R38E	USGS M-34*	Norman Hales	Agricultural	6"	–	1,100'	–	400 gpm	–	No Access; property being sold to Indianwood Residential & Golf Course Development
46	NE 1/4 SE 1/4 Sec 36 T39S R38E	USGS M-31*	Norman Hales	Agricultural	6"	–	1,100'	–	200 gpm	–	No Access; property being sold to Indianwood Residential & Golf Course Development
47	NE 1/4 SE 1/4 Sec 26 T39S R38E	USGS M-32*	Norman Hales	Agricultural	4"	–	1,100'	–	70 gpm	–	No Access; property being sold to Indianwood Residential & Golf Course Development
33	N 1/4 SW 1/4. SE 1/4 Sec 33 T39S R38E	43-00541	C. B. Myers	Agricultural	6	–	100'	–	275 gpm	Yes	2 wells
45	NW 1/4 SE 1/4 Sec 26 T39S R38E	USGS M-30*	Norman Hales	Agricultural	6"	450'	1,100'	–	75 gpm	–	No Access; property being sold to Indianwood Residential & Golf Course Development
51	NE 1/4 NW 1/4 Sec 26 T39S R38E	USGS M-915*	Mr. Quinn	Agricultural	8"	–	1,120'	–	160 gpm	Yes	
23	SE 1/4 SW 1/4 Sec 26 T39S R38E	43-00362	Caulkins Citrus	Industrial	8"	129'	175'	–	60 gpm	Yes	Caulkins Plant 2 wells
23	SW 1/4 SW 1/4 Sec 26 T39S R38E	43-00362	Caulkins Citrus	Industrial	10"	400'	1,000'	–	300 gpm	Yes	Caulkins Plant
40	SE 1/4 SE 1/4 Sec 27 T39S R38E	43-00270	Bay State Milling Company	Potable	3"	105'	105'	Steel	–	Yes	Screened Well
22	SE 1/4 NE 1/4 Sec 27 T39S R38E	43-00351	Hatcher Citrus	Agricultural	8"	100'	160'	–	525 gpm	–	Not Found
64	NE 1/4 NE 1/4 Sec 33 T39S R38E	–	FPL	Test	8"	168'	168'	–	250 gpm	No	Screened Well
54	SW 1/4 NW 1/4 Sec 2 T40S R38E	–	Tropical Fruits	Potable	3"	50'	50'	Steel	–	Yes	Could be 2 Wells at Site Screened Well

Well No.[1]	Location	Permit/ Ref. No.	Owner	Use	Casing Diameter	Casing Depth	Well Depth	Casing Material	Production Rate	Active	Comments
55	NE 1/4 NE 1/4 Sec 2 T40S R38E	–	Bud Slay	Potable	2"	105'	105'	Steel	–	Yes	Screened Well
56	NE 1/4 NE 1/4 Sec 2 T40S R38E	–	Chick Gaskin	Potable	2"	105'	105'	Steel	–	Yes	Screened Well
57	NE 1/4 NE 1/4 Sec 2 T40S R38E	–	Wilda Copeland	Potable	2"	105'	105'	Steel	–	Yes	Screened Well
59	NW 1/4 SE 1/4 Sec 27 T39S R38E	–	–	Potable	2"	105'	105'	Steel	–	Yes	Owner Unknown
60	NE 1/4 NE 1/4 Sec 2 T40S R38E	–	Jim Roberts	Potable	2"	105'	105'	Steel	–	Yes	Screened Well
61	NW 1/4 NW 1/4 Sec 26 T39S R38E	–	Bar-Nel Tree Farm	Potable	2"	105'	105'	Steel	–	Yes	Screened Well
62	SW 1/4 SW 1/4 Sec 35 T39S R38E	–	Roland Cope	Potable	–	–	30'	–	–	–	Well Inventoried in Florida Steel Report - No Access
63	SE 1/4 SW 1/4 Sec 35 T39S R38E	–	James Slay	Potable	–	–	100'	–	–	–	No Access
39	NE 1/4, SE 1/4, NW 1/4 Sec 27 T38N R39E	87-372	Indiantown Egg	Agricultural	4	100'	105'	–	–	Yes	4 wells
41	SW 1/4, NW 1/4, NE 1/4 Sec 35 T39N R38E	87-451	Florida Steel	Industrial/ Potable	6/2	130/105	–	–	600/50	No	3 wells, 1-6" 2-2"
69	SW 1/4, NW 1/4, NW 1/4, Sec 35 T39S, R38W	MF-37	Caulkins Citrus	Monitoring Well	10	391'	1,260'	Steel	–	No	SFWMD Monitoring Well

(1)See Figure 2.3.3-1 for location of corresponding number.

*U.S. Geological Survey Well Number

**SFWMD Well Number

Source: CH2M Hill, 1990

2.3.4 SURFICIAL HYDROLOGY

This section discusses the major water bodies in the vicinity of the site that may be affected by plant construction and operation. These effects include water withdrawal, storm water discharge, and changes in local runoff. Descriptions of the historical hydrologic characteristics of each water body including water level variation, flows, water quality, and water budget are included. The water bodies near the site which may be affected by the plant construction and operation are: Lake Okeechobee, St. Lucie Canal, and Taylor Creek/Nubbin Slough.

The primary source of the plant water is Taylor Creek/Nubbin Slough about a mile upstream of the S-191 control structure. The release of the water from this source is into Lake Okeechobee through the S-191 control structure.

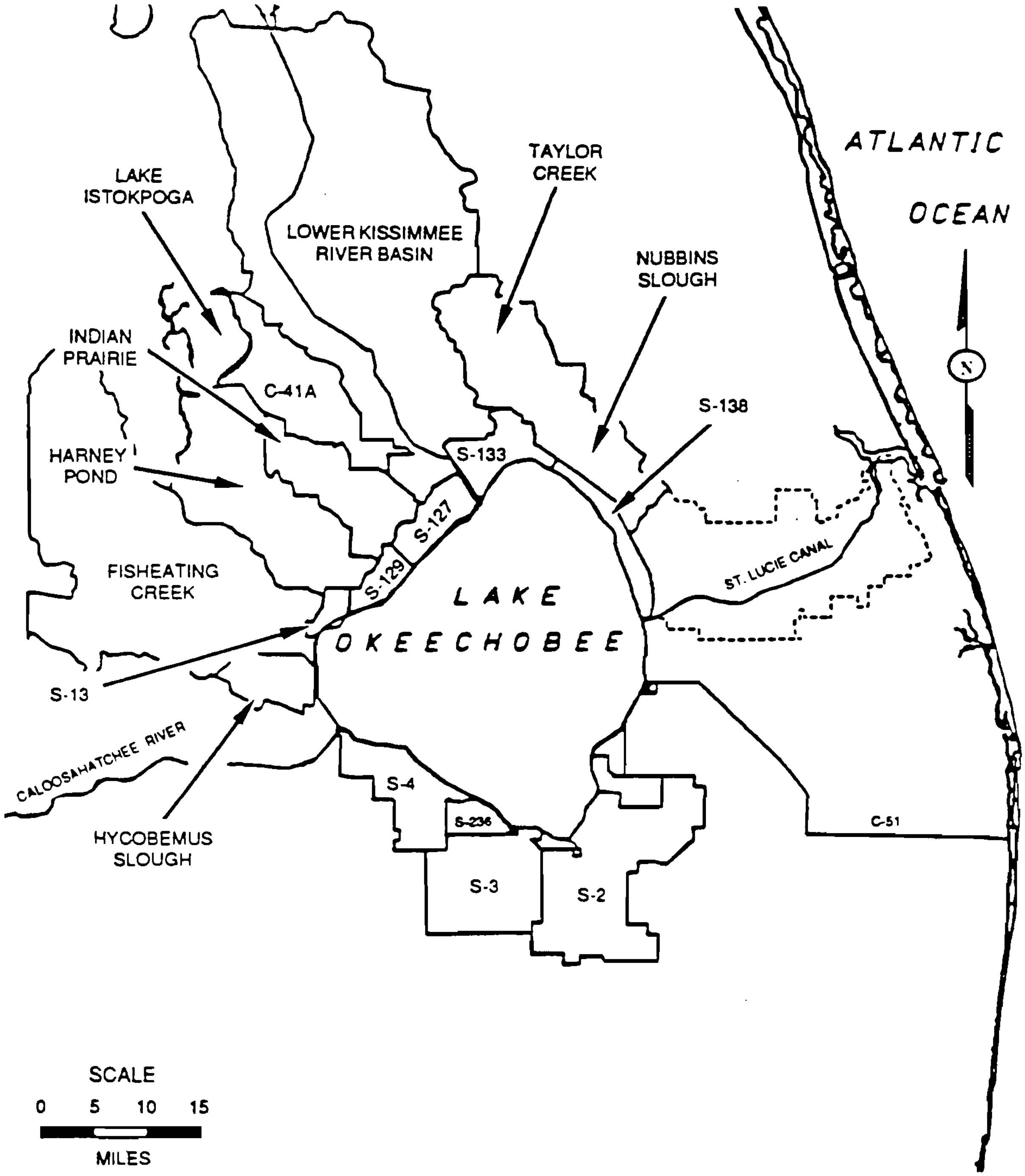
St. Lucie Canal conveys the water out of Lake Okeechobee to the Atlantic Ocean through two control structures. This canal passes about 2 miles south of the ICL site. Local runoff from the site and the surrounding areas may reach the St. Lucie Canal through drainage ditches.

2.3.4.1 Hydrologic Characterization

Lake Okeechobee

Description

The principal source of surface water in southeast Florida is Lake Okeechobee, which is approximately 10 miles west of the project site. The lake receives inflow from several streams from the northeast, north, and west sides of the lake, in addition to direct rainfall. The estimated lake surface area is approximately 680 mi^2 at a water level of El. 14 feet MSL, and the total watershed is approximately 5,650 mi^2 (USGS, 1981). Figure 2.3.4-1 shows the watershed boundary contributing to the lake.



Source: SFWMD

Figure 2.3.4-1.

LAKE OKEECHOBEE WATERSHED

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The lake is diked to form a reservoir, and is regulated by control structure gates at several outlets. The U.S. Army Corps of Engineers regulates the stages in the lake for navigation, municipal water supply, irrigation, and flood control. The present regulation schedule, established in 1978, varies from 15.5 feet MSL during the wet season to 17.5 feet MSL during the dry season. Figure 2.3.4-2 is a presentation of the regulation schedule. When the lake stage exceeds the maximum regulation schedule at any time, regulating releases are made in order to bring the lake stage down to the maximum level. When the lake level is in Zone C (see Figure 2.3.4-2), no regulating releases are made. Lake levels in Zone B are lowered by releases at three major outflows (North New River, Hillsboro, and Miami Canals). If additional releases are still needed they are made through the Caloosahatchee River and the St. Lucie Canal.

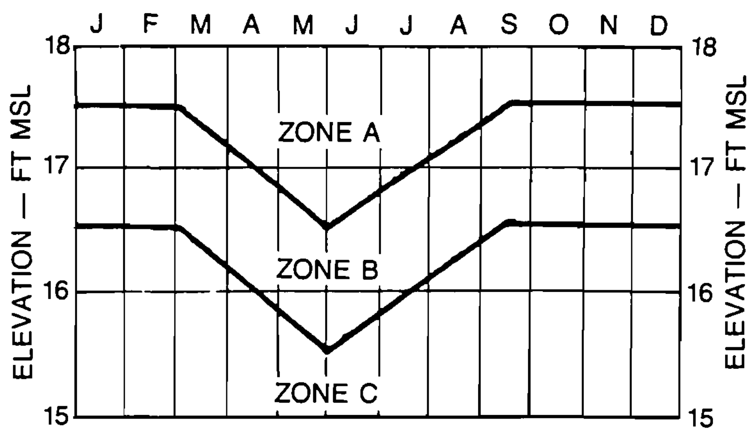
Water Levels and Storage

Historic water levels in Lake Okeechobee have been collected by the U.S. Geological Survey from October 1931 to the present time. However, because of the modifications made on the outlets which affected the regulation schedule, only historic data after the May 1978 implementation of the current regulation schedule (Figure 2.3.4-2) are presented and discussed in this section. These data are analyzed and presented in Table 2.3.4-1 as mean monthly, and maximum and minimum mean monthly water levels. All the minimum mean monthly water levels occurred in 1981 with the exception of April which occurred in 1982.

The lake is approximately circular in shape with an almost flat bottom. The maximum variation in the surface area between El. 13 and 16 feet MSL is approximately 12 percent. The elevation-area-storage curves are shown on Figure 2.3.4-3.

Water Budget

Lake Okeechobee receives its runoff from the surrounding drainage basins and from direct precipitation. The lake has nine major inflow streams and five major



Source: SFWMD

Figure 2.3.4-2.

LAKE OKEECHOBEE OPERATING RULE

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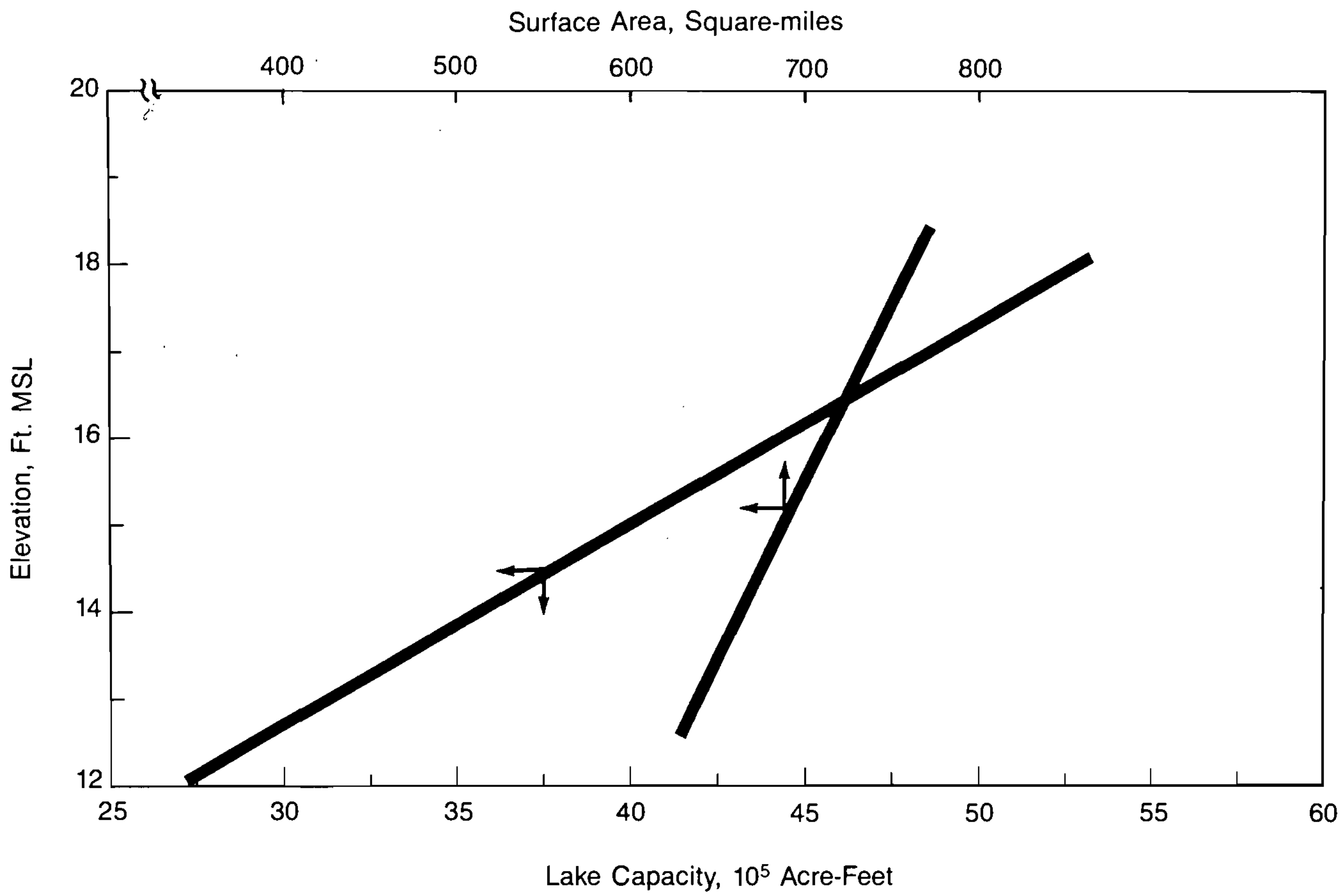

Figure 2.3.4-3.

ELEVATION, AREA, AND CAPACITY CURVES OF LAKE OKEECHOBEE

Source: Developed by Bechtel from data in the USGS Water Supply Papers for Florida and SFWMD Studies

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Table 2.3.4-1
LAKE OKEECHOBEE WATER LEVELS, FT MSL (1978-1989*)

Month	Average	Maximum Mean Monthly	Minimum Mean Monthly
Oct	15.38	17.49	11.85
Nov	15.34	17.46	11.55
Dec	15.21	17.46	11.14
Jan	15.18	17.35	10.87
Feb	15.09	17.65	10.82
Mar	14.94	17.98	10.98
Apr	14.53	17.06	11.12
May	14.00	18.77	10.89
June	13.73	15.47	10.39
July	13.90	15.93	9.91
Aug	14.27	16.24	10.27
Sept	14.78	16.54	11.64

*These water levels are since the recent regulation started in May 1978 and are shown on Figure 2.3.4-2.

Source: USGS Water Supply Papers for Station 02-2764 outflow canals (Figure 2.3.4-4). Inflows and outflows pass through control structures.

The largest source of water to the lake is direct rainfall. For an average annual precipitation of 48 inches, this volume amounts to about 1,900,000 acre-feet per year.

A significant portion of the inflow occurs during the high rainfall season (June-October). The Kissimmee River is the largest surface inflow contributor to the lake. The mean annual inflow from the Kissimmee River into the lake is approximately 1,600,000 acre-feet per year.

A water budget study performed by SFWMD for the period 1973-1979 (SFWMD, May 1981), showed a mean annual inflow, including direct rainfall on the lake, of approximately 3,500,000 acre-feet per year. During this period, direct rainfall contribution was 1,350,000 acre-feet per year. The lake discharges into several canals through control structures. The water budget study performed (SFWMD, May 1981) showed a mean annual outflow volume from the study period of approximately 3,100,000 acre-feet per year. About 65 percent of the outflow is lost by evaporation from the lake.

Lake Water Quality

A water sampling program was conducted by SFWMD at 40 stations in Lake Okeechobee between 1973 and 1979. These samples were collected to determine dissolved nutrients, anions, dissolved oxygen, temperature, specific conductor, and pH. This program was implemented to determine the material budget into and out of the lake. Inflows from major surface tributaries were monitored also. The summary of the lake's water quality developed by SFWMD is presented in this report as Table 2.3.4-2.

The inflow load to the lake varies considerably from one stream to another. The Kissimmee River and Taylor Creek/Nubbin Slough (at S-191) introduce the highest

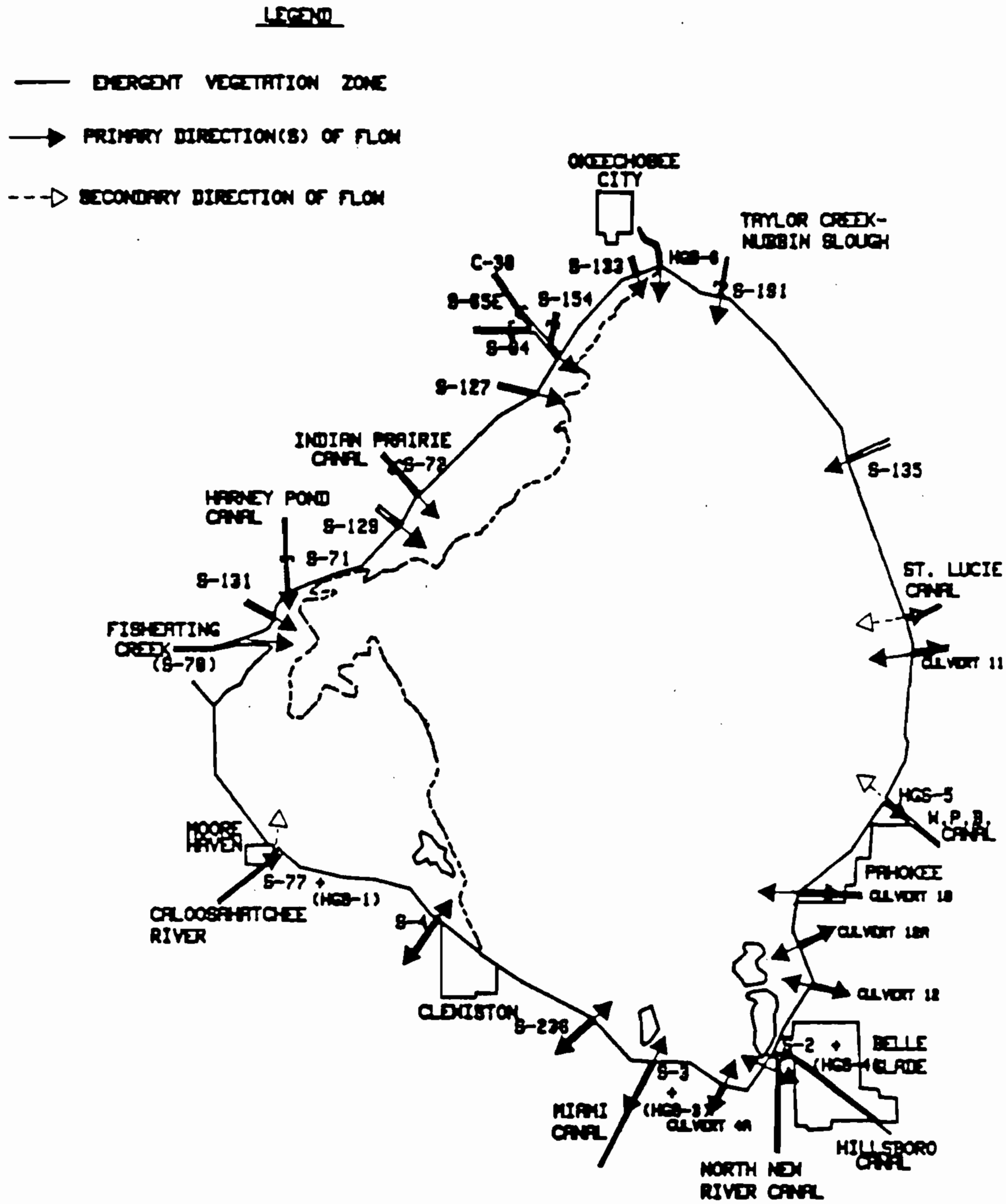

Figure 2.3.4-4
INFLOWS AND OUTFLOWS TO LAKE OKEECHOBEE

Source: SFWMD

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Table 2.3.4-2
SELECTED WATER QUALITY PARAMETERS OF LAKE OKEECHOBEE
(1973-1979)

Parameter[1]	Avg. 1973-1979
Ortho-Phosphate	0.018
Total Phosphate	0.063
Inorganic N	0.16
Organic N	1.57
Total N	1.73
Conductance (mhos/cm)	589
Cl	87.4
Na	56.3
K	4.4
Ca	45.1
Mg	17.3
Hardness($CaCO_3$)	184
SO_4	54.6
SiO_2	6.5
Alkalinity (meq/1)	2.5
Total Fe	0.44
Dissolved oxygen	8.6
Turbidity (JTU)	18.0
Color (Pt units)	43
Secchi Disc (M)	0.6
Cholorophyll a (g/L)	25.7

[1]Units in mg/L unless otherwise noted.

Source: South Florida Water Management District (SFWMD, May 1981) loads of total phosphate, total nitrogen, and chloride. The rainfall contribution to the total nitrogen was 24.3 percent of the total inflow to the lake.

In connection with the Martin Project, Florida Power and Light performed a water quality monitoring program including Lake Okeechobee (FPL, December 1989). Data in the lake were collected at one station near the St. Lucie Canal inlet. Temperature data at this location for 1978 to 1987 are presented in Figure 2.3.4-5.

St. Lucie Canal

Description

The St. Lucie Canal (Figure 2.3.4-1) is a major outflow canal from Lake Okeechobee that receives water at the east side of the lake. The canal (C-44) extends from the lake, west of Port Mayaca, to the South Fork of the St. Lucie River, for a total length of approximately 30 miles. The canal is manmade with a trapezoidal cross section, ranging in bed width from 150 feet at Port Mayaca to 200 feet at the lock near Stuart (S-80) (FPL, December 1989). The bed level also varies from +4 feet MSL at Port Mayaca to -3 feet MSL at the lock near Stuart (S-80). Both locks are used to control the water level in the canal to facilitate navigation, flood control, or water supply.

Water Levels

The design water depth for navigation in the canal is 8 feet (USGS, 1983). To maintain the depth, the optimum water level is maintained between El. 14 and 14.5 feet MSL (Veril, 1990). When the lake level drops below El. 14 feet MSL, the canal level is set to fluctuate with the lake.

During severe drought, such as the condition during 1989 and 1990, the canal is maintained between 0.2 and 1.0 feet below the lake level. These levels are for zero flow conditions in the canal. When the two locks are open, the water level slopes from about El. 15 feet MSL near Port Mayaca to about El. 4 feet MSL at Lock S-80 near Stuart.

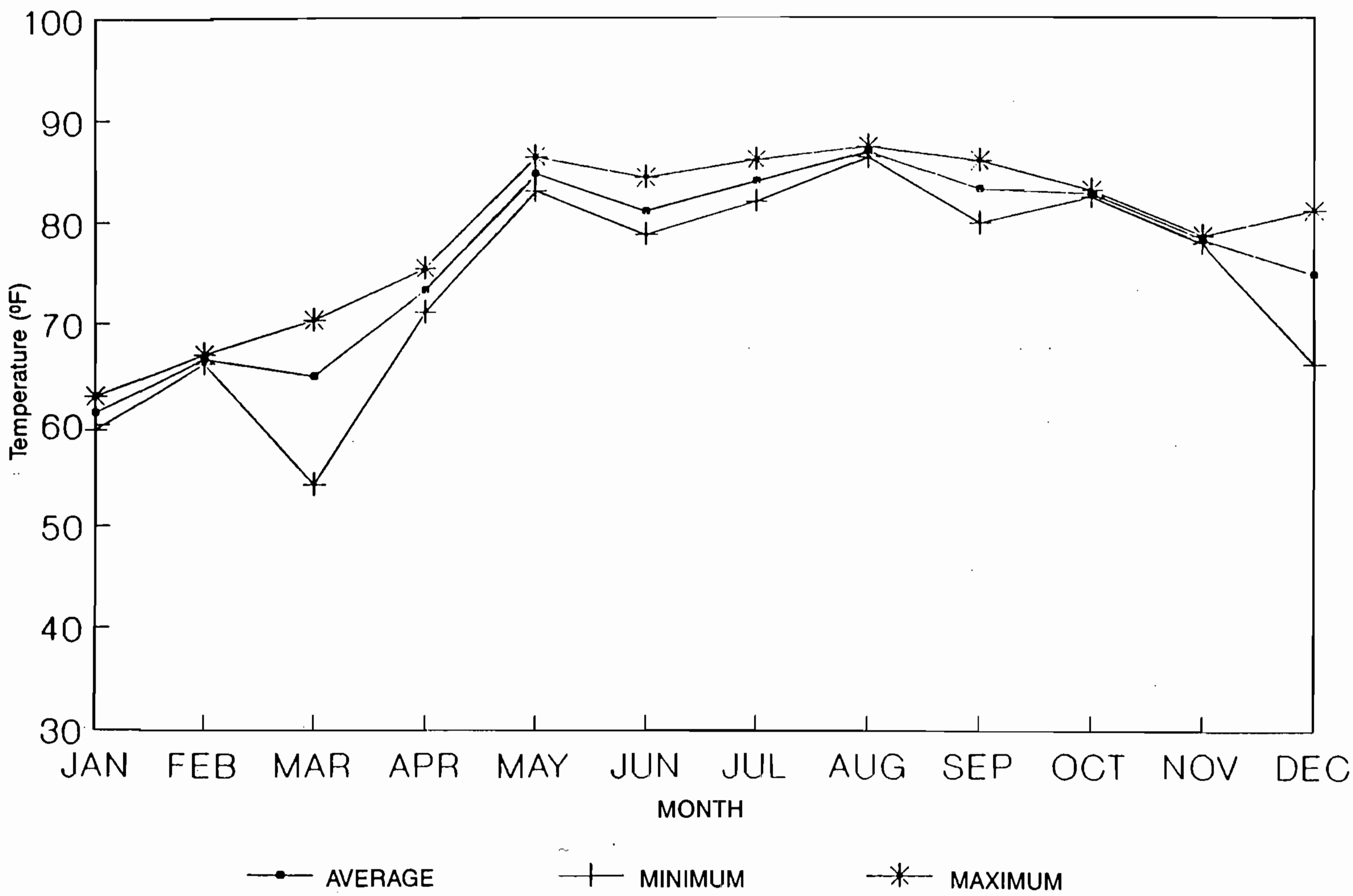

Figure 2.3.4-5.
WATER TEMPERATURES — LAKE OKEECHOBEE, 1978-1987

Source: FPL, 1989

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Discharge

The St. Lucie Canal receives its water from direct inflow from the watershed between Port Mayaca (S-308) and its outlet at Lock S-80 near Stuart, and from releases from Lake Okeechobee. The estimated watershed area of the canal is 140,772 acres (220 mi^2) (SFWMD, May 1987). Under a normal year, releases from the lake are made for 1 month and, in 10-year drought, for 3 months to supplement the inflow to meet water users' demand from the canal. Correlation studies (SFWMD, May 1987) between the rainfall and the basin inflow into the canal showed that monthly inflow runoff to the canal is about 30 percent of the rainfall over the canal basin. Thus, for a mean annual rainfall of about 46.13 inches over the canal basin, the average annual runoff is 163,000 acre-feet which is equivalent to 223 cfs.

The flow in the St. Lucie Canal is completely regulated by the locks at its upstream end at Port Mayaca and the downstream end near Stuart at its outlet. The USGS maintains flow records at each lock. A summary of these records for the period 1983-1989 is presented in Table 2.3.4-3.

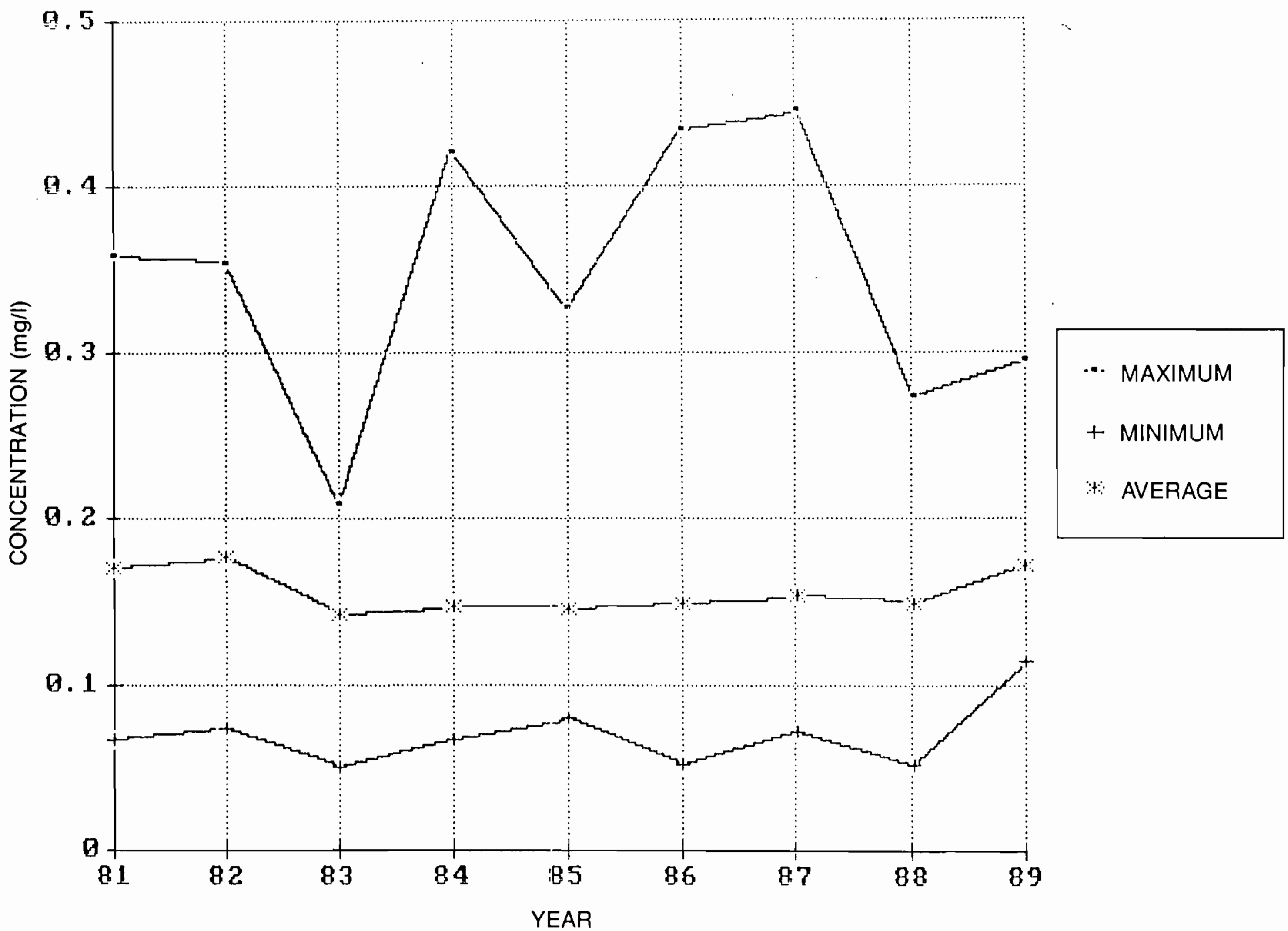
Water Quality

The St. Lucie Canal (C-44) is classified as a Class III surface water body as per the Water Quality Criteria in F.A.C. 17-302. This criteria are presented in Table 2.3.4-4.

Water quality samples have been collected and analyzed by SFWMD from January 1973 until the present time. These data are collected at Port Mayaca station (C44 S308). For the purpose of this application, these data are evaluated to determine seasonal and long-term trends. Particular emphasis is given to the years after 1981 to determine if there is a lowering trend in phosphorus level due to the implementation of Lake Okeechobee water quality management developed by SFWMD (SWIM Plan, SFWMD, January 1989). Data for the period of records are analyzed and summarized in Table 2.3.4-5. Figure 2.3.4-6 presents the maximum and minimum values of total phosphate, and Figure 2.3.4-7 presents specific conductance for the period 1981-1989. The data shown on these figures indicate

Figure 2.3.4-6.
ST. LUCIE CANAL WATER TOTAL PHOSPHATE AT S-308, 1981-1989

Source: Data from SFWMD



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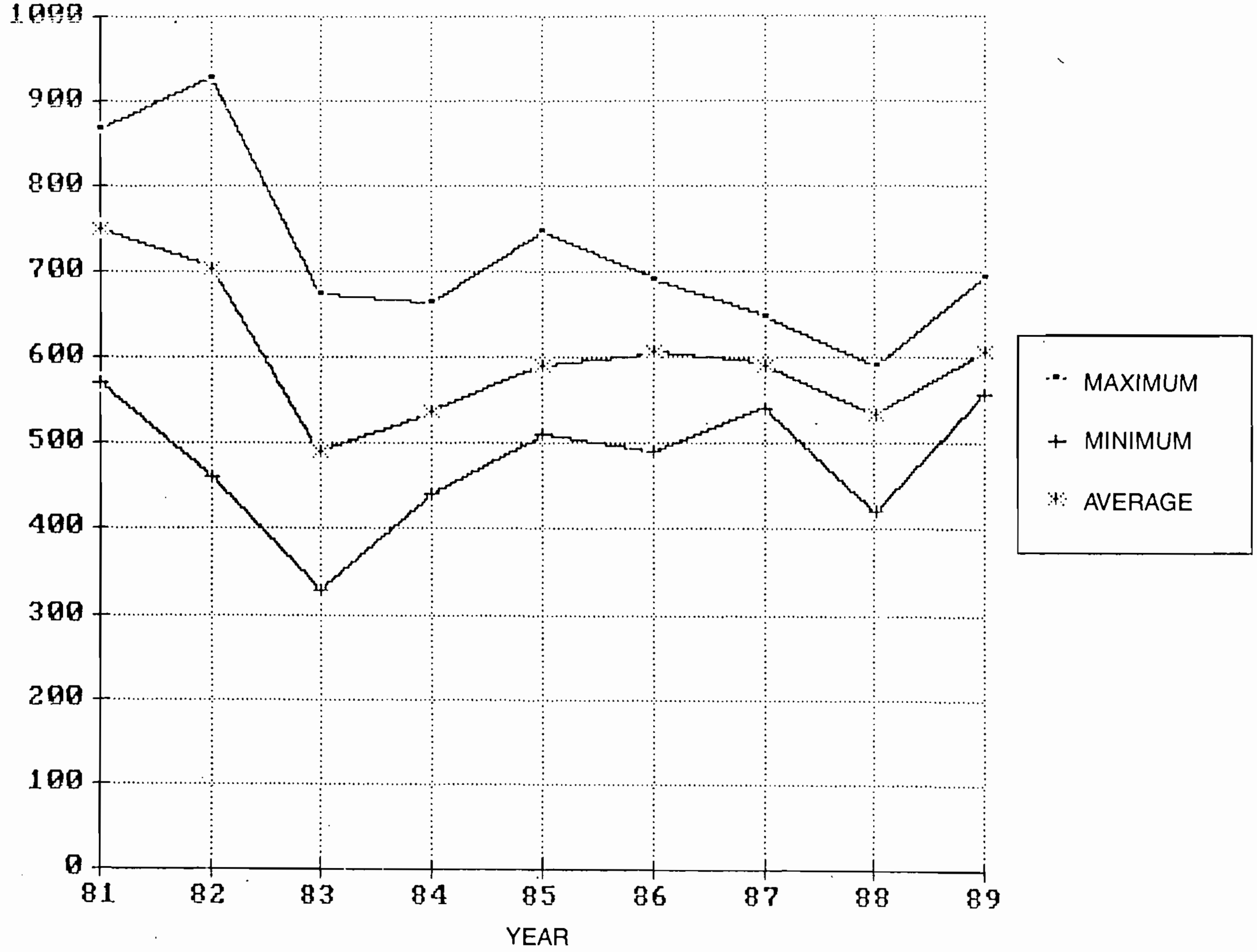

Figure 2.3.4-7.
ST. LUCIE CANAL WATER SPECIFIC CONDUCTANCE AT S308, 1981-1989

Source: Data from SFWMD

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Table 2.3.4-3
ST. LUCIE CANAL MEAN MONTHLY DISCHARGE (IN CFS), PERIOD 1983 - 1989

	At Lake Okeechobee Station 02-276870			At Lock Nr. Stuart Station 02-02770		
Month	Mean Monthly	Max-Mean Monthly	Min-Mean Monthly	Mean Monthly	Max-Mean Monthly	Min-Mean Monthly
Oct	-147	228	-1101	247	770	20
Nov	57	232	-120	290	789	30
Dec	74	144	-139	152	303	20
Jan	112	274	-130	187	300	20
Feb	666	3264	123	703	3777	20
Mar	562	7246	-647	1414	7453	20
Apr	1138	4620	-246	1127	4784	20
May	377	1131	71	318	878	20
June	150	653	-420	307	574	12
July	23	549	-618	277	906	12
Aug	37	1032	-247	469	1169	12
Sept	-252	82	-1036	265	490	12

Source: USGS Water Supply Papers

Table 2.3.4-4
APPLICABLE WATER QUALITY CRITERIA
(UNITS ARE MG/L UNLESS OTHERWISE NOTED)

Parameter	Lake Okeechobee (Class I) and St. Lucie Canal (Class III)
Alkalinity	20 (minimum)
Ammonia	0.02
Arsenic	0.05
Bacteria (Fecal Col.)	various limits
Beryllium	0.011 or 1.10[(2)]
Boron	--
Cadmium	0.0008 or 0.0012[(2)]
Chlorine	0.1
Chromium	0.5
Copper	0.03
Cyanide	0.0005
Detergent	0.5
D.O. (minimum)	5
Fluoride	5
Iron	1.0
Lead	0.03
Mercury	0.002
Nickle	0.1
Nutrients	non-numeric limits
Oil and Grease	
Dissolved	5.0
Free	0
Pesticides	extensive list
pH (standard units)	6-8.5 and ± 1
Phenols	0.0001
Phthalate Esters	0.0003
PCBs	0.000001
Radioactive Substances	
Radium (pc/l)	5
Alpha (pc/l)	15
Selenium	0.025
Silver	0.00007
Specific Conductance (micromho/cm)	1275[(1)]
Total Dissolved Gases	110% Saturation
Turbidity (NTU)	29
Zinc	0.03

(1) Not to exceed 50 percent above background.
(2) Dependent on hardness.

Source: F.A.C. 17-302, Part III, Water Quality Criteria - Surface Water

Table 2.3.4-5
WATER QUALITY OF ST. LUCIE CANAL AT PORT MAYACA S-308 (1973-1989)

Parameter	Units	Average	Minimum	Maximum
Temperature	°C	24.7	14.8	32.8
D.O.	mg/l	7.4	1.8	12.1
Sp. Conductance	μmhos	600.0	330.0	926.0
pH	units	7.88	6.95	9.09
NO_2	mg/l	0.012	0.002	0.131
NH_4	mg/l	0.06	0.01	0.44
Ortho-Phosphate	mg/l	0.058	0.002	0.345
Total Phosphate	mg/l	0.141	0.01	0.444
Cl	mg/l	84.2	36.50	198.10
Alkalinity	Meq/l	2.51	0.40	4.50

Source: SFWMD

that the average phosphorus concentration and specific conductance (a measure of TDS) are nearly the same for the long-term data.

In addition to the measurements made at Port Mayaca by SFWMD, since 1978 FPL (FPL, December 1989) has maintained a water quality sampling program at various locations along the St. Lucie Canal, including a station at the Port Mayaca Lock and another station near Indiantown. A summary of water temperature measurements at these two locations for maximum, average, and minimum values are presented in Figures 2.3.4-8 and 2.3.4-9, respectively.

Taylor Creek/Nubbin Slough

Taylor Creek/Nubbin Slough (Class III) is the name commonly given to the basin that drains into Lake Okeechobee through a gated water control structure, Spillway Structure S-191, on the northeast shore of the Lake Okeechobee (Figure 2.3.4-10).

In 1973, the discharge from 104.5 square miles (upper Taylor Creek) was diverted into L-63N and L-63S, the new 10-mile long SFWMD canals that intercept Nubbin Slough and other tributaries (Mosquito Creek, Lettuce Creek, and Henry Creek). The L-63N and L-63S canal flows are then discharged into the Lake Okeechobee through a 1.1-mile canal (C-59) and the Structure S-191 (SFWMD, June 1986).

The basin formed by this diversion, the current Taylor Creek/Nubbin Slough basin, encompasses 188 square miles. The upper Taylor Creek portion of the basin is composed of four major tributaries: Williamson Main, Northwest Taylor Creek, Little Bimini Creek, and Otter Creek. Land uses in the basin, based on 1980 estimates, are primarily improved pasture (68 percent), forest and rangeland (22.3 percent), urban (3.2 percent), and citrus and miscellaneous (6.5 percent) (SFWMD, January 1989).

Figure 2.3.4-8
WATER TEMPERATURES — ST. LUCIE CANAL AT PORT MAYACA, 1978-1987

Source: FPL, 1989

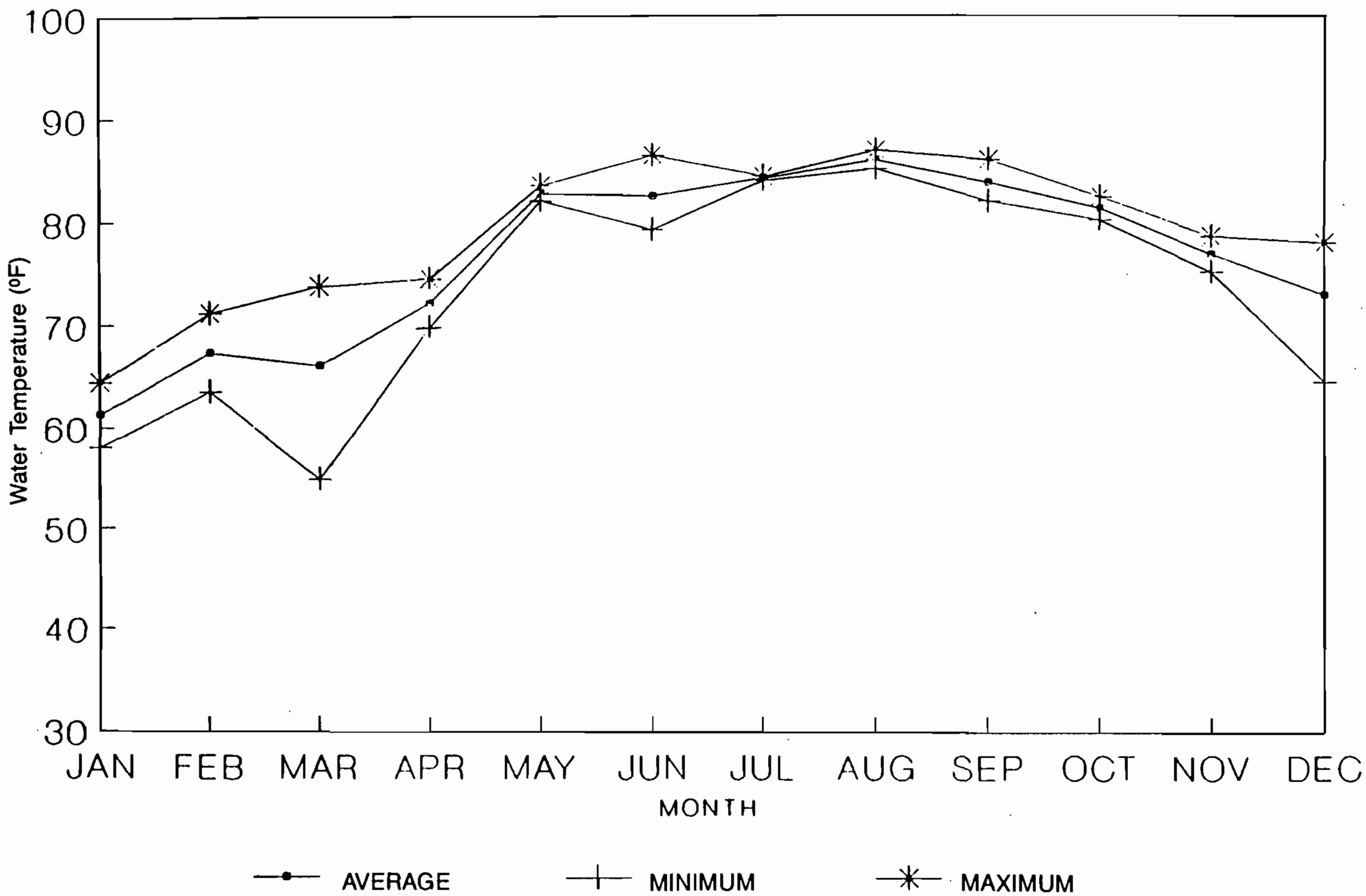

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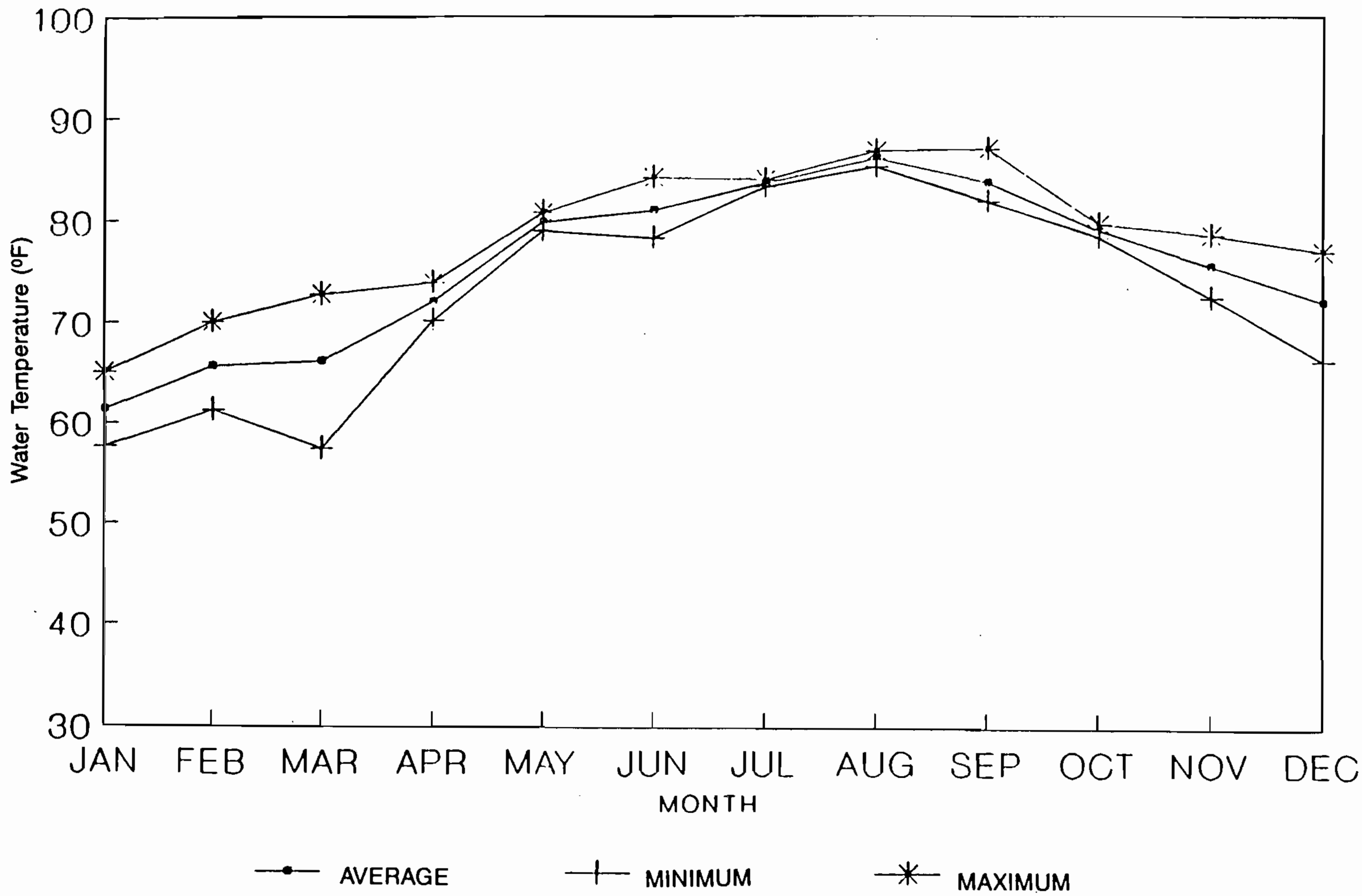
Figure 2.3.4-9
WATER TEMPERATURES — ST. LUCIE CANAL,
1978-1987

Source: FPL, 1990.



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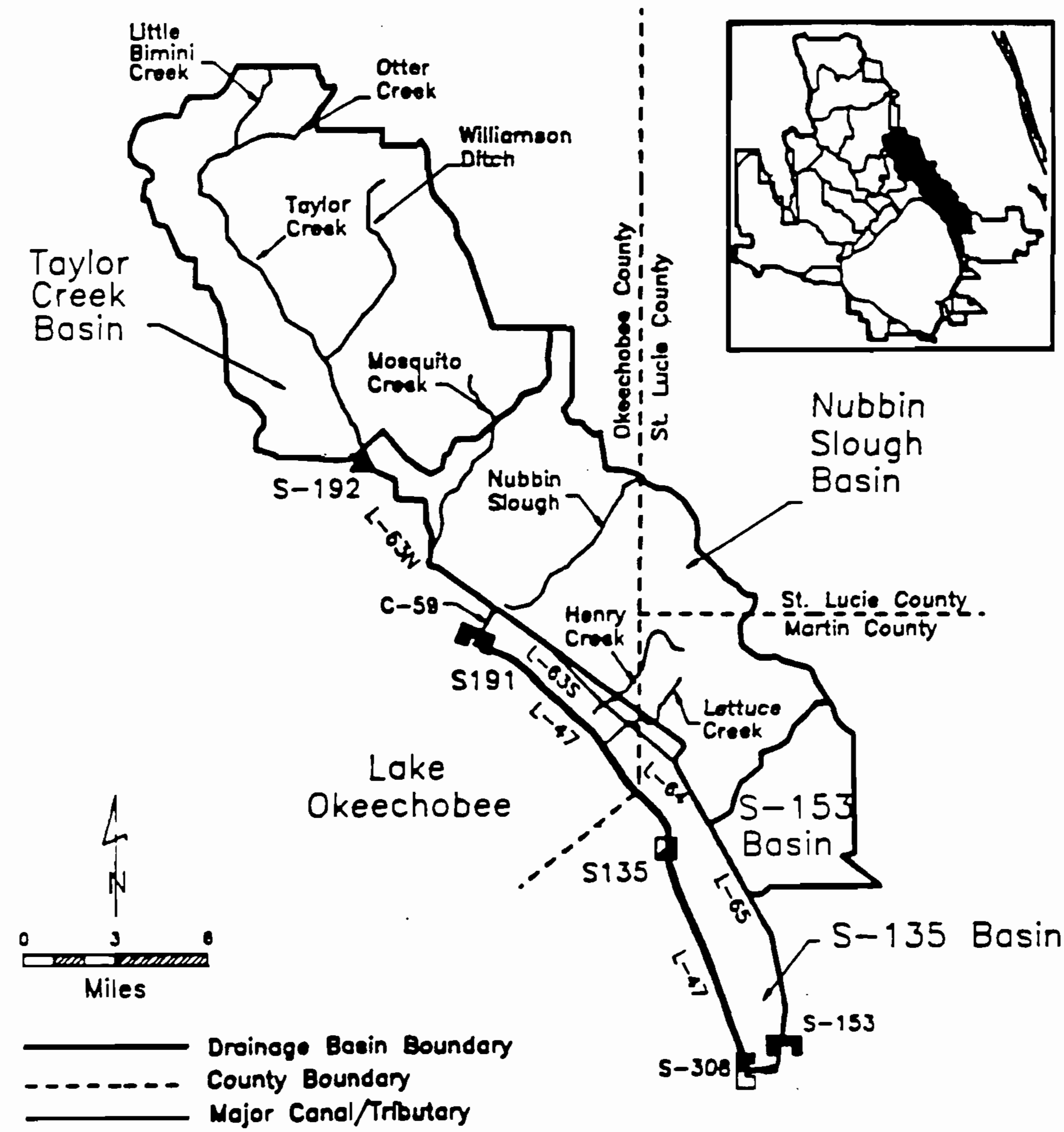

Figure 2.3.4-10
TAYLOR CREEK/NUBBIN SLOUGH WATERSHED BOUNDARY

Source: SWIM Plan for Lake Okeechobee, SFWMD, 1989.

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Canal Cross Sections

Canal C-59 is about 1.1 miles long, connecting L-63 N&S to the S-191 structure. The design canal bed width is about 150 feet with invert at -4 feet MSL and side sloped 2:1. This general information is obtained from design drawings developed by the U.S. Army Corps of Engineers and Garris Engineers, Inc. of 1971.

Canal L-63S (Nubbin Slough) is about 5.5 miles long with a variable bed width and level. The bed width ranges from 100 feet at its downstream end to about 10 feet at its upstream end near State Road 15B. The bed level changes from -4 to +20 feet MSL with side slopes of 2:1.

A bathymetric survey was performed at the junction of the three canals in connection with the base work for locating the plant water intake to supply water to the ICL site. The area surveyed is shown in Figure 2.3.4-11. The surveyed cross sections of Canals L-63N&S and C-59 are shown in Figure 2.3.4-12

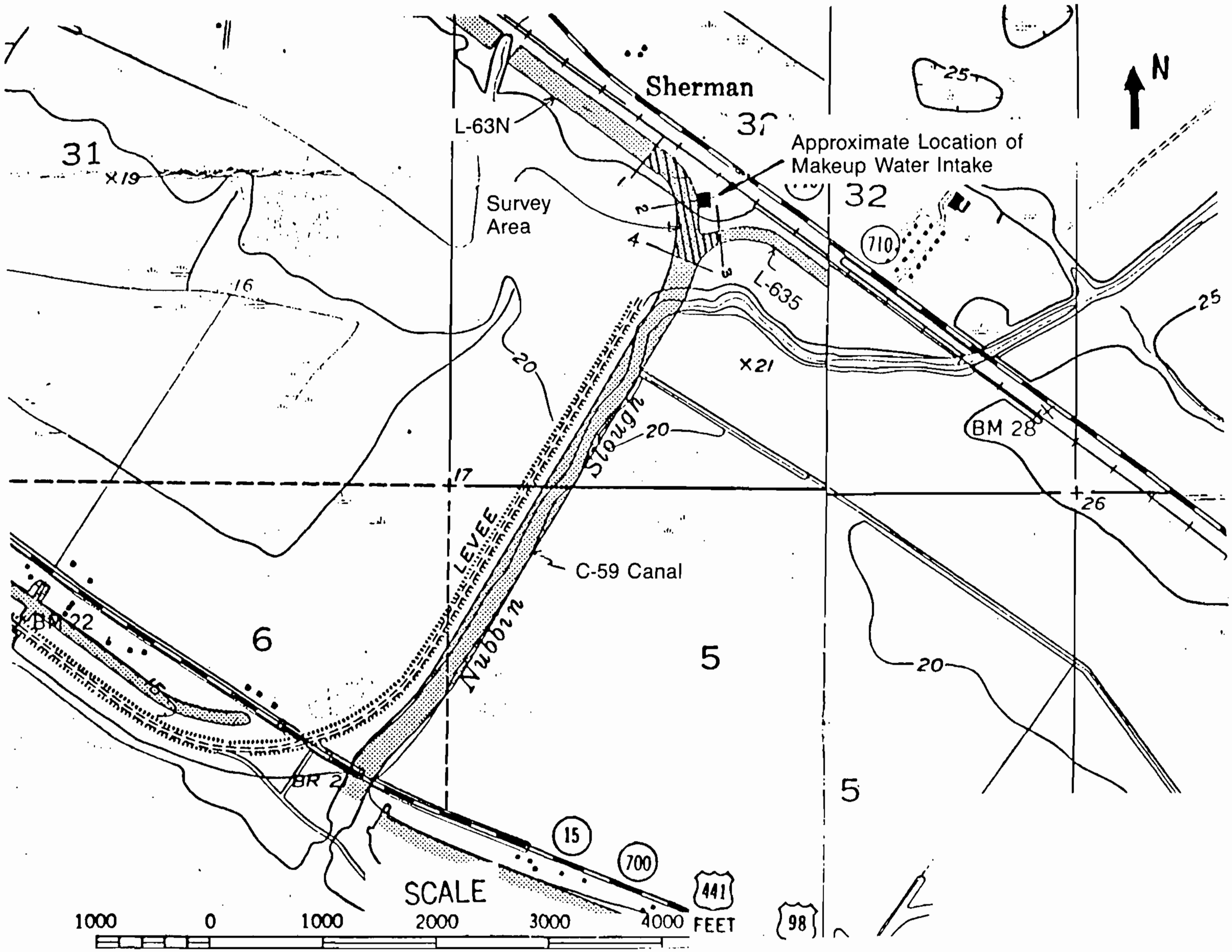
Water Levels

The water level in Canal C-59 is controlled by the operation of control structure S-191. This structure is a reinforced concrete, gated spillway with discharge controlled by three cable operated vertical lift gates. Operation of the gates is automatically controlled so that the gate hydraulic operating system opens or closes the gates in accordance with the seasonal operational criteria (SFWMD, June 1986).

This structure maintains optimum water control stages in the upstream agricultural area. It passes the 10-year design flood without exceeding upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels; it prevents flooding from hurricane tides on Lake Okeechobee; and it permits backflow up to 330 cfs to the north to meet agricultural water requirements.

Figure 2.3.4-11
BATHYMETRIC SURVEY LOCATION

Source: Bechtel 1990



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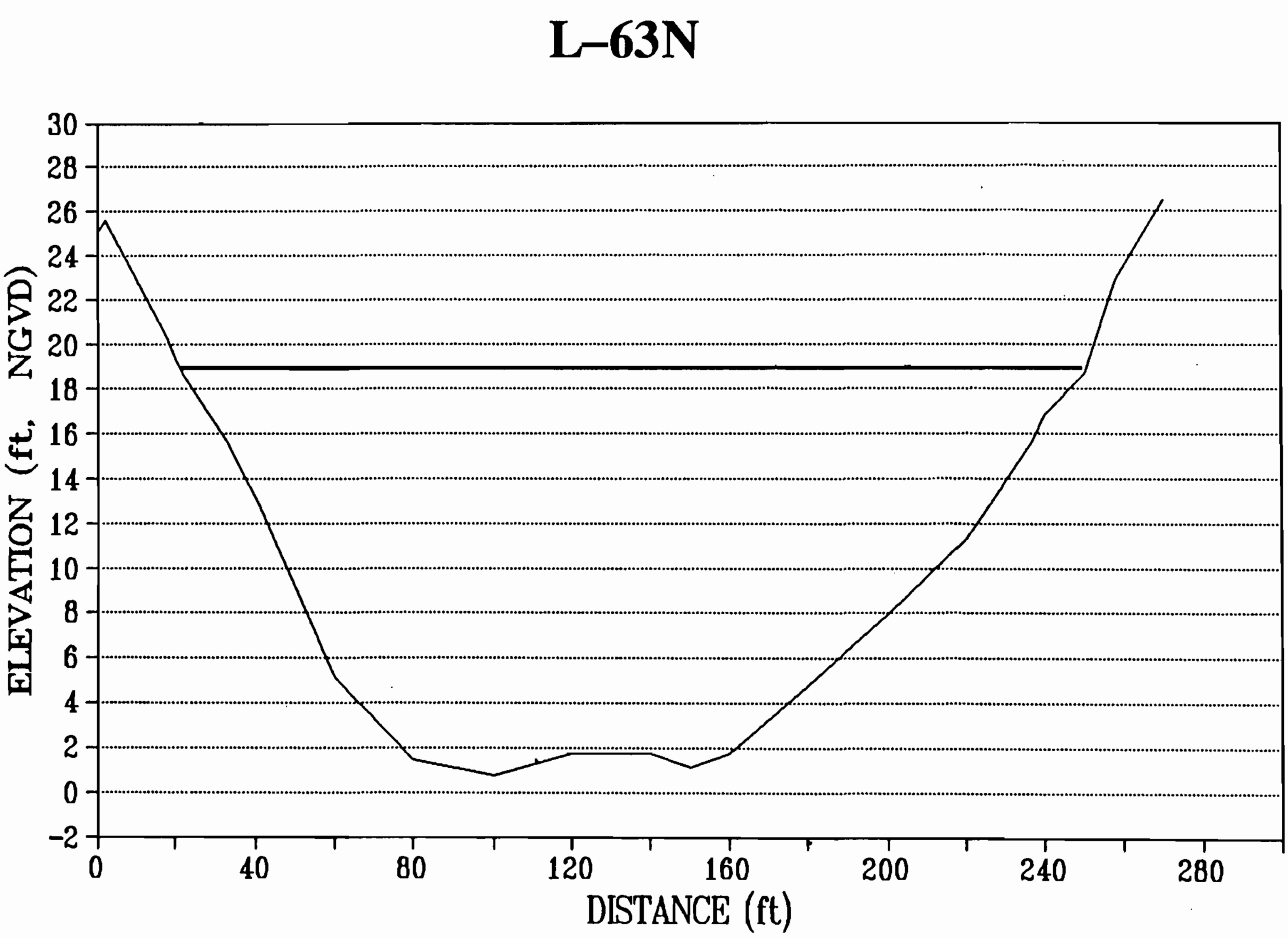

Figure 2.3.4-12 Sheet 1
CROSS SECTION OF L-63N CANAL NEAR
PLANT WATER INTAKE

Source: ECT, 1990

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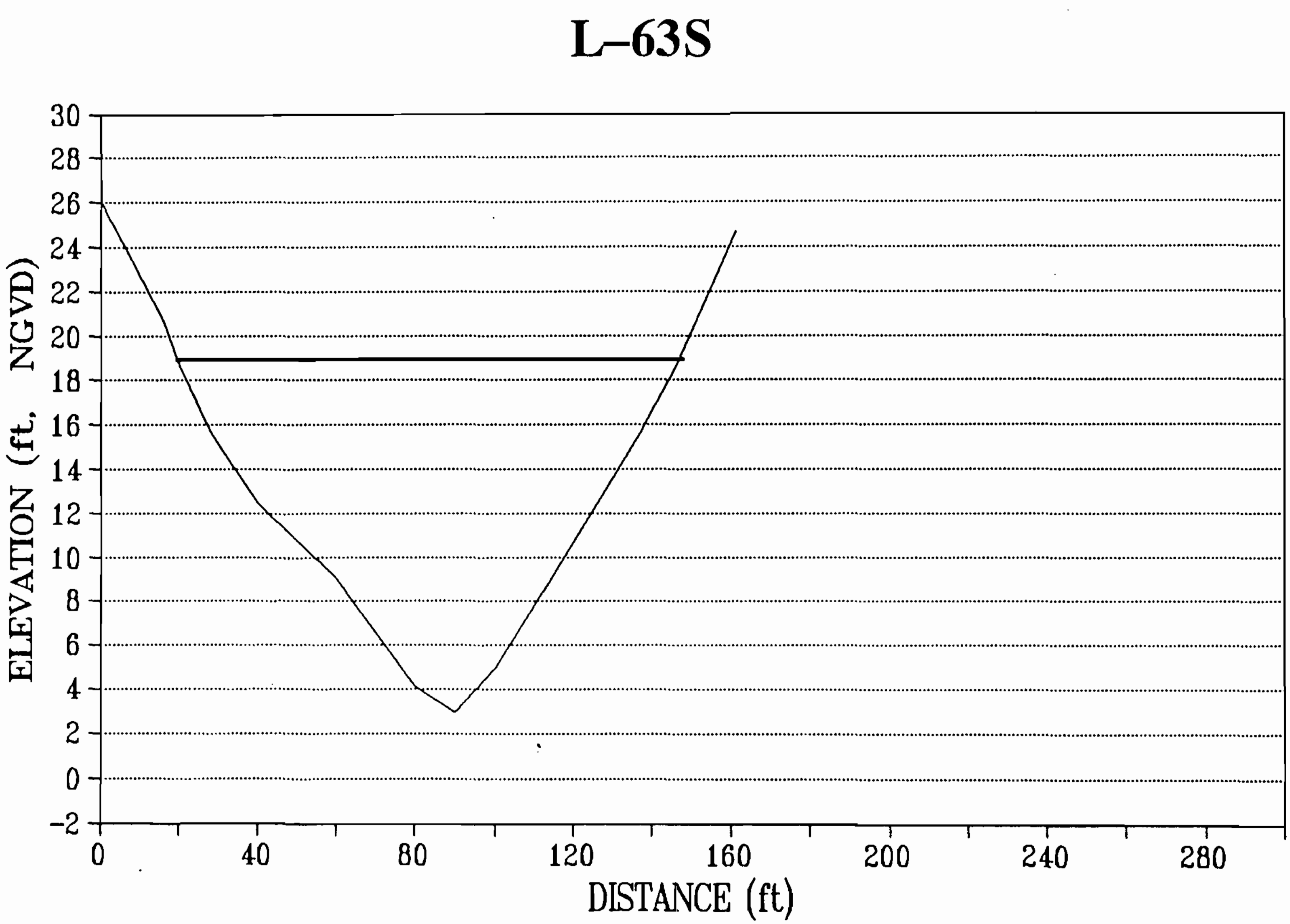

Figure 2.3.4-12 Sheet 2
CROSS SECTION OF L-63S CANAL NEAR THE JUNCTION WITH C-59

Source: ECT, 1990

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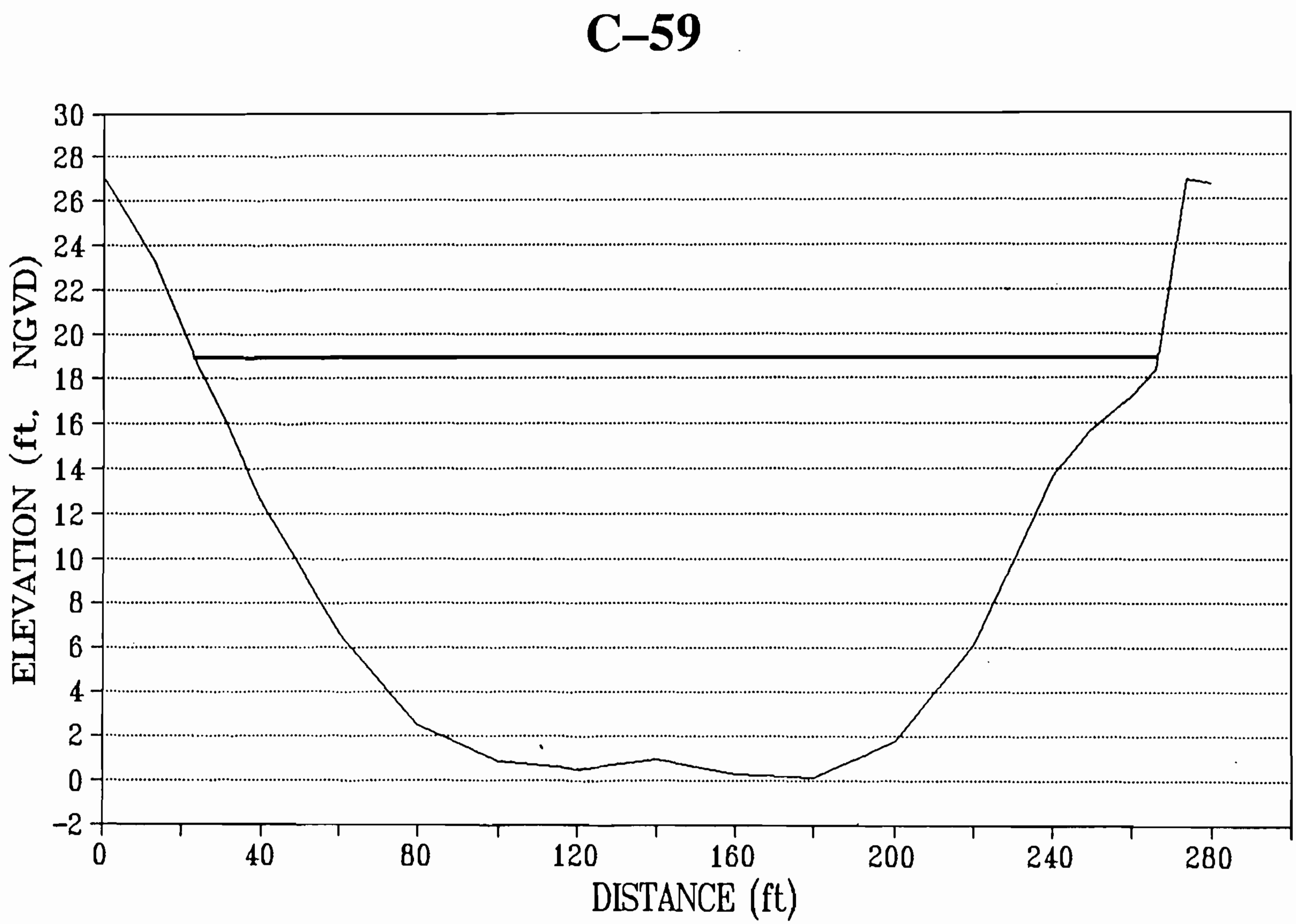

Figure 2.3.4-12 Sheet 3
CROSS SECTION OF C-59 UPSTREAM OF S-191

Source: ECT, 1990

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This structure is operated to maintain, insofar as is possible, headwater elevations within 0.2 feet above design water level and 0.2 feet below the 19.0-foot optimum water level (SFWMD, June 1986). Four manually operated gates on overflow slots in the main gate control small discharges without raising the upstream stage. When the discharge exceeds the capacity of these gates, the automatic controls function as follows:

- When the headwater elevation rises to 19.7 feet, the gates will open at 6 inches per minute, but the gate opening will be governed by the Differential Head versus Gate Position Curve, and it will not exceed the maximum allowable opening position.

- When the headwater elevation rises or falls to 19.5 feet, the gates will become stationary.

- When the headwater elevation falls to 19.3 feet, the gates will close at 6 inches per minute.

Historical daily water levels at S-191 have been collected by SFWMD since 1973. The water level data are summarized to show monthly and maximum and minimum monthly averages, as presented in Table 2.3.4-6.

Discharges

Flow records at S-191 since July 1973 showed that the flow is not continuous and responds largely to the rainfall. During any given month, the flow can vary from several hundred cubic feet per second to zero within a few days. In general, the rainy season (April to October) exhibits large flow, both in magnitude and in duration. The winter months generally have very low discharge as a result of the low rainfall. In the water budget study performed by SFWMD for Lake Okeechobee for the period from 1973 to 1979 (SFWMD, May 1981), the mean annual discharge from S-191 into the lake amounted to about 154,000 acre feet per year, which

Table 2.3.4-6
HISTORIC WATER LEVELS OF TAYLOR CREEK/NUBBIN SLOUGH AT S-191 (1974-1989)

Month	Monthly Avg. ft	Daily Min. ft	Daily Max. ft
January	19.10	18.55	19.58
February	19.11	18.57	19.93
March	19.11	18.76	19.58
April	19.07	18.27	19.70
May	19.02	18.50	19.55
June	19.05	18.14	19.58
July	19.12	18.34	20.65
August	19.14	18.11	19.57
September	19.10	18.01	20.34
October	19.10	17.70	19.59
November	19.14	18.80	19.59
December	19.12	18.37	19.58

Source: South Florida Water Management District, Data Management Division, Department of Research and Evaluation

represents about 4 to 5 percent of the total inflow to the lake of about 3,500,000 acre feet.

The daily flow records at S-191 obtained from the SFWMD were analyzed to determine seasonal and long-term variability. Table 2.3.4-7 presents the mean maximum and minimum monthly average discharges for each month for the period 1974 to 1989. Based on these data, the long-term mean annual flow at S-191 is 106,000 acre feet per year. This rate of inflow to the lake reflects the below average precipitation in 1981, 1986, and 1989.

Water Quality

The Taylor Creek/Nubbin Slough basin was singled out by the 1986 Lake Okeechobee Technical Advisory Committee as a priority basin in which to apply phosphorus controls. Approximately 143 tons of phosphorus are discharged from the basin to the Lake Okeechobee each year. This basin ranks as the number one phosphorus contributor to the lake with an annual flow-weighted concentration of 0.947 mg/l (USGS, 1981). Over the period of 1973 through 1987, the Taylor Creek/Nubbin Slough watersheds annually contributed about 21.2 percent of the phosphorus input into Lake Okeechobee, yet contributed only 3.7 percent of the lakes inflow water (SFWMD, January 1989).

Water quality samples have been collected and analyzed at S-191 by South Florida Water Management District since 1973. These data are presented in this section for two periods. The initial period covers 1973 to 1980 and the recent period, 1980 to 1989. This division is selected to show the effect of the water quality management and improvement program established by SFWMD. Table 2.3.4-8 presents a summary of the data collected by SFWMD (SFWMD, May 1981) in connection with Lake Okeechobee Water Quality Studies. These studies showed that Taylor Creek/Nubbin Slough at S-191 was the largest contributor of phosphorus (28.5 percent) with minor contribution to total nitrogen and chloride.

Table 2.3.4-7
HISTORIC MEAN DISCHARGES (csf) FROM TAYLOR CREEK/NUBBIN SLOUGH AT S-191 (1974-1989)

Month	Average	Minimum	Maximum
January	103.5	8.2	597.3
February	105.0	3.1	583.9
March	91.9	3.4	379.2
April	44.3	0	226.1
May	62.7	0	339.0
June	151.2	0	878.6
July	181.5	4.7	744.9
August	275.3	7.2	693.7
September	396.9	6.6	1849.5
October	159.8	15.7	516.9
November	95.2	8.1	512.3
December	89.2	8.0	518.5

Source: South Florida Water Management District, Data Management Division, Department of Research and Evaluation

Table 2.3.4-8
SELECTED WATER QUALITY PARAMETERS AT S-191
(APRIL 1973 - MARCH 1980)

Parameter	Concentration		Units
	Mean	Range	
TOC	20.50	8.9-35.9	mg/l
TSS	9.6	1.0-136.4	mg/l
Sp.Conductance	60.3	130-1300	µmhos/cm
pH	7.06	5.7-8.51	
Na	61.94	70.0-151.20	mg/l
K	7.66	2.17-13.46	mg/l
Ca	35.56	7.00-74.47	mg/l
Mg	11.72	2.80-25.00	mg/l
Total Fe	0.48	0.02-1.37	mg/l
SO_4	38.4	9.5-75.5	mg/l
Cl	111.1	15.6-355.8	mg/l
Silica	6.5	0.5-48.0	mg/l
Alkalinity	1.38	0.34-4.22	Meq/l
Hardness	137.0	29.0-276.1	mg/l
Ortho-Phosphate	0.749	0.577-0.992	mg/l
Total Phosphate	0.906	0.737-1.106	mg/l
Total Weighted Nitrogen	2.29*	1.95-2.74	mg/l

*Weighted mean annual average values 1973-1979.

Source: South Florida Water Management District (SFWMD, May 1981)

The data in Table 2.3.4-9 present the 1980 to 1989 average water quality data. Comparison of these tables shows a clear lower concentration of nitrate and phosphate in the most recent years. Other parameters remain approximately the same.

2.3.4.2 Measurement Programs

No independent measurement programs were undertaken for the SCA. Water quality data were obtained from historical sources.

Table 2.3.4-9
WATER QUALITY OF TAYLOR CREEK/NUBBIN SLOUGH AT S-191 (1980-1989)

Parameter	Concentration
pH	7.1
Alkalinity (Meq/l)	64
Total Disolved Solids	380
Total Hardness (as $CaCO_3$)	130
Silica	7.8
Ammonia	-
Calcium	34
Magnesium	11
Sodium	61
Potassium	8.1
Iron	0.50
Copper	-
Manganese	-
Sulfate	33
Chloride	110
Fluoride	-
Nitrate	0.46
Phosphate	0.81

NOTE: Concentrations are in mg/l of the ion.

Source: South Florida Water Management District Water Quality Computer Printout Data Sheets

2.3.5 VEGETATION/LAND USE

2.3.5.1 Site Description

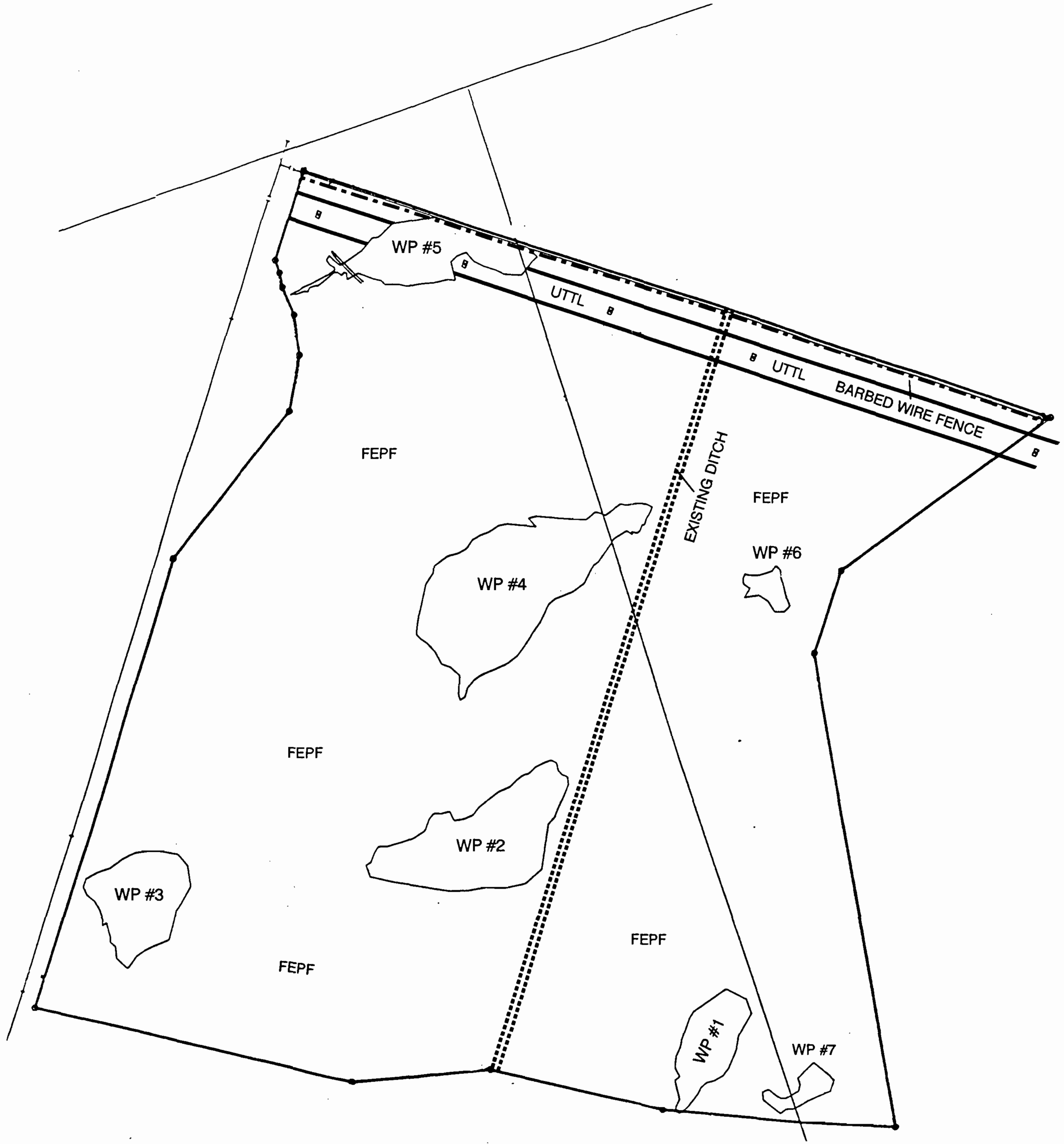
The proposed ICL facility will be located south of SR 710, approximately 4 miles south-southeast of FPL's Martin plant site, and approximately 3 miles west-northwest of Indiantown, the nearest community. The site adjoins a highly developed area consisting of existing and former industrial facilities along SR 710. The ICL facility will also include an approximately 19-mile-long cooling water pipeline right-of-way between the site and a proposed cooling water intake located along Taylor Creek/Nubbin Slough.

The ICL site is located on level, undeveloped terrain bounded by an existing FPL transmission line, the Caulkins Indiantown Citrus Processing facility, and the FSC facility to the north, and by pine flatwoods habitat to the east, west, and south. The surrounding land uses are primarily industrial and agricultural, and include citrus, improved pasture, rangeland, truck crops, and sugarcane land categories.

The predominant natural vegetation of the site consists of pine flatwoods with scattered shallow wet prairie wetlands containing herbaceous and shrub vegetation. Figure 2.2.3-1 is a land cover/land use map of the project area (project site and a 5-mile radius) as previously shown in Section 2.2.3.3. Figure 2.3.5-1 shows a more detailed vegetation and land use map of the approximately 232-acre project site.

The vegetation and land use components of the project site and the surrounding land located within a 5-mile radius were categorized using the Level III SFWMD Land Use and Land Cover Classification System. Since FDER approved mapping of land use and land cover classifications using the more detailed and regionally adapted SFWMD land use and land cover classification system for another recent power plant site certification application, this SFWMD system of classification was

Figure 2.3.5–1
VEGETATION/LAND USE MAP OF THE ICL PROJECT SITE



KEY

FEPF – PINE FLATWOODS
WP – WET PRAIRIE
UTTL – MAJOR TRANSMISSION LINE

N

0 500 1000
SCALE IN FEET

SOURCE: SOUTH FLORIDA WATER MANAGEMENT DISTRICT LAND USE AND LAND COVER CLASSIFICATION, n.d.; ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC., 1990

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also used in this application instead of the Florida Land Use and Cover Classification System (FLUCCS) (1976). A copy of SFWMD's Land Use and Land Cover Classification System is provided in Chapter 10.

The following vegetation community types were identified on and within a 5-mile radius of the ICL project site:

- **Agriculture (A)**
  Improved pasture (APIM)
  Citrus (AMCT)
  Sugarcane (ACSC)
  Truck crops (ACTC)

- **Rangeland (R)**
  Grassland (RG)
  Brushland (RSSB)
  Palmetto prairies (RSPP)

- **Forested uplands (F)**
  Pine flatwoods (FEPF)
  Pine/cabbage palm (FMPC)
  Cabbage palms/oaks (FMCO)
  Forested old field (FMOF)
  Mixed forested (FM)

- **Wetlands (W)**
  Non-forested freshwater (WN)
  Pine and wet prairies (WXPP)
  Cypress swamp (WFCY)
  Mixed forested (WFMX)

Acreages of each vegetation type on the project site are shown in Table 2.3.5-1. In addition to these acreage determinations, a qualitative evaluation of ecological quality is also provided for each community type, together with information on the level and principal source of existing ecological disturbances (see Table 2.3.5-1). The *"low"* quality designation is provided to reflect a highly altered and/or impacted condition. Vegetation assigned a "moderate" level of ecological quality display evidence of some physical disturbance, but still retain a physiognomy associated with the representative natural community type. A *"high"* quality classification refers to community types with little or no disturbances that appear to be in a relatively

Table 2.3.5-1

SUMMARY OF VEGETATION COMMUNITIES AT THE INDIANTOWN COGENERATION PROJECT SITE, 1990

Vegetation Community Type*	Acreage (acres)	Relative Ecological Quality+	Level of Ecological Disturbance	Principal Source of Disturbance
Pine and wet prairie	232	Moderate to high	Moderate	Periodic wildfires
Pine flatwoods--FEPF**	(200)	Moderate to high	Low	Cattle grazing, road construction
Wet prairie--WP	(24)	Moderate to high	Moderate	Drainage
Ruderal land--UTTL	(8)	Low	High	Construction and clearing operations
Total uplands	208			
Total wetlands	24			
Total area	232			

* Letters that represent the Level III SFWMD Land Use and Land Cover Classification Code and Vegetation Community Types shown on Figure 2.3.5-1.

\+ High = displays little or no physical disturbance; of a pristine quality.
Moderate = evidence of physical disturbance present, but still retains representative structure and species composition.
Low = poor quality, highly altered condition.

**Vegetation types that reflect subcommunity designations used to further describe and delineate pine and wet prairie on the project site.

Source: ECT, 1990.

undisturbed state. Mapped data and descriptive accounts which follow reflect site conditions within 6 months of the filing date of this application.

2.3.5.2 Vegetation Community Quality and Condition

The most significant alterations to the vegetation communities on the proposed ICL site are those related to drainage and use of the site as cattle rangeland. Historical drainage patterns have been altered by the construction of a deep drainage ditch traversing the plant site in a north-south direction, by construction of a transmission line right-of-way along the northern boundary of the site, and by several off-road vehicle trails and access roads throughout the site.

The effects of drainage alteration are most apparent in the wet prairies; changes to the pine flatwoods of the site are less apparent. The changes in wetlands are manifested in the increase in upland plant species in the outer transition zone. This is most obvious in wetlands adjacent to the ditch. Even though species changes are obvious in all wet prairies, the functional values remain moderate to high.

The pine flatwoods are relatively undisturbed except for road construction and minor effects of cattle grazing. The greatest change observed is due to past wildfires (within the last 5 to 10 years) which destroyed extensive areas of the canopy and groundcover. In some areas, areas of former canopy composed of mature south Florida slash pine were killed.

The greatest effect of periodic fires is the destruction of invading oaks and other hardwoods within the pine flatwoods community. Fire, a natural factor in the maintenance of flatwoods throughout Florida, is necessary to maintain the structural and functional integrity of pineland communities. In general, the quality and condition of pine flatwoods on the site remains moderate to high due to such periodic burning.

2.3.5.3 Dominant Indicator Vegetation

South Florida plant communities (i.e., wildlife habitats) exhibit characteristics of subtropical and temperate vegetation depending upon various edaphic, climatic, and topographic features. The classification of these uplands, wetlands, and aquatic systems is usually accomplished by the vegetative structure, plant species dominance and diversity, soil substrate, topographic relief, and hydroperiod.

The vegetation communities of the site and within a 5-mile radius of the ICL project site were qualitatively surveyed by plant ecologists/taxonomists in the spring (dry season) and summer-fall (wet season) of 1990. Natural vegetation communities on and within a 5-mile radius of the proposed project site consist of pine and wet prairie (WXPP), pine flatwoods (FEPF), pine/cabbage palms (FMPC), cabbage palm/oaks (FMCO), mixed-forested uplands (FM), non-forested freshwater wetlands (WN), cypress swamp (WFCY), mixed-forested swamp (WFMX), and palmetto prairie (RSPP). Slightly altered plant communities include forested old fields (FMOF), brushland (RSSB), and grassland (RG). Agricultural lands in which the original vegetation has been replaced with a cultivar(s) for the purpose of farming, includes improved pasture (APIM), citrus (AMCT), truck crops (ACTC), and sugarcane (ACSC). Pine and wet prairie is the dominant natural community type within the undeveloped portions of the project area.

As indicated previously, 16 natural, slightly altered, or agricultural plant community types have been identified as existing on or within 5 miles from the ICL site. All of these vegetation communities were divided into uplands and wetlands, and described in terms of vegetation, physical structure, and ecology.

A plant species inventory of the ICL site is provided in Table 2.3.5-2. The plant species are listed by three plant community types. From a vegetation perspective, the entire 232-acre plant site is designated as pine and wet prairie. However, to provide a more detailed species listing by plant association, three sub-community

Table 2.3.5-2
Plant Species Inventory of the ICL Project Site
(Page 1 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)* PF	WP	RL
Trees				
Acer rubrum	Red maple		X	
Ilex cassine	Dahoon holly	X		
Magnolia virginiana	Sweetbay magnolia	X		
Melaleuca quinquenervia	Punk tree	X		
Persea palustris	Swampbay	X		
Pinus elliottii var. densa	South Florida slash pine	X		
Quercus nigra	Water oak	X		
Quercus virginiana	Live oak	X		
Quercus laurifolia	Laurel oak	X		
Sabal palmetto	Cabbage palm	X		
Shrubs and Small Trees				
Annona glabra	Pond apple		X	
Asimina reticulata	Pawpaw	X		
Baccharis halimifolia	Groundsel bush	X		
Befaria racemosa	Tarflower	X		
Callicarpa americana	Beautybush	X		
Cephalanthus occidentalis	Buttonbush		X	
Gaylussacia dumosa	Dwarf huckleberry	X		
Hypericum fasciculatum	St. John's-wort		X	
Hypericum hypericoides	St. Andrew's-cross	X		
Hypericum tetrapetalum	St. John's-wort	X		
Hypericum reductum	St. John's-wort	X		
Ilex glabra	Gallberry	X		
Ludwigia peruviana	Primrose willow		X	X
Lyonia fruticosa	Staggerbush	X		
Lyonia lucida	Fetterbush	X		
Myrica cerifera	Wax myrtle	X	X	X
Quercus minima	Dwarf live oak	X		
Rhus copallina	Winged sumac	X		X
Salix caroliniana	Carolina willow		X	
Schinus terebinthifolius	Brazilian pepper		X	X
Serenoa repens	Saw palmetto	X		

Table 2.3.5-2
Plant Species Inventory of the ICL Project Site
(Page 2 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)* PF	WP	RL
Shrubs and Small Trees (Continued)				
Stillingia aquatica	Corkwood		X	
Vaccinium myrsinites	Shiny blueberry	X		
Herbs				
Aletris lutea	Yellow colic-root	X		
Ambrosia artemisiifolia	Common ragweed			X
Amphicarpum muhlenbergianum	Blue maidencane		X	
Andropogon brachystachyus	Shortspike bluestem	X	X	
Andropogon virginicus	Broomsedge	X	X	
Andropogon virginicus var. glaucus	Chalky bluestem	X	X	
Aristida lanosa	Longleaf threeawn		X	
Aristida stricta	Wiregrass	X		
Aristida spiciformis	Bottlebrush threeawn	X		
Asclepias pedicellata	Milkweed	X		
Axonopus affinis	Common carpetgrass	X		X
Axonopus furcatus	Big carpetgrass		X	
Azolla caroliniana	Mosquito fern			X
Bacopa monnieri	Hyssop		X	
Balduina angustifolia	Yellow buttons	X		
Bidens alba	Beggar-ticks			X
Blechnum serrulatum	Saw-toothed fern		X	X
Boehmeria cylindrica	False nettle		X	X
Cassia chamaecrista	Partridge-pea	X		
Centella asiatica	Coinwort		X	X
Cladium jamaicense	Sawgrass		X	
Commelina diffusa	Day-flower	X		X
Conyza canadensis	Dwarf horseweed			X
Cuphea carthagenensis	Cuphea		X	
Cynodon dactylon	Bermudagrass		X	
Cyperus haspan	Sedge		X	
Cyperus polystachyos	Sedge		X	
Cyperus ligularis	Sedge	X		
Dichanthelium spp.	Dichanthelium grasses	X	X	

Table 2.3.5-2
Plant Species Inventory of the ICL Project Site
(Page 3 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)* PF	WP	RL
Herbs (Continued)				
Dichanthelium dichotomum var. ensifolium	Dichanthelium			
Dichanthelium erectifolium	Dichanthelium grass		X	
Digitaria decumbens	Pangolagrass			X
Diodia virginiana	Buttonweed	X		
Eclipta alba	Eclipta		X	X
Eichhornia crassipes	Water hyacinth			X
Eleocharis baldwinii	Clubrush	X	X	
Elephantopus elatus	Florida elephant's-foot	X		
Emilia fosbergii	Cupid's shavingbrush			X
Eragrostis spectabilis	Purple lovegrass	X		
Erechtites hieracifolia	Fireweed		X	
Erianthus giganteus	Sugarcane plumegrass		X	
Eriocaulon compressum	Pipewort		X	
Eulophia alta	Wild coco	X		
Eupatorium capillifolium	Dog fennel	X	X	X
Eupatorium compositifolium	Dog fennel	X	X	
Eupatorium mohrii	Dog fennel	X		
Euthamia minor	Bushy goldenrod	X		
Fuirena scirpoidea	Umbrellagrass		X	
Gnaphalium obtusifolium	Rabbit's tobacco	X		X
Gratiola ramosa	Gratiola	X	X	
Hydrocotyle umbellata	Marsh pennywort		X	X
Juncus effusus	Soft rush		X	
Lachnanthes caroliniana	Redroot		X	
Lachnocaulon anceps	Bog-buttons	X	X	
Limnobium spongia	Frog's-bit		X	
Lippia nodiflora	Carpetweed			X
Ludwigia maritima	Ludwigia	X		
Ludwigia microcarpa	Ludwigia		X	
Ludwigia suffruticosa	Ludwigia	X		
Osmunda regalis	Royal fern		X	
Oxalis corniculata	Lady's sorrel			X
Oxypolis filiformis	Water dropwort		X	
Panicum hemitomon	Maidencane		X	
Panicum repens	Torpedograss		X	

Table 2.3.5-2
Plant Species Inventory of the ICL Project Site
(Page 4 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)* PF	WP	RL
Herbs (Continued)				
Panicum rigidulum	Redtop panicum	X	X	
Paspalum notatum	Bahiagrass	X	X	X
Paspalum plicatulum	Brownseed paspalum	X	X	
Paspalum setaceum	Thin paspalum	X		
Peltandra virginica	Green arum		X	
Phytolacca americana	Pokeberry	X		X
Piloblephis rigida	Savory pennyroyal	X		
Pistia stratiotes	Water lettuce		X	
Pityopsis graminifolia	Pityopsis	X		
Pluchea rosea	Marsh fleabane	X	X	X
Polygala rugelii	Yellow batchelor's button	X	X	
Polygala setacea	Milkwort	X		
Polygala cymosa	Milkwort		X	
Polygala ramosa	Milkwort	X	X	
Polygonum hydropiperoides	Smartweed		X	
Polypremum procumbens	Rustweed	X		X
Pontederia cordata	Pickerelweed		X	X
Proserpinaca pectinata	Mermaid-weed		X	
Pteridium aquilinium	Bracken fern	X		X
Pterocaulon virgatum	Blackroot	X		
Ptilimnium capillaceum	Mock bishop's-weed			X
Rhexia cubensis	Meadow beauty	X	X	
Rhexia mariana	Meadow beauty	X	X	
Rhexia nuttallii	Meadow beauty	X		
Rhynchospora fascicularis	Beak rush		X	
Rhynchospora inundata	Beak rush		X	
Rhynchospora microcarpa	Beak rush		X	
Rhynchospora tracyi	Beak rush		X	
Richardia scabra	Richardia	X	X	
Sabatia grandiflora	Marsh pink	X		
Sacciolepis striata	American cupscale		X	
Sagittaria lancifolia	Arrowhead		X	
Schoenolirion albiflorum	Sunnybells	X		
Scoparia dulcis	Sweetbroom	X		X
Setaria geniculata	Knotroot foxtail	X		X
Sida rhombifolia	Indian hemp	X		X

Table 2.3.5-2
Plant Species Inventory of the ICL Project Site
(Page 5 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)* PF	WP	RL
Herbs (Continued)				
Solidago fistulosa	Goldenrod	X		X
Spartina bakeri	Sand cordgrass		X	
Spermacoce verticillata	Spermacoce	X		
Sporobolus floridanus	Florida dropseed	X		
Sporobolus domingensis	Coral dropseed			X
Syngonanthus flavidulus	Bantam-buttons	X	X	
Thalia geniculata	Flag		X	
Thelypteris palustris	Marsh fern		X	X
Thelypteris kunthii	Marsh fern		X	X
Typha latifolia	Common cattail		X	X
Woodwardia virginica	Virginia chain fern		X	X
Xanthium strumarium	Cocklebur			X
Xyris caroliniana	Yellow-eyed grass	X	X	
Xyris cf. ambigua	Yellow-eyed grass		X	
Vines				
Campsis radicans	Trumpet-vine	X		X
Cynanchum scoparium	Cynanchum	X		X
Galactia volubilis	Milk Pea	X		
Galactia elliottii	Milk Pea	X		
Lygodium japonicum	Japanese Climbing Fern			X
Mikania scandens	Climbing Hempvine		X	
Momordica charantia	Wild Balsam Apple		X	X
Sarcostemma clausum	White-vine	X		X
Smilax auriculata	Greenbrier	X		
Smilax bona-nox	Catbrier	X		X
Toxicodendron radicans	Poison Ivy	X		
Vigna luteola	Cow Pea			X

Table 2.3.5-2
Plant Species Inventory of the ICL Project Site
(Page 6 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)* PF	WP	RL
Vines (Continued)				
Vitis munsoniana	Southern Fox Grape	X		X
Epiphytes				
Phlebodium aureum	Golden polypody	X		X
Tillandsia recurvata	Ball moss	X		X
Tillandsia usneoides	Spanish moss	X		X

*WXPP: Pine and Wet Prairies-PF and WP designations used for the natural upland and wetland components of pine and wet prairie, (i.e., pine flatwoods and wet prairie, respectively). The RL designation is used to describe the species composition of ruderal land on the site, including roadsides, ditches, and the existing transmission line right-of-way.

Source: ECT, 1990

types have been included under the pine and wet prairie designation [i.e., pine flatwoods (PF), wet prairie (WP), and ruderal land (RL)].

To further evaluate vegetation species composition and structure within the project site, a quantitative sampling of vegetation was conducted within the relatively undisturbed areas of pine and wet prairie in September 1990. Two hydrologically-isolated wet prairies and three separate locations within the pine flatwoods were surveyed using the quadrat method along five transects as described in Section 2.3.6.3. Data summaries of values generated from the sampling (i.e., dominance, frequency, relative dominance, relative frequency, and importance value and rank) are provided in Tables 2.3.5-3 through 2.3.5-6. Narratives of the sampling results are also presented in the pine and wet prairie community description provided in the following paragraphs.

Uplands

Agricultural Areas

Improved Pasture, Citrus, Sugarcane, and Truck Crops. Agricultural lands do not exist on the proposed plant site, but occur within a 5-mile radius. The most commonly encountered agricultural land is pasture. These areas have been cleared of native vegetation and planted with native or introduced grasses (bahia grass, winter rye, etc.). In the absence of maintenance or cattle grazing, these areas become dominated by old field vegetation such as dog fennel, broomsedge, and various legumes. The citrus groves are planted primarily with sweet orange and grapefruit. Truck crops basically consist of vegetables that vary with the season as well as market demand. Because of specialized growing needs, areas designated as sugarcane are almost always planted as such, except for small plots of rice and/or sod, which are sometimes substituted.

Table 2.3.5-3

QUANTITATIVE VEGETATION DATA ON THE HERBACEOUS LAYER OF WET PRAIRIE NO. 1

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I.V.	I.V. Rank
Amphicorpum muhlenbergianum	0.5625	0.2000	8.49	20.00	28.49	1
Axonopus furcatus	0.6250	0.1606	9.43	16.06	25.49	2
Andropogon brachystachyus	0.5625	0.1281	8.49	12.81	21.30	3
Panicum hemitomon	0.3750	0.1156	5.66	11.56	17.22	4
Water	0.3750	0.0825	5.66	8.25	13.91	5
Rhynchospora tracyi	0.2500	0.0713	3.77	7.13	10.90	6
Rhynchospora microcarpa	0.4375	0.0250	6.60	2.50	9.10	7
Pluchea rosea	0.3750	0.0163	5.66	1.63	7.29	8
Dichanthelium erectifolium	0.3125	0.0175	4.72	1.75	6.47	9
Hypericum fasciculatum	0.3125	0.0113	4.72	1.13	5.85	10
Aristida lanosa	0.2500	0.0181	3.77	1.81	5.58	11
Centella asiatica	0.3125	0.0075	4.72	0.75	5.47	12
Limnobium spongia	0.1875	0.0188	2.83	1.88	4.71	13
Pontederia cordata	0.0625	0.0375	0.94	3.75	4.69	14
Eleocharis baldwinii	0.1250	0.0188	1.89	1.88	3.77	15
Euthemia minor	0.1875	0.0081	2.83	0.81	3.64	16
Andropogon virginicus var. glaucus	0.1250	0.0156	1.89	1.56	3.45	17
Rhynchospora fascicularis	0.1250	0.0125	1.89	1.25	3.14	18
Ludwigia microcorpa	0.1250	0.0056	1.89	0.56	2.45	19
Myrica cerifera	0.1250	0.0038	1.89	0.38	2.27	20
Proserpinaca pectinata	0.1250	0.0038	1.89	0.38	2.27	20
Bare ground	0.0625	0.0031	0.04	0.31	1.25	22
Sacciolepis striata	0.0625	0.0031	0.94	0.31	1.25	22
Xyris ambigua	0.0625	0.0031	0.94	0.31	1.25	22
Xyris caroliniana	0.0625	0.0031	0.94	0.31	1.25	22
Gratiola ramosa	0.0625	0.0025	0.94	0.25	1.19	23
Psilocarga nitens	0.0625	0.0025	0.94	0.25	1.19	23
Rhexia mariana	0.0625	0.0013	0.94	0.13	1.07	24
Eupatorium compositifolium	0.0625	0.0006	0.94	0.06	1.00	25
Ludwigia suffruticosa	0.0625	0.0006	0.94	0.06	1.00	25
TOTAL	**6.6250**	**1.0001**	**99.98**	**100.01**	**199.99**	

Source: ECT, 1990.

Table 2.3.5-4

QUANTITATIVE VEGETATION DATA ON THE HERBACEOUS LAYER OF WET PRAIRIE NO. 2

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I.V.	I.V. Rank
Axonopus furcatus	1.0000	0.4558	18.46	45.58	64.04	1
Amphicarpum muhlenbergianum	0.8333	0.1308	15.39	13.08	28.47	2
Euthamia minor	0.9167	0.1000	16.92	10.00	26.92	3
Bare ground	0.5000	0.1250	9.23	12.50	21.73	4
Andropogon virginicus var. glaucus	0.4167	0.0750	7.69	7.50	15.19	5
Rhynchospora microcarpa	0.5000	0.0267	9.23	2.67	11.90	6
Hypericum fasciculatum	0.4167	0.02417	7.69	2.42	10.11	7
Rhexia mariana	0.3333	0.0100	6.15	1.00	7.15	8
Xyris caroliniana	0.1667	0.0250	3.08	2.50	5.58	9
Eragrostis spectabilis	0.1667	0.0025	3.08	0.25	3.33	10
Aristida spiciformis	0.0833	0.0167	1.54	1.67	3.21	11
Sacciolepis striata	0.0833	0.0083	1.54	0.83	2.37	12
TOTAL	**5.4167**	**1.000**	**100.00**	**100.00**	**200.00**	

Source: ECT, 1990.

Table 2.3.5-5
QUANTITATIVE VEGETATION DATA ON THE HERBACEOUS LAYER OF PINE FLATWOODS
(Page 1 of 2)

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I.V.	I.V. Rank
Aristida stricta	0.6000	0.3105	11.01	31.05	42.06	1
Andropogon virginicus	0.4500	0.1095	8.26	10.95	19.21	2
Open	0.4500	0.0845	8.26	8.45	16.71	3
Aristida spiciformis	0.4000	0.0695	7.34	6.95	14.29	4
Dichanthelium dichotomus	0.4000	0.0495	7.34	4.95	12.29	5
Hypericum reductum	0.3500	0.0450	6.42	4.50	10.92	6
Ilex glabra	0.3000	0.0310	5.50	3.10	8.60	7
Shrubs	0.1000	0.0620	1.83	6.20	8.03	8
Rhynchospora sp.	0.1000	0.0515	1.83	5.15	6.98	9
Euthemia minor	0.2500	0.0130	4.59	1.30	5.89	10
Pine needles/shrubs	0.0500	0.0490	0.92	4.90	5.82	11
Bare ground	0.1000	0.0205	1.83	2.05	3.88	12
Andropogon virginicus var. glaucus	0.1500	0.0090	2.75	0.90	3.65	13
Vaccinium myrsinites	0.1500	0.0070	2.75	0.70	3.45	14
Open/shrub	0.0500	0.0245	0.92	2.45	3.37	15
Lyonia lucida	0.1000	0.0125	1.83	1.25	3.08	16
Dichanthelium sabularum	0.1500	0.0020	2.75	0.20	2.95	17
Hypericum tetrapetalum	0.1500	0.0020	2.75	0.20	2.95	17
Richardia scabra	0.1500	0.0020	2.75	0.20	2.95	17
Axonopus affinis	0.1000	0.0055	1.83	0.55	2.38	18
Lyonia fruticosa	0.1000	0.0035	1.83	0.35	2.18	19
Solidago chapmanii	0.1000	0.0010	1.83	0.10	1.93	20
Vitis munsoniana	0.1000	0.0010	1.83	0.10	1.93	20
Xyris caroliniana	0.0500	0.0100	0.92	1.00	1.92	21
Pterocanlon virgatum	0.0500	0.0075	0.92	0.75	1.67	22
Pinus elliottii	0.0500	0.0050	0.92	0.50	1.42	23
Panicum rigidulum	0.0500	0.0025	0.92	0.25	1.17	24
Solidago fistulosa	0.0500	0.0025	0.92	0.25	1.17	24
Trunk	0.0500	0.0025	0.92	0.25	1.17	24
Aster reticulatus	0.0500	0.0010	0.92	0.10	1.02	25

Table 2.3.5-5

QUANTITATIVE VEGETATION DATA ON THE HERBACEOUS LAYER OF PINE FLATWOODS

(Page 2 of 2)

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I.V.	I.V. Rank
Eleocharis baldwinii	0.0500	0.0010	0.92	0.10	1.02	25
Gratiola dumosa	0.0500	0.0010	0.92	0.10	1.02	25
Polygala rugelii	0.0500	0.0005	0.92	0.05	0.97	26
Rhexia mariana	0.0500	0.0005	0.92	0.05	0.97	26
Rhexia nuttallii	0.0500	0.0005	0.092	0.05	0.97	26
TOTAL	**5.450**	**1.0000**	**99.99**	**100.00**	**199.99**	

Source: ECT, 1990.

Table 2.3.5-6

QUANTITATIVE VEGETATION DATA ON THE SHRUB AND CANOPY LAYERS OF PINE FLATWOODS

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I.V.	I.V. Rank
SHRUB						
Serenoa repens	1.000	0.4750	23.81	47.50	71.31	1
Open	0.8000	0.2720	19.05	27.20	46.25	2
Ilex glabra	0.7000	0.1725	16.67	17.25	33.92	3
Lyonia fruticosa	0.4500	0.0175	10.71	1.75	12.46	4
Quercus minima	0.3500	0.0295	8.33	2.95	11.28	5
Lyonia lucida	0.2500	0.0145	5.95	1.45	7.40	6
Myrica cerifera	0.2000	0.0050	4.76	0.50	5.26	7
Asimina reticulata	0.1000	0.0015	2.38	0.15	2.53	8
Befaria racemosa	0.1000	0.0010	2.38	0.10	2.48	9
Vaccinium myrsinites	0.1000	0.0010	2.38	0.10	2.48	9
Pine needles	0.0500	0.0075	1.19	0.75	1.94	10
Pinus elliottii	0.0500	0.0025	1.19	0.25	1.44	11
Gaylussacia dumosa	0.0500	0.0005	1.19	0.05	1.24	12
TOTAL SHRUB LAYER	**4.200**	**1.0000**	**99.99**	**100.00**	**199.99**	
CANOPY						
Pinus elliottii	0.5500	0.0476	100	100	300	1

Source: ECT, 1990.

Rangeland

<u>**Grassland/Brushland/Palmetto Prairies**</u>. For convenience, grasslands, brushlands, and palmetto prairies are grouped together under rangeland reflecting the general usage of these areas for cattle grazing without maintenance procedures used for improved pasture.

Grasslands occur on areas in which the native vegetation has been cleared. With no further maintenance, these areas have become vegetated by opportunistic, weedy species. Characteristic plants include broomsedge, goldenrods, several species of legumes, and sedges.

Brushlands probably were grasslands which have become overgrown with woody shrubs in the absence of fire or intense grazing. Common shrubs include wax myrtle, groundsel tree, oak saplings, and occasionally, saw palmetto. Herbs are abundant and similar in composition to those found in grasslands.

Palmetto prairie is the least disturbed of all rangeland categories. They are generally single-tiered communities dominated by saw palmetto and other shrubs characteristic of pine flatwoods. In some instances, a sparse canopy comprised of slash pine and cabbage palm is discernible. All rangeland associations were pine flatwoods communities prior to clearing or clear cutting in most instances.

Forested Uplands

<u>**Pine Flatwoods**</u>. Pine flatwoods is the dominant plant community type within Florida. The flatwoods in the project study area are dominated by south Florida slash pine in the overstory and saw palmetto in the shrub layer. Other woody components of the understory stratum include trees (e.g., laurel oak, cabbage palm, live oak, and water oak) and shrubs (pawpaw, tarflower, dwarf huckleberry, gallberry, staggerbush, fetterbush, shiny blueberry, and dwarf live oak).

The herb stratum is dominated by a variety of wiregrasses and other associated forbs, including yellow colic-root, milkweed, yellow buttons, partridge-pea, Florida elephant's-foot, purple lovegrass, bushy goldenrod, and rabbit's tobacco. These open woodlands are a fire-maintained association, characterized by a flat terrain supported by a sandy soil substrate.

Pine/Cabbage Palms. Low areas of pine flatwoods that retain water for slightly longer periods of time create a somewhat mesic to hydric condition. Over time, non-flatwood plants become established, causing a shift or succession in community species composition and structure. Cabbage palms are one of the first species that invade wet pinelands. These pine/cabbage palm communities are typically small areas within slight depressions or along the lowland fringes of larger pine flatwoods. Other pine/cabbage palm associates include laurel oak, dahoon holly, wax myrtle, water oak, and bay trees.

Cabbage Palms/Oaks. Another possible seral stage in a succession of flatwoods is the cabbage palm/oak association. This mesic to hydric community type has also been referred to as hammock and is typically thought to be a climax or preclimax stage of flatwood, resulting from the absence of fire. The cabbage palm/oak association is typically a closed-canopy forest type dominated by a diverse assortment of broad-leaved evergreen trees, including tropical trees and shrubs. These associations are typically small, circular in shape, and situated along swamp strands or within pine and wet prairies.

Forested Old Field. After a native forest has been cleared and planted for agricultural purposes and then abandoned for a long period or time, forested old fields develop. These forests generally contain a diverse species composition of naturalized weedy opportunistic herbs, shrubs and trees, as well as native plants. Common old field associates include wax myrtle, groundsel tree, Brazilian pepper, punk tree, laurel oak, and Carolina willow.

Mixed Forested Upland. Mixed forested refers to any generic, forested upland community that supports a mixture of upland trees. Typically, lower categories within the mixed forested designation define the community types by the presence of two or more dominant tree species. The mixed forested designation alone is provided when a community type does not fit within the nine subcategories provided in the SFWMD land use/land cover classification system or the dominant species are simply unknown.

Wetlands

Non-forested Freshwater Wetland

The non-forested freshwater wetland designation encompasses a rather heterogenous group of herbaceous marshes whose structure and composition is based on the frequency of burning as well as the degree of flooding in the rainy season. These wetlands support a diverse herbaceous vegetation dominated by emergents such as sawgrass, sand cordgrass, maidencane, smartweed, spike rushes, pickerelweed, duck potato, and yellow-eyed grasses. Shrubs which may be found include primrose willow, buttonbush, St. John's wort, and corkwood. The predominance of shrubs is often correlated with frequency of fire.

These freshwater marshes usually exhibit zonation based upon elevational and environmental gradients. Typically, a diverse transitional area exists between the normal low-water stage and a high water contour that is delineated by upland species such as saw palmetto and wax myrtle.

Pine and Wet Prairie

This wetland/upland mosaic community type is one of the most dominant in south Florida. Pine and wet prairie are the predominant natural vegetation communities within the 5-mile radius of the site and completely dominate the plant site proper. Pine and wet prairies consist of upland pinelands interspersed with wet prairie wetlands. The pinelands are similar to the pine flatwoods description, except that in some wetter areas saw palmetto and other flatwoods shrubs and herbs are replaced with wetland species. Wet prairies are seasonally-inundated systems, typically dependent upon seasonal rainfall and surface runoff for hydroperiod. The prairie basically consists of open lowlands dominated by a variety of water-tolerant grasses and other aquatic macrophytes. Typical herbaceous species associated with wet prairies include maidencane, dichanthelium grasses, blue maidencane, chalky and shortspike bluestem, longleaf threeawn, hyssop, arrowhead, saw-toothed fern, sedges, clubrush, pipewort, and redroot.

Wet prairies differ from freshwater marshes in hydroperiod, soils, and plant species composition. Typically, wet prairies exhibit a more shallow topographic relief, are underlain by poorly-drained sandy soils, and are dominated by transitional to hydric grasses; while freshwater marshes are relatively deep depressions that are inundated for a longer duration, have a well-developed organic layer, and support a diversity of obligate to facultative wet aquatic macrophytes.

Approximately 200 acres of pine flatwoods and 24 acres of wet prairie and ditch are present on the 232-acre site. An additional 8 acres of ruderal or disturbed land also occur within the proposed site as an existing transmission line right-of-way, clearings, roads, and trails. The ruderal land component of the project site contains a diverse array of opportunistic weedy plants, such as common ragweed, bahia grass, beggar's-ticks, and dropseeds.

The wet prairies wetlands on the project site vary slightly in size, configuration, topographic relief, and hydroperiod. These natural features tend to regulate species composition and structure, together with other environmental factors such as drainage, rainfall, cattle/hog perturbations, edaphic conditions, and exotic species invasion. For comparative purposes, two hydrologically isolated wet prairies were sampled: a 0.45-acre, shallow depression located in the northeastern corner of the site (WP No. 6) and an 8.16-acre, deeper wetland located in the center of the property (WP No. 4).

Both of the wet prairies sampled were relatively undisturbed. The smaller wet prairie was dominated by big carpetweed, blue maidencane, and bushy goldenrod, in order of magnitude. These three species are indicative of a transitional hydroperiod (i.e., dry most of the year with saturated to inundated conditions seasonally). The surface soil of the wet prairie within the depression was dry at the ground surface during the sampling period. Species composition was uniform across the relatively flat system.

During the September 1990 surveys, the larger wetland was wet at the upland/wetland interface (saw palmetto edge) and contained 6 to 14 inches of water in the center. Transitional wetland species during this stage of the wet or rainy season occurred in a somewhat homogeneous fashion along the more landward reaches of the wetland. However, the ponded center of the wetland supported more obligate hydrophytes such as pickerelweed, maidencane, frog's-bit, and mermaid's weed.

The zonation of obligate and facultative wetland species within the wetland conformed to the hydroperiod and soil types. The center of the wetland is ponded for 2 to 6 months in the rainy season and has a poorly drained, organic surface layer (Sanibel muck), while the wetland fringe is drier and is supported by a more sandy, poorly drained hydric soil (Lawnwood fine sand depressional).

The dominant wetland species of the wet prairie included blue maidencane, big carpetweed, shortspike bluestem, and maidencane, in order of magnitude.

The physiognomy of the pine flatwoods was rather homogeneous throughout. The herbaceous layer was dominated by wiregrass and other typical flatwoods species such as broomsedge, bottlebrush threeawn, dichanthelium grass, St. John's wort, and gallberry seedlings.

The shrub strata was dominated by the conspicuous saw palmetto. Woody components of the shrub layer in order of magnitude include gallberry, staggerbush, dwarf liveoak, pawpaw, and tarflower. The canopy was open and consisted solely of south Florida slash pine. The south Florida slash pine sampled ranged in diameter-at-breast-height (dbh) from 4 to 16.5 inches.

The pine flatwoods onsite are underlain by three nearly level, poorly drained sandy soils including Lawnwood fine sand, Waveland sand, and Basinger fine sand. Under normal conditions, the water table is typically at a depth of less than 10 inches for 2 to 6 months and anywhere from 10 to 40 inches deep for 6 or more months.

Cypress Swamp

Cypress swamp is a closed-canopy wetland forest type dominated by cypress. This wetland association occurs as isolated, somewhat circular configurations with dome-like profiles or as strands along major drainageways. Other aquatic arboreal and shrubby associates of the cypress swamp include red maple, tupelo, sweetbay magnolia, swampbay, wax myrtle, Carolina willow, popash, and elm. Aquatic macrophytes that are typically associated with this seasonally-inundated wetland include pickerelweed, lizard's tail, water hyacinth, arrowhead, royal fern and smartweed.

Mixed Forested Swamp

The mixed forested designation includes all swamps that contain a mixture of hardwood trees and cypress. Hardwood species associated with the mixed forested swamp include red maple, tupelo, sweetbay magnolia, swampbay, hackberry, and Carolina willow. Barley Barber Swamp, located next to the FPL Martin power plant cooling ponds, is a good example of mixed forested swamp within a 5-mile radius of the proposed ICL site.

2.3.5.4 Summary

The plant community types present within and adjacent to the proposed ICL site are regionally common. The wet prairies and pine flatwoods communities on the site have not, for the most part, been severely impacted by human-related activities. The wet prairies exhibit a shift to more upland plant species in the transition zones due to alterations to historical drainage patterns, yet retain basic wetland functional values. The pine flatwoods show some effects from cattle grazing and road/trail construction, but retain a natural aspect with regard to structure and function. The exceptions are several small disposal areas previously used for disposal of organic milling by-products. In contrast, surrounding areas have been greatly impacted by industrial and agricultural activities.

2.3.6 ECOLOGY

This section discusses species that are officially designated as endangered, threatened, or species of special or regional concern by the U.S. Fish and Wildlife Service (USFWS), Florida Game and Fresh Water Fish Commission (FGFWFC), Florida Department of Agriculture and Consumer Services (FDACS), Treasure Coast Regional Planning Council (TCRPC), and/or Florida Committee on Rare and Endangered Plants and Animals (FCREPA) and that, based on a literature survey, onsite habitat analysis, and consultations with state, regional, and local agencies, may reasonably be expected to occur in the vicinity of or on the ICL site. This assessment also addresses the status of such species within a surrounding study area including sections of southwestern St. Lucie, western Martin, and southern Okeechobee Counties.

The TCRPC staff previously prepared a listing of plant and animal species of regional concern for review and comment for similar studies conducted in the project area. Using the TCRPC species list as a base, project ecologists supplemented this list of species of regional concern with additional protected species from USFWS, FGFWFC, FCREPA, and FDACS lists. The resulting list of species of regional concern is shown in Table 2.3.6-1 for vegetation, and Table 2.3.6-2 for wildlife species.

For each listed species, the selection criteria which determined their inclusion in this application included their known or expected occurrence on the project site and surrounding study area as residents, migrants, or transients; their potential for occurrence in western Martin or southern Okeechobee and southwestern St. Lucie Counties; potential for impacts due to site clearing and preparation, construction, and facility operation and maintenance; and other agency concerns such as the presence of unique or suitable habitat.

The following sections include both individual discussions for endangered and threatened species and selected species of special or regional concern which

Table 2.3.6-1
IMPORTANT PLANT SPECIES KNOWN OR SUSPECTED TO OCCUR IN MARTIN, ST. LUCIE, AND OKEECHOBEE COUNTIES
(Page 1 of 2)

Common Name	Scientific Name	Designated Status* FWS+	FDACS**	FCREPA++
Giant leather fern	Acrostichum danaeifolium		T	
Venus-hair fern	Adiantum capillus-veneris		T	R
Curtiss milkweed	Ascelpias curtissii		E	T
Four-petal pawpaw	Asimina tetramera	E	E	E
Wild birdnest fern	Asplenium serratum		E	E
Unnamed spleenwort fern	Asplenium trichomanes-dentatum		T	T
Black mangrove	Avicennia germinans			SSC
Silver palm	Coccothrinax argentata		C	T
Climbing dayflower	Commelina gigas	UR1	T	T
Large-flowered rosemary	Conradina grandiflora	UR2	E	
Lakela's mint	Dicerandra immaculata	E	E	
Butterfly orchid	Encyclia tampensis		T	
Beach creeper	Ernodea littoralis		T	T
Rein orchid	Habenaria odontopetala			T
Nodding pinweed	Lechea cernua	UR2	E	
Catesby lily	Lilium catesbaei		T	
Sea lavender	Mallotonia gnaphalodes		E	T
Scrub Indian pipes	Monotropa brittonii	UR2		
Boston fern	Nephrolepis biserrata		T	
Dancing-lady orchid	Oncidium bahamense (O. variegatum)		E	T
Hand fern	Ophioglossum palmatum	UR5	E	E
Paper-like nailwort	Paronychia chartacea	T	E	
Golden polypody	Phlebodium aureum		T	
Star-scale fern	Pleopeltis revoluta		T	E
Tiny polygala	Polygala smallii	E	E	E
Wisk fern	Psilotum nudum		T	
Beach star	Remirea maritima		E	E
Red mangrove	Rhizophora mangle			SSC
Dwarf palmetto	Sabal minor		T	
Scrub palmetto	Sabal etonia		T	
Curly-grass fern	Schizaea germanii	UR2	E	R
Sand spikemoss	Selaginella arenicola		T	
Aspidium fern (unnamed)	Thelypteris interrupta		T	
Marsh fern	Thelypteris palustris		T	
Aspidium fern (unnamed)	Thelypteris kunthii		T	

Table 2.3.6-1
IMPORTANT PLANT SPECIES KNOWN OR SUSPECTED TO OCCUR IN MARTIN, ST. LUCIE, AND OKEECHOBEE COUNTIES
(Page 2 of 2)

Common Name	Scientific Name	Designated Status* FWS+	FDACS**	FCREPA++
Wild pine; air plant	Tillandsia paucifolia		T	
Wild pine; air plant	Tillandsia balbisiana		T	
Wild pine; air plant	Tillandsia setacea		T	
Twisted air plant	Tillandsia flexuosa		T	T
Vanilla orchid (unnamed)	Vanilla mexicana		T	
Shoestring fern	Vittaria lineata		T	
Carter's mustard	Warea carteri	E	E	
Florida coontie	Zamia pumila (Z. floridana, Z. integrifolia)	UR5	C	T

* T = Threatened.
R = Rare.
SSC = Species of special concern.
E = Endangered.
C = Commercially exploited.
UR1 = Under review for federal listing, with substantial evidence in existence indicating at least some degree of biological vulnerability and/or threat.
UR2 = Under review for listing, but substantial evidence of the biological vulnerability and/or threat is lacking.
UR5 = Still formally under review for testing, but no longer considered for listing because recent information indicates species is more widespread or abundant than previously believed.

\+ USFWS (list published in List of Endangered and Threatened Wildlife and Plants, 50 CFR 17.11-12).
** DACS (list published in Preservation of Native Flora of Florida Act, Section 581.185-187, Florida Statutes).
\+ + FCREPA (1979).

Source: ECT, 1990.

Table 2.3.6-2
ENDANGERED AND THREATENED FISH AND WILDLIFE SPECIES AND SPECIES OF SPECIAL CONCERN KNOWN OR SUSPECTED TO OCCUR IN MARTIN, ST. LUCIE, AND OKEECHOBEE COUNTIES
(Page 1 of 3)

Common Name	Scientific Name	FCREPA	FGFWFC	USFWS
Invertebrates				
Scarab beetle	Ataenius saramari	RSU		
Scarab beetle	Peltotrupes profundus	RSU		
Mangrove tree crab	Aratus pisonii	T		
Colorful mangrove crab	Goniopsis cruentata	T		
Red widow spider	Latrodectus bishopi	SSC		
Fishes				
Opossum pipefish	Oostethus lineatus	R		
Common snook	Centropomus undecimalis		SSC	
Amphibians				
Gopher frog	Rana areolata aesopus	T	SSC	UR2
Reptiles				
Atlantic leatherback	Dermochelys coriacea coriacea	R	E	E
Gopher tortoise	Gopherus polyphemus	T	SSC	UR2
Atlantic green turtle	Chelonia mydas mydas	E	E	E
Atlantic hawksbill	Eretmochelys imbricata	E	E	E
Atlantic loggerhead	Caretta caretta caretta	T	T	T
Florida scrub lizard	Sceloporus woodi	R		
Eastern indigo snake	Drymarchon corais couperi	SSC	T	T
Florida pine snake	Pituophis melanoleucus mugitus		SSC	UR2
American alligator	Alligator mississippiensis	SSC	SSC	TSA
Birds				
Brown pelican	Pelecanus occidentalis	T	SSC	Magnificent
frigatebird	Fregata magnificens	T		
Least bittern	Ixobrychus exilis	SSC		
Great white heron	Ardea herodias occidentalis	SSC		
Great egret	Casmerodius albus	SSC		

Table 2.3.6-2
ENDANGERED AND THREATENED FISH AND WILDLIFE SPECIES AND SPECIES OF SPECIAL CONCERN KNOWN OR SUSPECTED TO OCCUR IN MARTIN, ST. LUCIE, AND OKEECHOBEE COUNTIES
(Page 2 of 3)

Common Name	Scientific Name	FCREPA	FGFWFC	USFWS
Birds (contd.)				
Snowy egret	Egretta thula	SSC	SSC	
Little blue heron	Egretta caerulea	SSC	SSC	
Tricolored heron	Egretta tricolor	SSC	SSC	
Reddish egret	Egretta rufescens	R	SSC	UR2
Black-crowned night heron	Nycticorax nycticorax	SSC		
Yellow-crowned night heron	Nycticorax violaceus	SSC		
White ibis	Eudocimus albus	SSC		
Glossy ibis	Plegadis falcinellus	SSC		
Roseate spoonbill	Ajaja ajaja	R	SSC	
Woodstork	Mycteria americana	E	E	E
Osprey	Pandion haliaeetus	T	SSC	
American swallow-tailed kite	Elanoides forficatus			UR2
Snail kite	Rostrhamus sociabilis	E	E	E
Southern bald eagle	Haliaeetus leucocephalus	T	T	E
Cooper's hawk	Accipiter cooperii	SSC		
Short-tailed hawk	Buteo brachyurus	R		
Crested caracara	Polyborus plancus	T	T	UR2
Southeastern American kestrel	Falco sparverius paulus	T	T	UR2
Merlin	Falco columbarius	SU		
Peregrine falcon	Falco peregrinus	E	E	T
Florida clapper rail	Rallus longirostris scotti	SU		
Limpkin	Aramus guarauna	SSC	SSC	
Florida sandhill crane	Grus canadensis pratensis	T	T	
Piping plover	Charadrius melodus	SSC	T	T
American oystercatcher	Haematopus palliatus	T	SSC	
Caspian tern	Sterna caspia	SSC		
Royal tern	Sterna maxima	SSC		
Sandwich tern	Sterna sandvicensis	SSC		
Least tern	Sterna albifrons	T	T	
Black skimmer	Rhynchops niger	SSC		
Burrowing owl	Athene cunicularia floridana	SSC	SSC	

Table 2.3.6-2
ENDANGERED AND THREATENED FISH AND WILDLIFE SPECIES AND SPECIES OF SPECIAL CONCERN KNOWN OR SUSPECTED TO OCCUR IN MARTIN, ST. LUCIE, AND OKEECHOBEE COUNTIES

Common Name	Scientific Name	FCREPA*	FGFWFC+	USFWS**
Birds (contd.)				
Hairy woodpecker	Picoides villosus auduboni	SSC		
Red-cockaded woodpecker	Picoides borealis	E	T	E
Florida scrub jay	Aphelocoma coerulescens	T	T	UR2
Migrant loggerhead shrike	Lanius lydovicianus migrans			UR2
Black-whiskered vireo	Vireo altiloguus	R		
Bachman's warbler	Vermivora bachmani	E	E	E
Kirtland's warbler	Dendroica kirtlandii	E	E	E
Prairie warbler	Dendroica discolor paludicola	SSC		
Bachman's sparrow	Aimophila aestivalis			UR2
Mammals				
Sherman's fox squirrel	Sciurus niger shermani	T	SSC	UR2
Florida mouse	Peromyscus floridanus	T	SCC	UR2
Round-tailed muskrat	Neofiber alleni	SSC		
West Indian manatee	Trichechus manatus latirostris	T	E	E

Note: E = Endangered.
T = Threatened.
TSA = Threatened by similarity of appearance.
SSC = Species of special concern.
R = Rare.
RSU = Rare or status undetermined.
C = Commercially exploited.
UR2 = Under review for listing, but substantial evidence of the biological vulnerability and/or threat is lacking.

* FCREPA, 1979.
\+ FGFWFC, 1990.
** USFWS (list published in List of Endangered and Threatened Wildlife and Plants, 50 CFR 17.11-12).

Source: ECT, 1990.

occur or may be expected to occur in the study area; and general discussions for the remaining species which either share specific habitat types (e.g., wetlands, pine flatwoods) or, for plants, are afforded collective protective status by FDACS due to their taxonomic affinities (e.g., ferns and fern allies, palms, orchids, lilies, and bromeliads). Following the endangered species analysis, this section also addresses those species considered to be species of recreational or commercial importance, or fishery resources.

The probability of occurrence for endangered and threatened species within the proposed ICL project site was based on field surveys, known locations for such species (e.g., eagle nests, wading bird colonies), information provided by regulatory agency staff, recent and historical reports of occurrence in the scientific literature, and on the presence of suitable habitat as shown on the SFWMD land use and land cover maps (at 1:24,000 scale) and aerial photographs. Results showed that no federally designated Critical Habitat or other habitat features important to endangered and threatened species exist in the vicinity of the proposed plant site. For those vertebrates, particularly birds, which have extensive ranges and show significant daily and/or seasonal movement and distribution patterns between different habitat types, the probability of occurrence of these species was primarily based on the presence or absence of suitable habitat. Similarly, the specific areas of occurrence of many plant species listed in Table 2.3.6-1 are not known or mapped for south Florida, and their probability of occurrence is based on habitat suitability and range of distribution.

This ecology section is presented in four parts beginning with a review and discussion of species-environmental relationships. The presence of pre-existing stress and its effect on area biota are subsequently discussed. Methodologies used to obtain the baseline site characterization data are described. Finally, the aquatic biology at the proposed intake in TC/NS is presented.

2.3.6.1 Species-Environmental Relationships

Description of Site and Vicinity Habitat Types

Detailed descriptions of the project site and adjacent property (5-mile radius) vegetation community types, structure, and species composition were provided in Section 2.3.5. Two vegetative communities, i.e., wildlife habitat types, cover most of the project site's uplands and wetlands, and also comprise the dominant habitat types in areas surrounding the site.

Pine flatwoods cover most of the site's uplands. The flatwoods in the project study area are dominated by south Florida slash pine in the overstory and saw palmetto in the shrub layer. Other woody species of the understory include dahoon holly, laurel oak, cabbage palm, live oak, water oak, sweetbay magnolia, and swampbay, as well as shrubs such as pawpaw, tarflower, dwarf huckleberry, gallberry, staggerbush, fetterbush, shiny blueberry, and dwarf live oak. The associated herbaceous species are dominated by a variety of wiregrasses and associated forb species.

Pine flatwoods comprise approximately 200 acres on the project site. An additional 8 acres of ruderal or disturbed upland, also formerly pine flatwoods, occurs within the proposed site as existing transmission corridor, right-of-way clearings, and graded areas. The ruderal land component of the project site contains a diverse array of opportunistic weedy plants which, along with the pine flatwoods habitat, provides a diverse number of feeding and nesting niches for numerous vertebrate species characteristic of pine flatwoods, edge, and shrub habitats.

With the exception of a man-made drainage ditch traversing the center of the site in a north-south direction, open wet prairies comprise the principal wetland and aquatic habitats of the site. The site's wet prairie habitats are characteristic of wet prairie communities common in south Florida. The wet prairie associations basically consist of open lowlands, dominated by a variety of water-tolerant grasses and other aquatic macrophytes.

Wet prairies are seasonally-inundated systems, typically dependent upon seasonal rainfall and surface runoff for hydroperiod. As a result, no fish or wading birds were located within the onsite wetlands during the May and July 1990 surveys. Only a few common species of fish occurred within the drainage ditch channeling effluent from the Caulkins' Indiantown Citrus Processing Plant's wastewater treatment facility across the project site. This ditch, which channels some effluent during the period of Caulkins' process operations, represents the principal aquatic habitat on the site.

Important Species

Protected species importance is based on species lists prepared by USFWS [50 Code of Federal Regulations (CFR) 17.11-12], FGFWFC (Section 39-27.003-005 FAC), FDACS (Preservation of Native Flora of Florida Act, Section 581.185-187, Florida Statutes), and TCRPC and Martin County species lists. Although not backed by federal law, state statute, or local ordinance, those plants, invertebrates, and vertebrates listed by FCREPA as endangered, threatened, special concern, or rare were also considered in this analysis.

Plant Species

Forty-three species of endangered, threatened, special concern, rare, or commercially exploited plants, or plants under federal review for inclusion on the endangered or threatened species list were determined to either occur or have a probability of occurrence within Martin, St. Lucie, and Okeechobee Counties. The 43 important plant species listed in Table 2.3.6-1 were evaluated for their potential of occurrence on the ICL site, and within a 5-mile radius of the project site. Field surveys for listed plant species were conducted on the project site in the spring and summer-fall of 1990. Individual discussions are provided for 11 plant species, while collective discussions are given for halophytes, ferns and fern allies, palms, bromeliads, lilies, and orchids. The scientific nomenclature of plant species listed in Table 2.3.6-1 follows Wunderlin (1982).

Halophytes. Five species of halophytes or salt-tolerant plants were identified as species of regional concern in coastal Martin County. These species include red and black mangrove, beach star, sea lavender, and beach creeper. Red and black mangroves form forests along the coastal shorelines of Martin and St. Lucie Counties. Beach star, sea lavender, and beach creeper are herbaceous halophytes that are restricted to the dunes and coastal strands also situated along coastal Martin and St. Lucie Counties. Due to the inland location of the site and adjacent lands, and the lack of saline habitat, no halophytic vegetation, as described above, would be expected.

Ferns and Fern Allies. Fifteen species of ferns, or fern allies, were identified as species of regional concern in Martin, St. Lucie, and Okeechobee Counties. Of the 15 species, only six were found to be listed by agencies other than FDACS. These were hand fern, curly-grass fern, venus-hair fern, wild birdnest fern, star-scale fern, and an unnamed spleenwort fern. The hand fern and wild birdnest fern are both listed as endangered by both FDACS and FCREPA. The hand fern is also under federal review for listing. Both species are found in tropical hammocks or deep swamps. While hand fern ranges into the study area, wild birdnest has only been reported for Monroe, Dade, Broward, and Collier Counties (FCREPA, 1979).

Due to the lack of suitable habitat and/or range, neither hand fern nor wild birdnest fern would be expected to occur on or within 5 miles of the site. Curly-grass fern and venus-hair fern are both listed as rare by FCREPA. Venus-hair fern and curly-grass fern are also listed as threatened and endangered by FDACS, respectively. In addition, curly-grass fern is under review for federal listing. Curly-grass fern is an extremely rare tropical fern that has been found in Pinellas, Palm Beach, and Dade Counties within wet pinelands, bay swamp islands, and hammock. Venus-hair fern is restricted to calcareous soil along sinks, ravines, and streams. Venus-hair fern has been found growing in Martin and Dade County. Neither of these ferns would be expected to occur on or within 5 miles of the ICL project site due to unsuitable habitat and/or reported range of distribution. Star-scale fern is listed as endangered by FCREPA and threatened by FDACS. Since only a single station has been discovered in northeastern Broward County within a tropical hammock, star-scale fern is not expected to occur either on or in the vicinity of the ICL project site. Finally, an unnamed spleenwort fern, Asplenium trichomanes-dentatum, is listed as threatened by both FCREPA and FDACS. This fern species is one of the smallest terrestrial ferns in Florida. It occurs along limestone outcroppings and rocks within sinks and tropical hammocks within Broward and Dade Counties. Due to its extremely limited range and specific habitat requirements, the unnamed spleenwort would not be expected to occur on or within 5 miles of the site.

The remaining nine species of ferns and fern allies are listed as threatened by FDACS primarily to protect them from commercial exploitation. As such, the threatened designation does not reflect the true status (i.e., population levels or distribution) of the majority of these species throughout Florida. In fact, many of the fern species listed as threatened by FDACS are common throughout Florida. Several of the FDACS-listed fern and fern ally species either occur (Phlebodium aureum, Thelypteris kunthii, and T. palustris), or are expected to occur within the wetlands on the ICL project site and within 5 miles of the project on adjacent lands. However, local populations of these species will not be significantly affected by construction of the power plant.

Palms. Three species of palm are listed in Table 2.3.6-1. Two of the palm species are listed as threatened only by FDACS. The third palm species, the silver palm, is listed as threatened by FCREPA and as commercially exploited by FDACS. Currently, the silver palm is considered to be limited to the rocky pinelands found in the Florida Keys and south Dade County (Wunderlin, 1990). However, historically the silver palm ranged in Florida from southeastern Palm Beach County to Key West. Because of its reported range, this species is unlikely to occur on or within 5 miles of the ICL site. The scrub palmetto does occur in Palm Beach, Martin, and St. Lucie Counties in sand pine scrub habitat; however, it is unlikely that any disturbance to this species will occur as a result of this project because of the absence of scrub habitat on or within 5 miles of the site. The third species, dwarf palmetto, may occur in the study area. However, this species would be reaching its southernmost habitat boundary in Martin County; therefore, large populations of dwarf palmetto are not expected to occur on or within 5 miles of the ICL project site.

Bromeliads, Lilies, and Orchids. Nine species of the listed plants are bromeliads, lilies, or orchids. Of these species, only the dancing-lady orchid (Oncidium bahamense, with O. variegatum a common synonym) is not expected to occur on or within 5 miles of the site. This species is commonly found in a sand pine scrub habitat, none of which has been found within the project vicinity. The remaining species are generally found in moist to wet hammocks, swamps, or wet pine flatwoods. Many are epiphytic, with the exception of the catesby lily, which is also found in wet savannas, and the rein orchid, which is found growing within the ground cover of hammocks. However, none of the remaining eight species of bromeliads, lilies, or orchids were discovered within the project vicinity during site walkovers in the spring and summer-fall of 1990.

Individual Species

The following 11 plant species, listed as threatened, endangered, rare, or species of special concern by FCREPA, FGFWFC, FDACS, and USFWS are described individually based on their status and/or potential for occurrence in the project area.

The Curtiss milkweed (Asclepias curtissii) is an endemic species in central peninsular Florida. This species is listed as threatened by FCREPA and endangered by FDACS. It is commonly found in upland areas having well drained soils, and its habitat includes sand pine scrub and mixed hardwood hammocks. This species is not expected to occur within 5 miles of the ICL project site due to the lack of suitable habitat.

The four-petal pawpaw (Asimina tetramera) is a small shrub endemic to Martin and northern Palm Beach Counties. It is listed as endangered by FCREPA, USFWS, and FDACS. The preferred habitat of the four-petal pawpaw includes old coastal dunes and open stands of sand pine. The species presence in Martin County has been verified; however, the four-petal pawpaw is not expected to occur on or within 5 miles of the ICL project site due to the lack of required habitat.

The large-flowered rosemary (Conradina grandiflora) is a shrub found along the east coast of Florida from Volusia County to Dade County. This species, listed as endangered by FDACS, is currently under review by USFWS for inclusion on its protected plants list. This species prefers the sandy, well-drained soils commonly found associated with sand pine scrub habitat. The presence of the large-flowered rosemary on or within 5 miles from the ICL site is unlikely because of the lack of suitable habitat.

Nodding pinweed (Lechea cernua) is listed as endangered by FDACS. It is also under review by USFWS for inclusion on their protected plant species list. This species prefers a white sand scrub habitat located along the central Florida ridge and along the east and west coasts. The primary reason for this species' decline is the alteration of its preferred habitat for agriculture and development. The nodding pinweed is not expected to occur on the ICL site or within 5 miles of the site because of the lack of suitable sand pine scrub habitat.

Scrub Indian pipes (Monotropa brittonii) is currently under federal review for listing on the protected plant species list. This species is commonly found as a parasite on various trees in rich woodlands and scrub habitat of north and central Florida. The scrub Indian pipe is not expected to occur on or within 5 miles adjacent to the ICL site due to the lack of hardwood hammocks or scrub in these areas.

Paper-like nailwort (Paronychia chartacea) is a species endemic to central Florida. It is currently listed by USFWS as threatened and as endangered by FDACS. This species is found in sand pine scrub habitat. It is unlikely that this species will occur on or within 5 miles of the ICL site because the required habitat is not present and its occurrence in the study area was not verified in the literature.

Tiny polygala (Polygala smallii) is listed as endangered by FDACS, FCREPA and USFWS. This small, biennial milkwort resembles and is clearly related to Polygala nana (Michx.) DC, which is a common milkwort in moist pinelands within northern and central peninsular Florida. However, tiny polygala is a distinctly separate species in terms of morphology and population location. Tiny polygala is an endemic to the rocky pinelands of south Florida, primarily eastern Broward and Dade Counties. Due to its very restrictive range and habitat requirements, it is not expected that tiny polygala occurs within the ICL site boundaries.

Carter's mustard (Warea carteri) is listed as endangered by both USFWS and FDACS. This endangered mustard inhabits sand hills and sand pine scrub and ranges as far south as Broward County and north to Brevard County on the eastern coast of Florida. Due to unsuitable habitat, Carter's mustard is not expected either on or within 5 miles from the ICL site.

Lakela's mint (Dicerandra immaculata) is listed as endangered by USFWS and FDACS. Lakela's mint is a rare endemic of sand pine scrub. It has only been found in St. Lucie and Indian River Counties. Due to range and suitability of habitat, Lakela's mint would not be expected to occur within 5 miles of the ICL project site.

The climbing dayflower (Commelina gigas) is a climbing herb with soft stems, fleshy, almost succulent leaves, and small, three-petalled blue flowers. Climbing dayflower is listed as threatened by both FCREPA and FDACS and under review for federal listing. This species is endemic to the area surrounding Lake Okeechobee. Climbing dayflower inhabits open swamp, wet hammocks, and banks associated with large open-water bodies. Climbing dayflower is not expected within the ICL site due to the absence of such habitats.

The Florida coontie (Zamia pumila, with Z. floridana, Z. integrifolia, and Z. umbrosa as synonyms) was once very abundant throughout Florida from Taylor County south to the Florida Keys. It is listed by FCREPA as threatened and by FDACS as a commercially exploited plant. The coontie inhabits areas with well-drained soils which include the high pinelands and Indian mound communities. This species may potentially occur on or within 5 miles from the proposed site in areas of suitable upland habitat; however, this conspicuous perennial species was not observed during systematic site walkovers in the spring and summer-fall of 1990.

Invertebrate, Fish, and Wildlife Species

The presence, or potential for occurrence, of wildlife species listed in Table 2.3.6-2 on the ICL project site and surrounding study area is primarily related to the presence of suitable habitat for cover, feeding, and reproduction. In general, the type and quality of wildlife habitats vary with vegetation type and structure, surrounding land use, and hydrology.

Using the SFWMD vegetation community classification (see Section 2.3.5), the principal community systems identified on and adjacent to the project site which serve as the principal wildlife habitat types include pine flatwoods and wet prairies. Ruderal areas and a ditch comprise minor habitat types and are of insufficient acreage to support distinct and separate wildlife compositions. Habitats such as grassland, improved pasture, agricultural lands (truck crops, sugarcane fields, and citrus groves), transportation rights-of-way, and industrial facilities in the immediate vicinity of the site are of relatively lower value to wildlife due to the limited diversity of niches, which is reflected in the lower wildlife species diversities in such habitats. Surface waters on the site (e.g., seasonally inundated marshes and the drainage ditch) were also examined to determine their potential habitat suitability for the two fish species under special consideration.

Five invertebrate and 62 vertebrate species, including 4 mammal, 46 bird, 10 reptile and amphibian, and 2 fish species were identified as important species occurring or possibly occurring in the study area (Table 2.3.6-2). The status and potential for occurrence of these animal species on and in the vicinity of the project site are discussed in the following paragraphs. It is important to note that a number of these species have different sized ranges of occurrence. Some species may be found in only a few isolated areas in specific habitats (e.g., bald eagle, snail kite), while others may occur throughout Martin County area as residents or migrants (e.g., wading birds).

The following sections include individual discussions for endangered and threatened species which occur, or potentially occur, on the ICL project site, and selected species of special or regional concern which occur or may be expected to occur in the surrounding study area (western Martin, southern Okeechobee, and southwestern St. Lucie Counties). General discussions are provided for the remaining species that either share specific habitat types (e.g., wetlands, pine flatwoods) or are not expected to occur onsite or near the site.

Invertebrate Species. Martin County lists five species of invertebrates as threatened, rare, or status undetermined. None of these species is expected to occur on or in the vicinity of the project site. Both scarab beetles occur in scrub or sandhill communities either along the coast or the central ridge, while the red widow spider has been found only in sand pine scrub in central and southeastern Florida. The two species of mangrove crabs are restricted to estuarine mangrove communities. No scrub, sandhill, or estuarine communities occur on or in the vicinity of the project site, and none of these species is expected to occur on or in the vicinity of the site.

Fish Species. Two fish species, including common snook and opossum pipefish, are listed by Martin County. Although both species invade freshwater, their principal habitat consists of salt and estuarine waters. Since the site lacks perennial lakes, natural streams, or drainages and canals of sufficient volume, neither of these species would be expected to occur onsite. Sampling of the on site drainage ditch did not result in the capture of either of these species.

The common snook (Centropomus undecimalis) is listed by FGFWFC as a species of special concern. Snook have specific habitat needs and prefer saline and estuarine mangrove shorelines and swamps. Potentially suitable habitat in the vicinity of the project site consists of manmade canals and spillways associated with St. Lucie Canal and Lake Okeechobee. However, aquatic communities in the western Martin, southwestern St. Lucie, and southeastern Okeechobee Counties study area do not include mangrove swamp systems or estuarine areas which serve as important spawning and nursery areas for snook.

Opossum pipefish (Oostethus lineatus) is listed as rare by FCREPA, but is not listed by other federal, state, or local agencies. Opossum pipefish inhabit shallow coastal areas and invade freshwater systems. This small pipefish is not a major forage or prey species, and is not expected to occur on or in canals and ditches in the vicinity of the site.

Amphibian Species. Gopher frog (Rana areolata), the only amphibian listed by Martin County, is designated as a species of special concern by FGFWFC, listed as threatened by FCREPA, and under review by USFWS. The primary cause for concern is habitat loss resulting from clearing for residential, commercial, and industrial development. Suitable habitat for gopher frogs includes xeric uplands such as sandhill and sand pine scrub communities. Although occasionally found in mouse burrows, crayfish holes, and stump holes, the gopher frog is most often associated with gopher tortoise burrows. The occurrence of the gopher frog within the study area is limited to suitable xeric habitat. The principal onsite habitats have high water-table conditions which do not support xeric habitat preferred by this species. For this reason, no populations of gopher frogs are expected to occur within or adjacent to the ICL project site, and none were found during two seasonal biological surveys.

Reptile Species. Nine reptile species are listed by Martin County. Four of these are marine turtles which do not occur in creeks and drainages of western Martin County. Three other species, including gopher tortoise, Florida scrub lizard, and

Florida pine snake, occur primarily in xeric habitats such as scrub or sandhill habitat. As such, scrub lizards and pine snakes are not expected to occur in western Martin County. Only two inactive gopher tortoise burrows were located along raised rights-of-way on the eastern portion of the project site during the wildlife surveys. However, two gopher tortoises were observed at the southeastern corner of the site and just outside and near the center of the eastern property boundary. These two individuals may actually have their burrows located offsite, since the high water table throughout the wet prairie and flatwoods habitats, and the flat topography of the site, make the majority of the ICL site unsuitable for this species.

The two remaining species, alligator and indigo snake, are expected to occur in suitable habitat of the project site. American alligator (Alligator mississippiensis), federally classified as threatened through its similarity in appearance [T(S/A)] to the American crocodile (Crocodylus acutus) and a species of special concern in Florida, exists throughout the state, and is found in nearly all wetland and aquatic habitat types in southern Florida. Potential habitat for this species in the site area ranges from seasonally inundated marshes to the drainage ditch. Alligators were observed during both seasonal surveys in a drainage ditch along the northern boundary of Caulkins Indiantown Citrus processing plant property.

The eastern indigo snake (Drymarchon corais couperi), classified as threatened by Florida and USFWS, is generally found in Florida and southeastern Georgia. Preferred habitat includes dry sandy areas, as well as moist vegetation communities. The indigo snake frequently uses gopher tortoise burrows as shelter in xeric habitats. Potential onsite habitat for the indigo snake consists of pine flatwoods and wet prairies. No indigo snakes were observed at the site, but individuals are expected to occur onsite and in similar habitats in the vicinity of the site.

Bird Species

Forty-five species of endangered, threatened, rare, or special concern species of birds are listed by Martin County. Brown pelican, magnificent frigatebird, great white heron, reddish egret, roseate spoonbill, Florida clapper rail, piping plover, American oystercatcher, Caspian tern, royal tern, sandwich tern, least tern, black skimmer, black-whiskered vireo, Florida prairie warbler, migratory Bachman's warbler, and Kirtland's warbler represent listed bird species restricted to, or primarily occurring in, marine, coastal, and estuarine habitats of Martin County. As such, none of these 17 species resides or nests on, or is expected to occur, on the ICL project site or in surrounding areas. Similarly, no bald eagles, ospreys, or snail kites are expected to nest or reside onsite due to the absence of suitable open water habitat on or in the immediate vicinity of the site and based on a lack of historical records maintained by FGFWFC and USFWS. However, such species may occur as occasional transients in the vicinity of the site.

The southern bald eagle (Haliaeetus l. leucocephalus) is listed as endangered by USFWS and as threatened by FCREPA and FGFWFC. Eagles occurring in peninsular Florida include permanent residents and seasonally occurring migrants. The distribution, population, status, nest locations, and reproductive success of resident Florida eagles are closely monitored by FGFWFC and the National Audubon Society (NAS) through annual counts and aerial nest surveys. Based on two seasonal surveys of the study area and a review of known nest locations and agency data, no bald eagle nests are known to occur in the vicinity of the site. Most eagle nests are located in tall pines or cypress high above the surrounding forest, are large and conspicuous, and can be detected during ecological surveys. The closest bald eagle nests are located northwest and west of FPL's Martin power plant site and in Jonathan Dickinson State Park, located within 5 miles and 30 miles to the northwest and east, respectively.

The osprey (Pandion haliaeetus) is designated as threatened by FCREPA and as a species of special concern by FGFWFC. The osprey inhabits primarily wooded edges of open water bodies such as lakes, rivers, and bays. Nesting occurs in pine and cypress trees in addition to utility poles and navigation channel markers. Habitat loss and nest disturbance are the primary cause for recent population declines in Florida. Since the project site contains no suitable nesting and feeding areas, ospreys are not expected to occur on or in the vicinity of the site. No ospreys were recorded during the two seasonal biological surveys conducted May and July 1990. Ospreys, however, are common at Lake Okeechobee and the St. Lucie Canal.

Although the snail kite (Rostrhamus sociabilis) occurs in Martin County, it is restricted to very specific habitats and ranges. Habitat requirements include extensive areas of shallow open waters with interspersed sawgrass. This raptor is listed as endangered by USFWS, FCREPA, and FGFWFC. The Critical Habitat for the snail kite designated by USFWS lies outside of Martin County, and includes all of Conservation Areas 1 (the Arthur R. Marshall Loxahatchee National Wildlife Reserve) and 2A and a portion of Conservation Area 3A. The ICL project site or surrounding areas do not include suitable snail kite habitat and are situated far away from the major kite use areas located to the south and west. As such, kites are not expected to occur on or to cross the project site, as land use types immediately east or west of this area provide no areas of potential, high quality kite habitat. The nearest snail kite populations occur along Lake Okeechobee and within the Arthur R. Marshall Loxahatchee National Wildlife Refuge.

Twelve species of protected wading birds are known or expected to occur in the vicinity of the ICL project site. These species include woodstork, sandhill crane, limpkin, great egret, little blue heron, snowy egret, tricolored heron, white ibis, least bittern, black-crowned night heron, yellow-crowned night heron, and glossy ibis. All of these wading birds are designated as species of special concern by FCREPA with the exception of the woodstork which is considered endangered, and the Florida sandhill crane which is considered threatened.

The habitat requirements of these wading birds are generally similar in that they require wetlands such as marshes and shallow open water for feeding, and shrub swamp or cypress swamp habitats for roosting and nesting. Wetland habitats on the ICL site include non-forested freshwater wetlands and a man-made drainage ditch only, and are unsuitable for nesting or roosting. Individuals of all these species of wading birds may, however, be expected to seasonally occur in suitable wetlands during periods of inundation. As a result of the current drought conditions, only a few little blue herons and snowy egrets were recorded along the northern boundary drainage ditches during the July wet season survey; no wading birds were observed in wetlands of the site. A record search of USFWS and FGFWFC files showed that no nesting colonies are located on or in the vicinity of the ICL project site.

Wood storks (Mycteria americana) are listed as endangered by USFWS, FCREPA, and FGFWFC due to their continued population decline caused by the progressive loss of suitable feeding and nesting areas (Ogden and Nesbitt, 1979; Ogden et al., 1980). As a result, their population status, colony locations, and reproductive success are closely monitored by FGFWFC and NAS through annual counts and ground and aerial colony surveys.

A review of FGFWFC colony data compiled during annual aerial surveys indicates that no known wood stork colonies are located in the vicinity of the project site. Individual storks or small flocks may feed or occur as transients throughout the study area that is suitable feeding habitat. Such areas may include wet prairie onsite and in the vicinity of the site.

The Florida sandhill crane (Crus canadensis pratensis) is a nonmigratory resident and is listed as threatened by FGFWFC and FCREPA. Florida sandhill cranes nest and feed in shallow freshwater marshes and wet prairies throughout central and south Florida. Feeding also occurs in low-lying pastures, shallow marshes, and prairies. The primary reasons for their population decline are habitat loss and human encroachment on nesting and feeding areas. The range of the Florida sandhill crane includes the study area, and it may occur as transient over the site. However, it is not expected to nest onsite due to lack of suitable nesting habitat, and this species was not recorded during the 1990 biological surveys of the ICL site.

The limpkin (Aramus guarauna) inhabits slow-moving freshwater habitats such as rivers, streams, marshes, and lake shores of Florida. Due to its dependence on wetland systems and the gradual loss of such wetlands, the limpkin is considered a species of special concern by FCREPA and FGFWFC. In the study area, limpkins may be expected to occur in suitable wetland systems in the vicinity of Lake Okeechobee and the water management areas. This species is not expected to feed or reside on the ICL project site due to the absence of suitable habitat, and bo limpkins were recorded during the May and July 1990 site surveys.

Bird species such as Florida scrub jay, burrowing owl, and red-cockaded woodpecker have specific habitat requirements which determine their distribution and occurrence in Florida. These habitat requirements, and their probability of occurrence on the ICL project site, are discussed in the following sections.

Florida scrub jays (Aphelocoma c. coerulescens), listed as threatened by FGFWFC, FCREPA, and USFWS, occur in xeric scrub habitats in scattered locations along the central Florida ridge and along coastal ridges. Florida scrub jays have specific habitat requirements and prefer oak scrub with saw palmetto, scattered sandpine, and rosemary; they avoid wetlands and forested communities such as pine flatwoods. The decline of Florida scrub jays is apparently caused by the loss of scrub habitat which has been converted to residential developments, citrus groves, and pastureland. Based on a review of range maps, aerial photographs, and site-specific information collected during seasonal site surveys, no habitat suitable for scrub jays occurs onsite or within the study area, and no scrub jays are expected to occur onsite or in the vicinity of the site.

The burrowing owl (Athene cunicularia) inhabits prairies, sandhills, pastures, and maintained grasslands with sandy ground with sparse growth. During the breeding season, the burrowing owl requires soil that is fairly well drained. During the remainder of the year, xeric conditions are less critical. Due to habitat loss throughout its range, the burrowing owl is listed as a species of special concern by FCREPA and FGFWFC. The site lacks sufficient areas of xeric or well-drained soils, and burrowing owls were not recorded onsite during the 1990 site surveys.

The red-cockaded woodpecker (Picoides borealis) is designated as endangered by USFWS and FCREPA and as threatened by FGFWFC. The red-cockaded woodpecker is usually restricted to pine flatwoods containing overmature longleaf and/or slash pine stands where it nests in trees affected by red heart disease. Although this habitat extends throughout the southeastern states, early harvesting of southern pine species has reduced the numbers of old, diseased trees preferred by these birds. As such, the remaining populations are restricted to relatively few, well-monitored specific locations. On the basis of these records and site surveys, red-cockaded woodpeckers are not known or expected to occur on or in the vicinity of the ICL site due to the absence of suitable nesting trees and colony sites.

Although listed species such as caracara, least tern, short-tailed hawk, and swallow-tailed kite may occur as occasional transients over the project site, they are not expected to occur onsite since the Indiantown Cogeneration Project site lies outside their primary range and/or lacks suitable nesting habitat.

The crested caracara (Polyborus plancus) is listed as threatened by FGFWFC, FCREPA, and USFWS. Caracaras occur over dry prairies, palmetto rangelands, and, to a lesser degree, improved pastures of south-central Florida. Reasons for this species' decline are not conclusively known, although habitat loss and encroachment by residential and agricultural developments appears to be the main cause. The Florida breeding range of caracaras decreased during the 1970s, with the present center of distribution located to the north and west of Lake Okeechobee. As such, crested caracaras may occur as occasional transients in the vicinity of the site. Caracaras were not recorded during the May and July 1990 site surveys.

The least tern (Sterna antillarum) is a coastal bird of the southeastern Florida coast and inhabits open sandy beaches. The least tern is listed as threatened by FCREPA and FGFWFC. Natural nesting sites occur between the shoreline and vegetated areas on beaches and, to a lesser extent, landfills, parking lots, construction sites, and tar/stone roof tops. The reasons for the decline of this species have been nesting disturbances and destruction of beach habitat due to development. The least tern can range inland to Lake Okeechobee, and may be expected to occur as an occasional transient in the vicinity of the project site. However, the latter does not provide suitable nesting areas or feeding areas. No least terns were recorded on the ICL project site during the May and July 1990 surveys.

The Florida range of the short-tailed hawk (Buteo brachyurus), which is listed as rare by FCREPA, includes the southeastern two-thirds of the state during the breeding season and the southern one-third during the winter months. Preferred habitat consists of an association of mixed woodland and savannah systems which include mature cypress stands, riparian hardwoods, mangrove swamp, and stands of pines which are adjacent to open prairie marshland. Marginally suitable habitat within the study area includes expansive pine and wet prairie with interspersed cypress domes and strands, and forested drainages. Since no preferred habitat occurs onsite and no individuals were recorded during onsite surveys, this hawk is not expected to occur within or adjacent to the project site.

The American swallow-tailed kite (Elanoides forficatus) is not listed by FGFWFC, but is currently under review by USFWS. Its preferred habitat is similar to that of the short-tailed hawk. Since the site lacks mixed hardwood swamp or riparian hardwood forest, this species is not expected to reside onsite. It was not recorded during the May and July 1990 biological surveys of the ICL project site.

Several listed species of birds are expected to occur in the study area within the pine flatwood and surrounding rangeland habitats either as migrants, transients, or residents. For example, peregrine falcons may occur as accidentals during migratory seasons, but generally are more common along the coast. The site does not offer significant feeding habitat for this species, which does not nest in Florida.

Other species are opportunistic and range into a variety of habitats such as forested old field, rangeland, grasslands, rights-of-way, and agricultural lands. Such species include Cooper's hawk, Bachman's sparrow, merlin, southeastern kestrel, loggerhead shrike, and hairy woodpecker. Habitat features that make flatwoods, rangeland, and a number of other habitats valuable for these bird species are their relatively open stands of trees and shrubs which provide roosting, nesting, and feeding resources. The decline of several of these species is partially attributable to loss and alteration of pine flatwoods habitats, primarily for agricultural purposes. Because of the presence of flatwood and rangeland habitat in the project area, all six of these species may occur. Loggerhead shrike were commonly observed throughout the site during the July 1990 surveys, and Bachman's sparrows occurred in the pine flatwoods. None of these species are listed as endangered.

Mammal Species

Four species of mammals are listed by Martin County. These species include Sherman fox squirrel, Florida mouse, round-tailed muskrat, and West Indian manatee. Due to their endangered population status and public recognition, Florida panthers are also addressed.

Currently, Florida panthers (Felis concolor coryi) occur primarily in large tracts of undisturbed lands to the west and southwest of the SR 710 corridor. The only recent reports of panthers in the vicinity of the study area is from the areas west of FPL's Martin site and from Corbett WMA, both involving specimens which were killed in the mid-1980s (FGFWFC, 1988).

Florida panthers are listed as endangered by USFWS, FGFWFC, and FCREPA. The majority of verified panther sightings are from Big Cypress Swamp, located far west of the study area. A review of its status in the area to the immediate northwest of the ICL project site showed that FGFWFC does not expect this species to occur in the vicinity of the site (FGFWFC, 1990). Considering the low panther population estimates, the high degree of urban industrial and agricultural development in the immediate vicinity and to the north, south, and east of the site, the likelihood of panther occurrence on the site is considered unlikely.

The Florida mouse (Peromyscus floridanus) is listed as threatened by FGFWFC, as a species of special concern by FCREPA, and is currently under review for listing by USFWS. This burrowing species is confined to xeric scrub habitats of peninsular Florida, and the principal habitat of this Florida endemic is sand pine scrub in an early successional stage. It also occurs in xeric longleaf pine-turkey oak and scrubby flatwood associations. Because no xeric habitat is found in or adjacent to the project site, no Florida mice are expected to occur. No Florida mice were captured during a systematic small mammal trapping program conducted as part of the July 1990 biological survey of the Indiantown Cogeneration project site.

Sherman's fox squirrel (Sciurus niger shermani), which is designated as threatened by FCREPA, as a species of special concern by FGFWFC, and under review for listing by USFWS, inhabits much of peninsular Florida where suitable habitat such as sandhill and scrub oak communities exist. Alteration of its habitat is the major reason for the decline of Sherman's fox squirrel populations. Because of the absence of suitable xeric habitat on or near the project site, Sherman's fox squirrels are not expected to occur, and none were observed during the 1990 biological surveys.

The West Indian manatee (Trichechus manatus latirostris) is designated as endangered by USFWS and FGFWFC and threatened by FCREPA. Manatees may occur within streams and canals of Martin County. Areas of potential occurrence include the St. Lucie Canal, and seaward of dammed sections of canals connecting

Lake Okeechobee with the Atlantic Ocean. This species does not occur on or near the ICL project site.

Round-tailed muskrats (Neofiber alleni) live in and around freshwater marshes composed of dense maidencane stands and pickerelweed. Although this species is found throughout much of Florida and southeastern Georgia, the round-tailed muskrat is designated a species of special concern by FCREPA and is currently under review for listing by USFWS. Because the muskrat is nocturnal and its presence is sporadic even in suitable habitat, accurate population estimates are difficult to obtain. Due to the presence of wet prairies onsite, these wetlands were searched for muskrat nests and individuals. No nests were found, and no muskrats were trapped or located during the May and July 1990 surveys of the site.

Species of Recreational and Commercial Importance

Numerous species of potential recreational and commercial importance occur on and in the vicinity of the ICL project site. Such species include white-tailed deer, eastern cottontail, gray squirrel, feral hog, wild turkey, bobwhite, mourning dove, white-winged dove, and several species of waterfowl as species of recreational importance, and raccoon, river otter, Virginia opossum, gray fox, striped skunk, and bobcat as species of commercial importance.

Although onsite population levels for these species have not been quantified, common pine flatwoods species such as white-tailed deer, raccoon, opossum, bobcat, eastern cottontail, gray squirrel, gray fox, feral hog, bobwhite, and mourning dove appear to be common based on tracks, calls, and direct sightings. In contrast, species such as river otter, waterfowl, white-winged dove, and wild turkey are not expected to reside onsite due to the absence of suitable habitat or existing impacts.

Indicator and Endemic Vertebrate Species

No vertebrate species endemic to Florida were observed on or in the vicinity of the ICL project site during the 1990 biological surveys. Indicator species recorded during these surveys included rice rat, southern leopard frog, southern cricket frog, and water moccasin in the freshwater marsh, and Bachman's sparrow, rufous-sided towhee, pine warbler, nuthatch, yellow-shafted flicker, bobwhite, oak toad, pinewoods treefrog, box turtle, eastern fence lizard, and eastern glass lizard in the pine flatwoods. Little green heron, mosquito fish, and flagfin molly comprised the dominant indicator species along the effluent drainage ditch.

2.3.6.2 Pre-Existing Stresses

The pre-existing stresses on the plant communities/wildlife habitats situated within the proposed site are discussed under Section 2.3.5.2. To summarize, the following conditions comprise the existing sources of stress to terrestrial habitats:

- Cattle grazing
- Fire
- Reduced hydroperiod due to local and regional drainage alterations
- Human activity (construction or roads, trails, and power line)

2.3.6.3 Measurement Program

The aquatic, wetland, and terrestrial resources within the project site and immediate vicinity were studied through field monitoring programs as part of the licensing effort.

Data Search/Literature Survey

Prior to conducting the field studies, pertinent literature was obtained to review the ecological information available for use in developing the database required to assess the potential effects resulting from the construction and operation of the proposed project.

A description of existing ecological and biological resources at the proposed ICL project site and along with associated facilities was developed from this database as well as from available literature. Such information sources also included extensive in-house data files compiled from prior ecological investigations in the area.

The information identified during the literature review included the following subjects:

- Regional vegetation descriptions, including successional patterns
- Plant species lists for the area of the proposed site
- Lists of birds, mammals, reptiles, amphibians, fish, and select invertebrates common to the proposed site
- Species checklists, reports of sightings, and abundance estimates
- Locations of rare, threatened, or endangered species or critical habitats for these species
- Occurrence of pre-existing stresses or perturbations such as fires, construction/clearing operations, overgrazing, drainage alterations, and exotic species invasions

Terrestrial and Wetlands Ecology

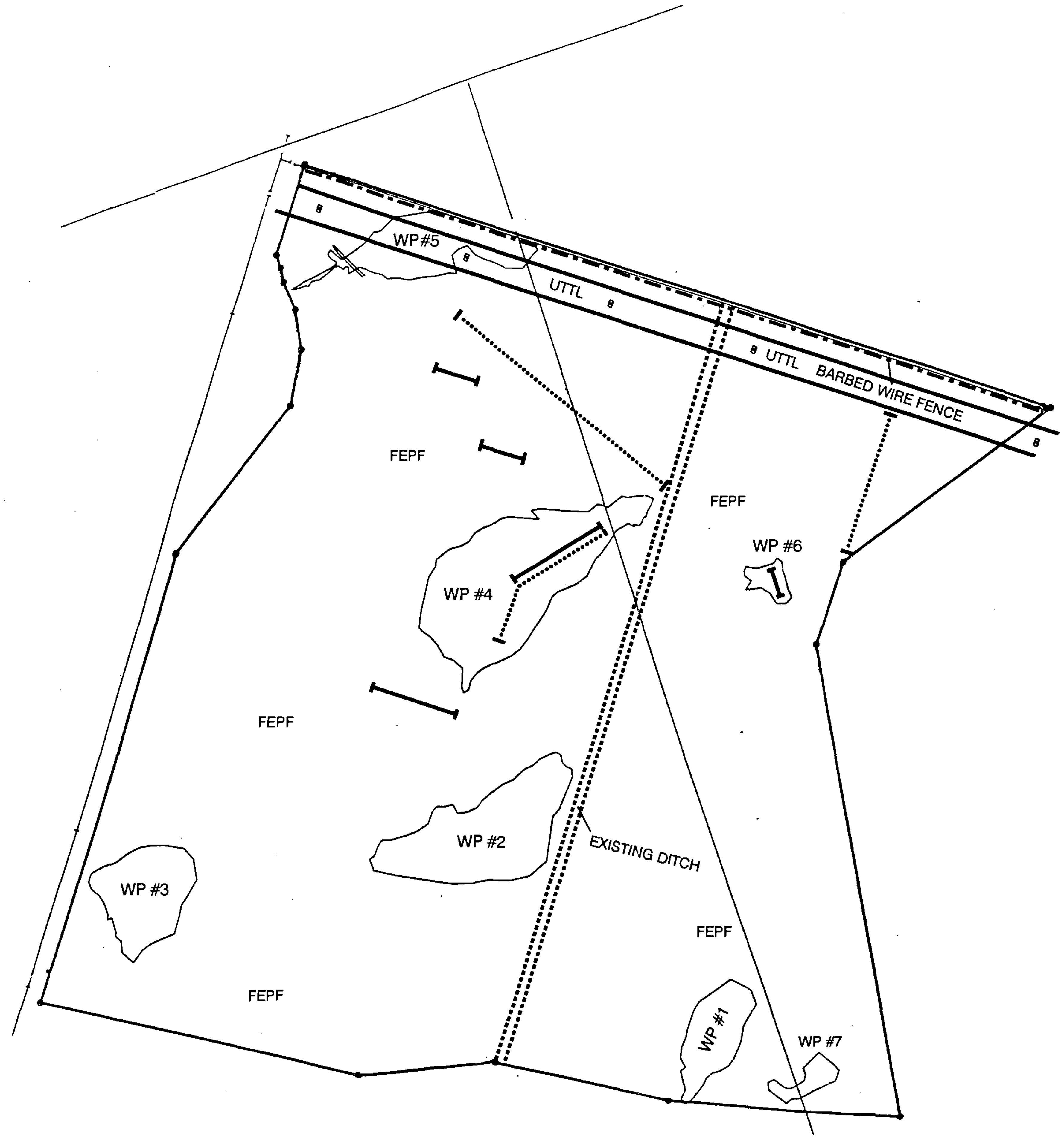
The objective of the field sampling program was to investigate the major vegetation communities and wildlife habitats within the proposed project site to quantitatively and qualitatively document important ecological features and biological resources, such as the presence of rare, threatened, or endangered biota or the potential for habitats to support significant wildlife populations. The terrestrial and wetlands ecology field studies were limited to two season samplings. The two seasons selected for sampling correspond to the spring dry season (May 1990) and the summer-fall wet season (July and September 1990). The field characterization programs for vegetation and wildlife are presented in Tables 2.3.6-3 and 2.3.6-4, respectively.

Sample locations were established in representative wildlife habitats or vegetation community types (Figure 2.3.6-1). Vegetation data were recorded from sampling areas located in representative communities selected on the basis of the following:

- Community size
- Community or species importance (wetlands, uniqueness, habitat for threatened or endangered species)
- Degree of habitat disturbance
- Potential effects from project development

Major natural vegetation types were delineated and mapped. Vegetation was sampled in the fall (September 1990) for all strata. A land cover map was prepared of the project site and for an area within a 5-mile radius of the project site using SFWMD land use and land cover maps, aerial photographs, and ground surveys. During the surveys, estimates of existing stress levels were made for communities

Figure 2.3.6–1
VEGETATION AND WILDLIFE TRANSECT LOCATIONS ON THE ICL PROJECT SITE



KEY

FEPF - PINE FLATWOODS
WP - WET PRAIRIE
UTTL - MAJOR TRANSMISSION LINE
- VEGETATION TRANSECTS
- WILDLIFE TRANSECTS

N

0 500 1000
SCALE IN FEET

SOURCE: ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC., 1990

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

G-10/90-1808-23

Table 2.3.6-3
TERRESTRIAL AND WETLAND VEGETATION MONITORING PROGRAM

Stratum	Method	Sampling Schedule	Sampling Frequency	Equipment	Data Analysis
Tree	Quadrat ($100 m^2$)	Fall	Once	Tape measure; DBH tape	Frequency, density, basal area, dominance, importance value
Shrub	Quadrat ($25 m^2$)	Fall	Once	Tape measure	Percent cover, dominance, frequency, importance value
Herb/ground	Quadrat ($1 m^2$)	Fall	Once	$1 m^2$ quadrat (PVC frame)	Percent cover, dominance, frequency, importance value

Source: ECT, 1990.

Table 2.3.6-4
TERRESTRIAL AND WETLAND WILDLIFE MONITORING PROGRAM

Taxa	Method	Sampling Schedule	Sampling Frequency	Data Analysis
Large mammals	Direct sightings, tracks along transects, ground surveys across entire site	Spring/summer	Daily for 5 days	Onsite status, distribution, relative abundance
Small mammals	Live-trapping along transects	Summer	Daily for 5 days	Onsite status, distribution, relative abundance
Birds	Transects, ground surveys across entire site	Summer	Daily for 5 days	Onsite status, distribution, relative abundance
Reptiles/ amphibians	Incidental observations along mammal and bird transects	Spring/summer	Daily for 5 days	Onsite status, distribution, relative abundance
Fish	Dip-netting	Summer	2 days	Species composition

Source: ECT, 1990.

located onsite. Specifically, evidence of fire, land clearing, cattle grazing, road construction, and drainage were recorded.

Wetland limits within the project site were delineated using joint application of USACE, FDER, and SFWMD wetland jurisdictional boundary determination methods. Wetland jurisdictional boundaries were then flagged and surveyed. The surveyed wetlands were then overlaid on the project site plan to ensure that the plant layout would avoid any possible encroachment. Natural upland buffers of 50 feet or greater were also identified along the wetland boundaries to ensure setback areas from project construction. Wildlife data were recorded from the same or nearby areas sampled for vegetation using quantitative techniques as shown on Table 2.3.6-4. Wildlife sampling areas were also selected based on the same criteria as indicated for vegetation. The terrestrial and wetlands field program:

- Described plant communities/wildlife habitats onsite

- Identified major plant species and wildlife populations associated with habitats onsite

- Determined the presence or absence of state and federally protected animal and plant species that would potentially occur in the site area

- Estimated the size and occurrence status of dominant wildlife populations for the area

Surveying and sampling terrestrial and wetland habitats for wildlife and vegetation species began in May 1990, and were concluded in September 1990.

Vegetation Community Field Studies

Vegetation mapping was based on updating existing SFWMD land cover and land use maps using current aerial photography, including color infrared of the site area, and ground reconnaissance. The identified natural plant community types located onsite (i.e., pine flatwoods and wet prairie) were then further investigated by conducting qualitative systematic walkovers to generate comprehensive plant species inventories, determine the presence or absence of listed plant species, and investigate the degree of disturbance to plant community structure and integrity based on such factors as fire, cattle grazing, clearing and construction activities, drainage alterations, and exotic species invasion. After the thorough qualitative surveys were included, representative habitat areas were selected for quantitative sampling. Five separate vegetation transects were established in the vegetation communities potentially affected or adjacent to project development. Transect locations are indicated on Figure 2.3.6-1. Quantitative information on plant community species composition were obtained using the following methodology.

Linear transects were established within three areas of pine flatwoods (165 to 330 feet in length) and in two separate wet prairie sites (110 and 450 feet in length). In the flatwoods, the canopy or tree quadrats were each 10 meters long by 10 meters wide and placed every 10 meters to provide contiguous 10 by 10 m^2 sampling plots along a belt transect. Trees greater than or equal to 4 inches diameter-at-breast-height (dbh) were sampled within each 10-m-by-10-m quadrat. The shrub layer was sampled in 5-m-by-5-m quadrats nested within and located at the bottom right corner of each tree plot. The shrub layer was identified as any palm species or woody vegetation with a dbh less than 4 inches and/or greater than or equal to 3.3 feet (1 meter) in height. Herbaceous or other ground layer vegetation, such as woody vines and shrub or tree seedlings/saplings, less than 3.3 feet or 1 meter in height was sampled in a 1-m^2 quadrat nested within each shrub quadrat at the bottom right corner. Within the shrub and herb quadrats, the percent cover by species was estimated and recorded to determine species dominance. Since no tree or shrub layers occurred within the wet prairies, only herb quadrats were used in the wetland vegetation sampling effort.

The herb quadrats were situated every 10 feet within the small wet prairie (WP No. 6) and every 30 feet in the larger wetland (WP No. 4) along each respective sampling transect. Only one transect was established in each of the two wet prairie sites sampled. The wetland transects crossed from one wetland/ upland interface boundary to the other through the center of each wet prairie. The number of sampling stations/quadrats in a transect/community depended on a species area curve and the extent of the community type.

Species dominance and frequency were calculated for canopy, shrub, and herbaceous strata of the pine flatwoods and for the ground layer in the wet prairie sites.

Tree density was also calculated for the pine flatwoods overstory. Relative values were then determined and summed to evaluate species importance values and rank within each community/site.

Vegetation/Land Use

The SFWMD Level III land use and land cover maps were modified where appropriate to reflect current land use and vegetation changes using aerial photography and ground truthing. All major vegetation community types greater than 5 acres in size were mapped. During site reconnaissance for the mapping effort, other data were collected to assess the relative quality of plant communities. Evidence considered during site surveys of relative quality included:

- Natural disturbances such as wildfires and severe storms

- Man-made or induced disturbances such as feral hog rooting, cattle grazing and trampling, ditching, draining, and controlled burning

- Invasion by exotic plant species such as punk tree, Brazilian pepper, and Australian pine

- Uniqueness and/or size

- Stage in ecological succession

Information obtained during the field efforts was used to identify dominant plant species and plant community structure and ecology.

2.3.6.4 Aquatic Biology at Proposed Intake

The northern end of the proposed pipeline corridor ends at the south bank of Taylor Creek/Nubbin Slough.

Infaunal and epifaunal macroinvertebrate communities were sampled along Taylor Creek/Nubbin Slough at three stations during May 1990. The epifaunal communities were sampled by allowing them to colonize Hester Dendy artificial substrate samplers. At each station, three samplers were suspended in the water column at mid-depth and allowed to incubate for 4 weeks. Infaunal communities were sampled with a petite Ponar grab. Ponar samples were collected along a transect to identify the populations inhabiting different substrate types. Four samples were analyzed from each of three stations.

Ninety-one taxa were identified during the present study. Sixty-two taxa were identified from artificial substrate samples, and 46 taxa were identified from the Ponar grab samples (Table 2.3.6-5). Individual species collected in each sample and their counts are shown in Section 10.7, Tables 10.7.1-1 through 10.7.1-6. Different species groups dominated the two sample types: the artificial substrate collected mostly insects while the Ponar collected tubificid worms (Tables 2.3.6-5 and 2.3.6-6). Insects were dominated by the family Chironomidae which is comprised of non-biting midge flies. Artificial substrate samplers collected species that typically inhabit vegetation. In fact, the dominant species collected in this

Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM TAYLOR CREEK, MAY/JUNE 1990
(Page 1 of 5)

Phylum Class Order Family Genus species	Sample Type Hester Dendy	 Ponar
Coelenterata		
Hydrozoa		
Hydroida		
Clavidae		
Cordylophora lacustris	X	
Hydridae		
Hydra sp.	X	
Platyhelminthes		
Turbellaria		
Tricladida		
Dugesia sp.	X	X
Bryozoa		
Phylactolaemata		
Plumatellidae		
Hyalinella punctata	X	
Nemertea		
Prostoma rubrum	X	
Nematoda		X
Annelida		
Oligochaeta		
Haplotaxida		
Naididae		
Allonais paraguayensis	X	
Bratislavia bilongata	X	
Chaetogaster diaphanum	X	
Dero nivea	X	
D. pectinata	X	
Nais variabilis	X	
Pristina aequiseta	X	
P. leidyi	X	X
P. synclites		X

Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM TAYLOR CREEK, MAY/JUNE 1990
(Page 2 of 5)

Phylum Class Order Family Genus species	Sample Type Hester Dendy	 Ponar
Pristinella jenkinae		X
Slavena appendiculata		X
Tubificidae		
Aulodrilus pigueti		X
Branchyuria sowerbyi		X
Limnodrilus hoffmeisteri		X
Immature with Capil.Setae		X
Immature without Capil.Setae		X
Hirudinea		
Rhynchobdellida		
Glossiphoniidae		
Batracobdella phalera	X	
Helobdella elongata		X
H. stagnalis	X	X
Placobdella pediculata		X
P. translucens	X	
Arthropoda		
Crustacea		
Ostracoda	X	
Amphipoda		
Talitridae		
Hyalella azteca	X	X
Mysidacea		
Taphromysis bowmani		X
Insecta		
Collembola	X	
Ephemeroptera		
Baetidae		
Baetis sp.		X
Caenidae		
Caenis diminuta	X	X

Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM TAYLOR CREEK, MAY/JUNE 1990

Phylum Class Order Family Genus species	Sample Type Hester Dendy	Ponar
Odonata		
Zygoptera		
Coenagriidae		
Enallagma sp.	X	
Ischnura sp.	X	
Homoptera		
Trichoptera		
Hydroptilidae		
Hydroptila sp.	X	
Orthotrichia sp.	X	X
Leptoceridae		
Oecetis sp.	X	X
Psychomiidae		
Cyrnellus sp.	X	
Polycentropus sp.	X	
Lepidoptera	X	
Coleoptera		
Dytiscidae	X	
Diptera		
Ceratopogonidae	X	X
Chaoboridae		
Chaoborus punctipennis		X
Chironomidae		
Tanypodinae		
Ablabesmyia rhamphe	X	X
Coelotanypus concinnus		X
Labrundinia neopilosella	X	X
Procladius sp.		X
Tanypus sp.		X
Orthocladinae		
Cricotopus bicinctus group	X	X
C. sylvestris group	X	
Nanocladius nr. distinctus	X	X
Orthocladius sp.	X	

Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM TAYLOR CREEK, MAY/JUNE 1990
(Page 4 of 5)

Phylum Class Order Family Genus species	Sample Type Hester Dendy	 Ponar
Chironominae		
Asheum beckae	X	
Chironomini sp. A Beck	X	X
Chironomus sp.		X
Cladotanytarsus sp.		X
Cryptochironomus fulvus gr.	X	
Dicrotendipes sp.		X
D. modestus	X	X
D. nervosus	X	
D. neomodestus	X	
D. simpsoni	X	
Endochironomus nigricans	X	X
Glyptotendipes sp.	X	X
Goeldichironomus sp.	X	X
G. carus	X	
Parachironomus sp.	X	
P. directus	X	
P. pectinatellae	X	
Phaenopsectra sp.	X	
Polypedilum illinoense		X
P. scalaenum		X
P. simulans		X
Pseudochironomus nr. pseudoviridis	X	
Tanytarsus glabrescens gr.	X	
T. sp. X Rutter	X	X
T. sp. XII Rutter	X	
T. sp. XIII Rutter	X	
Mollusca		
Gastropoda		
Ancylidae		
Hebetancylus excentricus	X	
Laevipex fuscus	X	

Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM TAYLOR CREEK, MAY/JUNE 1990
(Page 5 of 5)

Phylum Class Order Family Genus species	Sample Type Hester Dendy	 Ponar
Hydrobiidae		
Pyrogophorus platyrachis	X	
Planorbidae		
Gyraulus parvus	X	X
Planorbella scalaris	X	
Physidae		
Physella hendersoni	X	
Viviparidae		
Viviparus georgianus	X	X
Plecypoda		
Corbiculidae		
Corbicula fluminea		X
Unionidae		
Anodonta couperiana		X
Elliptio buckleyi		X
TOTAL	62	47

TOTAL TAXA IN STUDY: 91

Source: ECT, 1990

Table 2.3.6-6
PERCENT COMPOSITION OF THE MACROINVERTEBRATE POPULATIONS COLLECTED FROM TAYLOR CREEK/NUBBIN SLOUGH, MAY/JUNE 1990

	Oligochaeta		Crustacea	Insecta			
Stations	Naididae	Tubificidae	Amphipoda	Chironomidae	Other	Molusca	Other Invertebrates
Artificial Substrates							
Station 1	18		18	40	12	9	3
Station M	13		10	65	9	1	1
Station 2	6		13	71	8	<1	1
Mean (all stations)	12		14	59	10	3	2
Ponar grab							
Station 1	7	31	7	35	7	12	
Station M	2	60		7	2	27	
Station 2	14	48	6	19	-	13	
Mean (all stations)	8	46	4	20	3	17	

Source: ECT, 1990

study closely corresponded to those collected by Rudolph and Strom (1990) associated with macrophytes in Lake Okeechobee. The Ponar grab collected organisms that live on or in the substrate, in this case, deep layers of highly organic silt.

Although macroinvertebrate populations in the present study corresponded well with those collected by Rudolph and Strom (1990) from Lake Okeechobee, they did not reflect the composition of the benthos in the St. Lucie Canal as reported by FPL (1989). The organisms from the St. Lucie Canal were collected by the Ponar and no data were reported from artificial substrate samplers. The sediment of the St. Lucie Canal was different from that of Taylor Creek/Nubbin Slough canal. FPL (1989) reported the canal bottom to be a mixture of clays, silts, sands, and shell fragments. Although fine sand was the predominate substrate type, the second most predominate substrate was coarse gravel, primarily composed of shell fragments. These shell fragments obviously came from endemic populations, since mollusks comprised 67 percent of the benthic fauna. The substrate in Taylor Creek/Nubbin Slough was comprised of deep layers of silts and some detritus. Coarse sand and shell fragments were not observed. This sediment is more like that of Lake Okeechobee than the sediment in the St. Lucie Canal. The dissolved oxygen of the sediment was probably low in Taylor Creek/Nubbin Slough because of the low flow and highly organic sediment. Rudolph and Strom also reported low dissolved oxygen values at several stations in Lake Okeechobee during their spring and summer sampling. As typical for such a system, lower values occurred at the bottom of the water column.

Chironomidae comprised 59 percent of the invertebrates collected on all artificial substrate samplers (Table 2.3.6-6). Twenty chironomid taxa were collected. <u>Dicrotendipes</u> spp., <u>Goeldichironomus</u> spp., <u>Glyptotendipes</u> spp., <u>Parachironomus</u> spp., and <u>Asheum</u> <u>beckae</u> dominated the chironomids and have been reported to tolerate high organics and associated low dissolved oxygen regimes (Beck, 1977; Simpson and Bode, 1980; Roback, 1974; and Rudolph and Strom, 1990). Rudolph and Strom (1990) found that most of the chironomids mentioned above also dominated the fauna in the lake and were common at all stations. Most chironomids feed on algae, periphyton, or detritus that is scraped from the substrate or filtered from the water (Oliver, 1971). Therefore, the Hester Dendy artificial substrate suspended in the water column provides excellent habitat for these invertebrates. Periphyton grows well on the samplers and provides a ready food source for scrapers. Other species that construct tubes to catch detritus and microorganisms find these samplers provide a stable substrate for attachment. Thus, in the presence of high organics these organisms proliferate.

The second most numerous invertebrate group on artificial substrate was the Crustacea. This group was comprised exclusively of the amphipod Hyalella azteca. This species also dominated many of the samples of Rudolph and Strom (1990).

Naidid worms comprised 12 percent of the fauna of artificial substrate and other insects comprised 10 percent. Dominant naidids were species of Dero and Pristina; other insects were dominated by the mayfly Caenis diminuta. Again these species are known to tolerate low dissolved oxygen (below 5 ppm) and were common in Lake Okeechobee.

The freshwater bryozoan, Hyalinella punctata, was collected on artificial substrate and recorded as one individual found or 8 organisms per square meter (hereafter 8 organisms/m^2). This is a colonial organism, occurring in a colony of hundreds to thousands of individuals sometimes growing in several layers. Enumerating these organisms in this manner grossly underestimated the significance of these invertebrates to the epifaunal populations. In some cases, the colony covered 16 to 20 percent of the artificial substrate sampler. Another colonial organism, the hydrid Cordylophora lacustris, was also collected. This species was not as common or abundant as the bryozoan. During sample processing, the colonies broke up into pieces that were similar in size and each piece was enumerated.

The dominant group of benthic organisms collected by the Ponar grab was tubificid worms (46 percent). Five tubificid taxa were collected from the canal and four

(Limnodrilus hoffmeisteri, Aulodrilus pigueit, Branchuria sowerbyi, and immature tubificids without capilliform setae) occurred in large numbers. These tubificids are well-known for their tolerance to low dissolved oxygen associated with organic pollution (Brinkhurst and Cook, 1974).

Diptern families, Chironomidae, Chaoboridae, and Ceratpogonidae, comprised 20 percent of the benthos and were represented by 17 taxa. The diptera on artificial substrate consisted exclusively of Chironomidae; however, in Ponar samples, two related families of midges (Ceratopogonidae and Chaoboridae) were also collected and grouped in with the Chironomidae (Table 2.3.6-6). The phantom midge Chaoborus punctipennis dominated this group. These organisms can tolerate sediments of low oxygen concentrations. They live in the sediments during the day and migrate into the water column at night to feed. They are able to survive anoxic sediments by moving into water with higher oxygen concentrations at night.

Mollusca comprised 17 percent of Ponar samples. The dominant species was the Asiatic clam Corbicula fluminea. This is an introduced species which often becomes a biotic and economic problem. This species frequently occurs in extremely high densities out-competing the native fauna; it is also a well-known biofouling organism. Corbicula was particularly abundant at Station 2, occurring in all samples collected at that station. It was only found in one of the four Ponars collected from Station 1, but occurred in high densities in that sample. Freshwater mussels, Elliptio buckleyi and Anodonta couperiana were also collected in Ponar grab samples. Each station had at least one of these mussels present. These mussels do not live in severely stressed systems and their presence indicate conditions may be enriched but are not polluted (Fuller, 1974). In fact, a certain amount of eutrophication has been reported to be of service to mussels, by increasing the amount of available food. E. buckleyi had the bright green background coloration that they only get when in clean water (F.G. Thompson, Personal Communication).

Naidid worms comprised 8 percent of the benthos and primarily consisted of Dero and Pristina. Naidids are reported to inhabit aquatic vegetation, but these genera are often associated with sediments. As with other invertebrate groups, the same genera dominated naidids in Lake Okeechobee.

Crustacea and other insects were rarely collected in Ponar samples as they only comprised 4 percent and 3 percent of the infauna, respectively.

Densities of invertebrates collected during the study ranged from 431 to 11,727 organisms/m^2 (Table 2.3.6-7 and Section 10.5, Tables 10.5.1.6-1 through 10.5.1.6-6). Greatest invertebrate densities were found on artificial substrate samplers. At Stations 2 and M, these samplers contained densities of 11,727 and 1,152 organisms/m^2, respectively; whereas, densities averaged 5,016 organisms/m^2 at Station 1. High densities on these samplers reflect the enriched conditions in the system.

Since the samplers were suspended in the water column where oxygen was greatest, the populations were able to proliferate in the presence of high quantities of food. Macroinvertebrate densities were lower in Ponar samples, ranging from 431 organisms/m^2 at Station M to 5,016 organisms/m^2 at Station 2. Infaunal samples averaged 1,755 organisms/m^2 at Station 1.

The Shannon Weaver diversity index as described by Wilhm and Dorris (1968) was used to calculate the species diversity ($\bar{d}$) on each sample and at each station (Table 2.3.6-7). Mean diversity at the stations ranged from 2.67 to 4.42. Diversity is influenced both by the number of taxa collected and the distribution of organisms among the taxa. The number of taxa collected at the stations ranged from 11 to 51. The lowest mean diversity (2.67) and lowest number of taxa (11) were found at in Ponar samples at Station M; thus, indicating more stress in the sediments at this station than at other sites.

Table 2.3.6-7
DENSITY AND DIVERSITY FOR MACROINVERTEBRATES COLLECTED FROM TAYLOR CREEK/NUBBIN SLOUGH, MAY/JUNE 1990

	Artificial Substrates			Ponar Grab		
Station	Mean Density*	Taxa+	Diversity**	Mean Density	Taxa	Diversity
1	4,863	51	4.21	1,755	34	4.42
M	11,153	38	3.29	431	11	2.67
2	11,727	33	3.88	5,016	33	3.72

*Mean density reported in number of organisms per square meter.
+Taxa represent the total number of taxa collected in all samples.
**Shannon Weaver diversity calculation using the following formula:

$$\bar{d} = -\sum_{i}^{s} \left(\frac{ni}{n}\right) \log_2 \left(\frac{ni}{n}\right)$$

where: ni = number of individuals in the i'th species (s), and
n = total number of individuals collected.

Source: ECT, 1990

Except for Station M, mean diversity values were high, equaling 3.29 or greater at the stations. Wilhm and Dorris (1968) proposed a relationship between $\bar{d}$ and the pollutional status of the sampling stations. They rate stations with diversity values above 3 as having clean water, values from 1 to 3 as moderately polluted, and values less than 1 as heavily polluted. These guidelines were based on data from a variety of clean-water and polluted streams.

Based on the diversities, these stations (except for Station M) are considered to have clean water. Based on species composition and densities along with the diversities, the stations are assessed as undergoing various degrees of enrichment, but not enough to produce considerable stress on the macroinvertebrate communities.

2.3.7 METEOROLOGY AND AMBIENT AIR QUALITY

2.3.7.1 Meteorology

Climatology

The proposed ICL site is located approximately 4.8 km (3 miles) northwest of the community of Indiantown and 14.4 km (9 miles) east of Lake Okeechobee, Florida. Meteorological data used in this climatological evaluation were obtained from National Weather Service (NWS) stations in Belle Glade (located 43 km [27 miles] south southwest of the site), Okeechobee (located 37 km [23 miles] northwest), Port Mayaca (located 15 km [about 10 miles] west-southwest), and West Palm Beach (located 42 km [about 26 miles] south-southeast) (see Figure 2.3.7-1). Temperature and precipitation are measured at both the Belle Glade and Okeechobee stations, whereas only precipitation is measured at the Port Mayaca station. Due to the proximity of these stations to the ICL site, temperature and precipitation data collected at these stations are generally representative of the conditions observed at the proposed site.

West Palm Beach is a "first-order" weather station with a full range of surface and upper air observations. Terrain features between the West Palm Beach site and the ICL site are typified by low elevation and broad areas of flat relief. Based on similarity in terrain features, meteorological data collected at West Palm Beach are also considered representative for the dispersion conditions at the ICL site.

Thirty-year precipitation and temperature normals are available from both Okeechobee and Belle Glade. Temperature extremes are available from Belle Glade for the 49-year period from 1924 to 1972. Temperature data from these stations are summarized in Table 2.3.7-1. Monthly average temperatures during the winter are in the low sixties and during the summer are in the low eighties. The average annual ambient temperature of about 73 °F reflects the subtropical climate of the area. The highest temperature recorded for the area is 100 °F and the lowest is 24 °F.

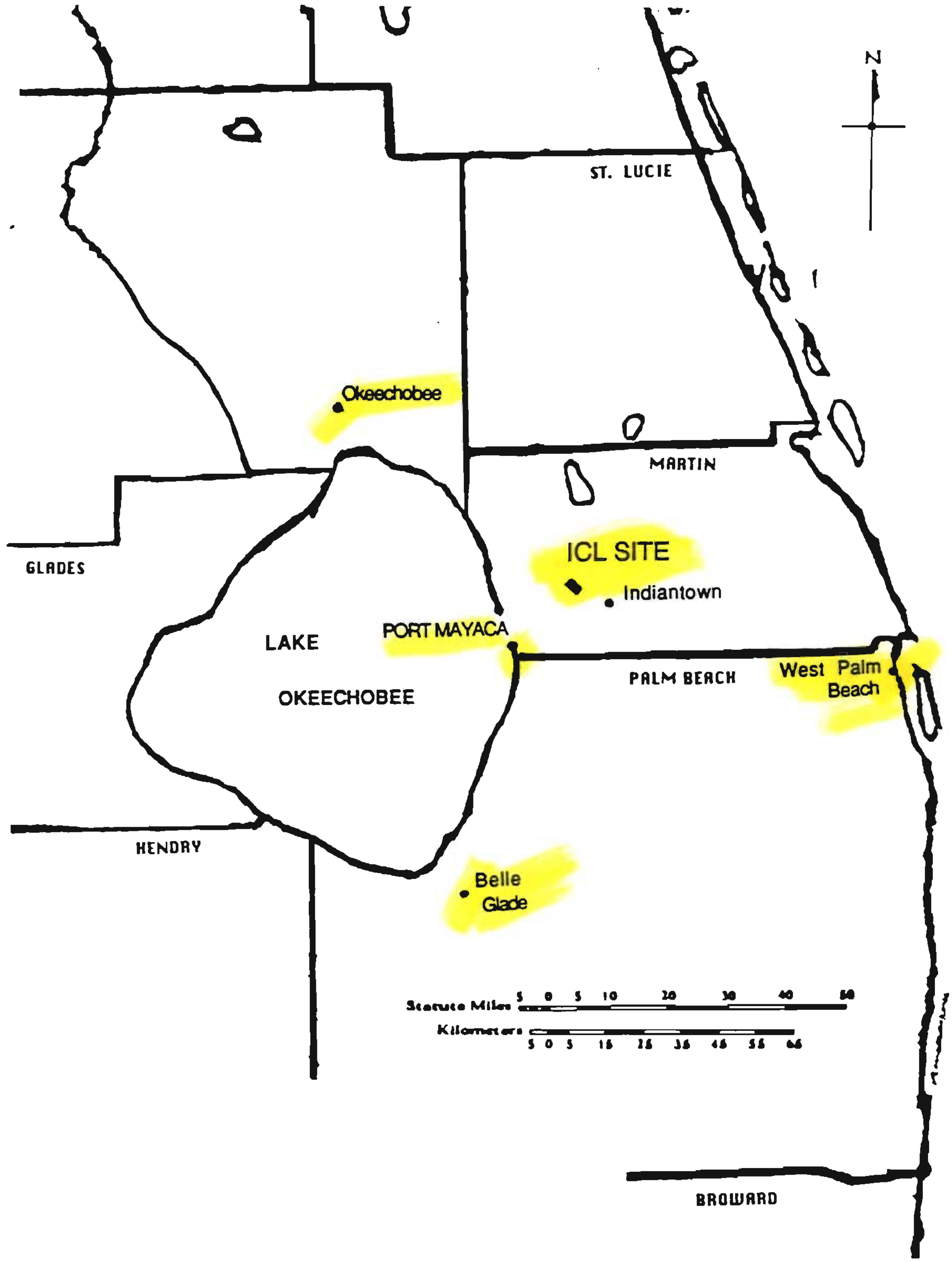


Figure 2.3.7-1.

NEARBY WEATHER STATIONS

Source: FPL, 1989

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Table 2.3.7-1
MONTHLY TEMPERATURE MEANS AND EXTREMES (°F) REPRESENTATIVE OF THE ICL SITE

Month	Daily Maximum(1)	Daily Minimum(1)	Monthly Average(2)		Highest Recorded(1)	Lowest Recorded(1)
			Belle Glade	Okeechobee		
January	75.5	54.2	62.8	62.3	89	24
February	76.9	53.8	63.7	63.3	92	27
March	79.5	56.3	67.3	67.4	93	27
April	82.9	60.3	71.3	72.4	95	33
May	86.5	64.7	75.1	76.6	95	44
June	88.5	70.1	78.8	79.9	98	54
July	90.5	72.1	80.3	81.2	100	62
August	90.5	72.8	80.7	81.6	99	61
September	85.3	69.4	79.7	80.5	96	60
October	84.4	68.5	75.1	75.7	94	40
November	78.7	60.6	68.6	69.0	91	32
December	76.0	55.6	64.0	63.6	89	25
Annual	82.9	63.2	72.3	72.8	100	24

(1) 49-year of data, 1924-1972, Belle Glade, Florida.
(2) 30-year of data, 1941-1970.

Sources: National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center, "Climatological Data for Florida, 1924-1978," Asheville, North Carolina.

Table 2.3.7-2 presents relative humidity data from the West Palm Beach weather station. The day and night relative humidities show little variation throughout the year, with a mid-day reading close to 60 percent and an annual predawn maximum of 80 percent. The least humid month of the year is April, while the highest humidity occurs during mid-summer. Heavy fogs occur approximately 10 days per year, mostly in the cooler months; however, this condition rarely persists long after sunrise on any given day.

Port Mayaca is the nearest NWS weather observation station measuring precipitation. Table 2.3.7-3 presents a summary of precipitation data for Belle Glade and Port Mayaca. The data indicate the occurrence of a significant precipitation maximum in the area in summer. This phenomena is caused by heavy, short-duration convective showers and thundershowers. Sixty percent of the total annual average rainfall occurs from June through September.

Mesoscale influences of Lake Okeechobee can add to the convective instability at the ICL site in the summer. Over the lake, sinking air suppresses the convective action of the lowest layers, creating a higher air density. The diverging lowest layer of lake air induces the warmer air over the land to be lifted as it moves ashore, and cumulus cloud formation begins. The local effects from the lake increase the rainfall of the region as well as generating mid-afternoon winds originating from Lake Okeechobee. The lake breeze may extend for several miles inland on a warm summer day.

Thunderstorms occur with great frequency in the area and can be locally intense. They cause high winds, heavy rain, occasional hail, and frequent lightning. The site area experiences 80 to 90 thunderstorms per year, 65 percent of which occur in the summer season.

Hurricanes are tropical cyclones in which winds reach speeds of 74 miles per hour (mph) or more. Near the center (eye), hurricane winds may gust to more than 200 mph, and the entire storm dominates the ocean surface and lower atmosphere over tens of thousands of square miles. The fastest wind speed recorded at West

Table 2.3.7-2
DIURNAL RELATIVE HUMIDITY
REPRESENTATIVE OF THE ICL SITE

(Relative Humidity [1] (%), West Palm Beach)

Month	Daytime	Nighttime
January	29	82
February	56	81
March	54	80
April	52	76
May	57	77
June	66	83
July	64	84
August	64	84
September	66	86
October	62	82
November	58	81
December	57	80
Annual	60	81

[1] 13-year averaged data, 1965-1977.

Sources: National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center, "Climatological Data for West Palm Beach, Florida, 1925-1978," Asheville, North Carolina.

Table 2.3.7-3
PRECIPITATION MEANS AND EXTREMES REPRESENTATIVE OF THE ICL SITE

Month	Belle Glade Precipitation (Inches)			Port Mayaca [3] Precipitation (Inches)		
	Normal[1]	Maximum[1]	Minimum[2]	Normal	Maximum	Minimum
January	1.99	8.53	0.11	1.54	7.06	0.00
February	1.97	5.55	0.03	2.13	5.79	0.22
March	3.21	15.01	0.33	2.44	14.65	0.09
April	2.96	9.05	0.01	2.32	6.88	0.03
May	4.74	9.61	1.08	4.95	10.27	0.45
June	9.08	24.11	0.59	7.62	14.75	1.95
July	8.58	15.30	1.78	6.72	13.48	1.97
August	8.21	16.38	2.65	5.97	10.22	1.65
September	8.82	19.50	1.99	6.21	11.67	1.15
October	5.65	15.84	0.49	5.23	11.15	1.31
November	1.74	12.44	0.13	1.24	5.33	0.06
December	1.80	7.09	0.05	1.61	5.69	0.02
Annual	58.75	84.68	40.99	47.98	60.65	28.38

(1) 30-year averaged data, 1941-1970.
(2) 49-year averaged data, 1924-1972.
(3) 28-year averaged data, 1951-1978.

Sources: National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center, "Climatological Data for West Palm Beach, Florida, 1925-1978," Asheville, North Carolina.

Palm Beach for the 28-year period ending 1977 was 86 mph in 1964, which was associated with Hurricane Dora. There were 14 hurricanes reaching the West Palm Beach area during 1886 to 1970 (NOAA Technical Memorandum NWS SR-58). Among those 14 hurricanes, 6 of them were with sustained winds of 125 mph or more.

Dispersion Meteorology

Wind Speed/Wind Direction

Based on the West Palm Beach data, the prevailing winds are from the east to east-southeast throughout most of the year. The 5-year annual and 5-year seasonal averaged wind roses for West Palm Beach for the period 1982 to 1986 are utilized to depict the ICL onsite wind patterns. Figure 2.3.7-2 shows the 5-year annual average wind rose for West Palm Beach, and Figures 2.3.7-3 through 2.3.7-6 show the 5-year seasonal averaged wind roses for West Palm Beach for the period 1982-1986.

The wind pattern at the ICL site is expected to be similar to that measured for West Palm Beach. However, in the warm summer season, the expected differences between the wind patterns for the proposed ICL facility and for West Palm Beach are mainly in the addition of westerly winds from Lake Okeechobee for the ICL site, and therefore, not quite as high a percentage of easterly winds is expected as is displayed by the West Palm Beach wind data. The 1-year (October 1988 to September 1989) meteorological data collected at the nearby Martin site confirms this prediction. Figure 2.3.7-7 shows the annual average wind rose for the Martin site which is approximately 2 miles west of the ICL site.

Stability

Atmospheric stability in conjunction with general wind patterns and mixing heights determines the potential of the atmosphere to disperse airborne pollutants. Atmospheric stability conditions are typically categorized as unstable, neutral, or stable. An unstable atmosphere is one in which rapid diffusion takes place in both the horizontal and vertical directions. In terms of temperature change with height,

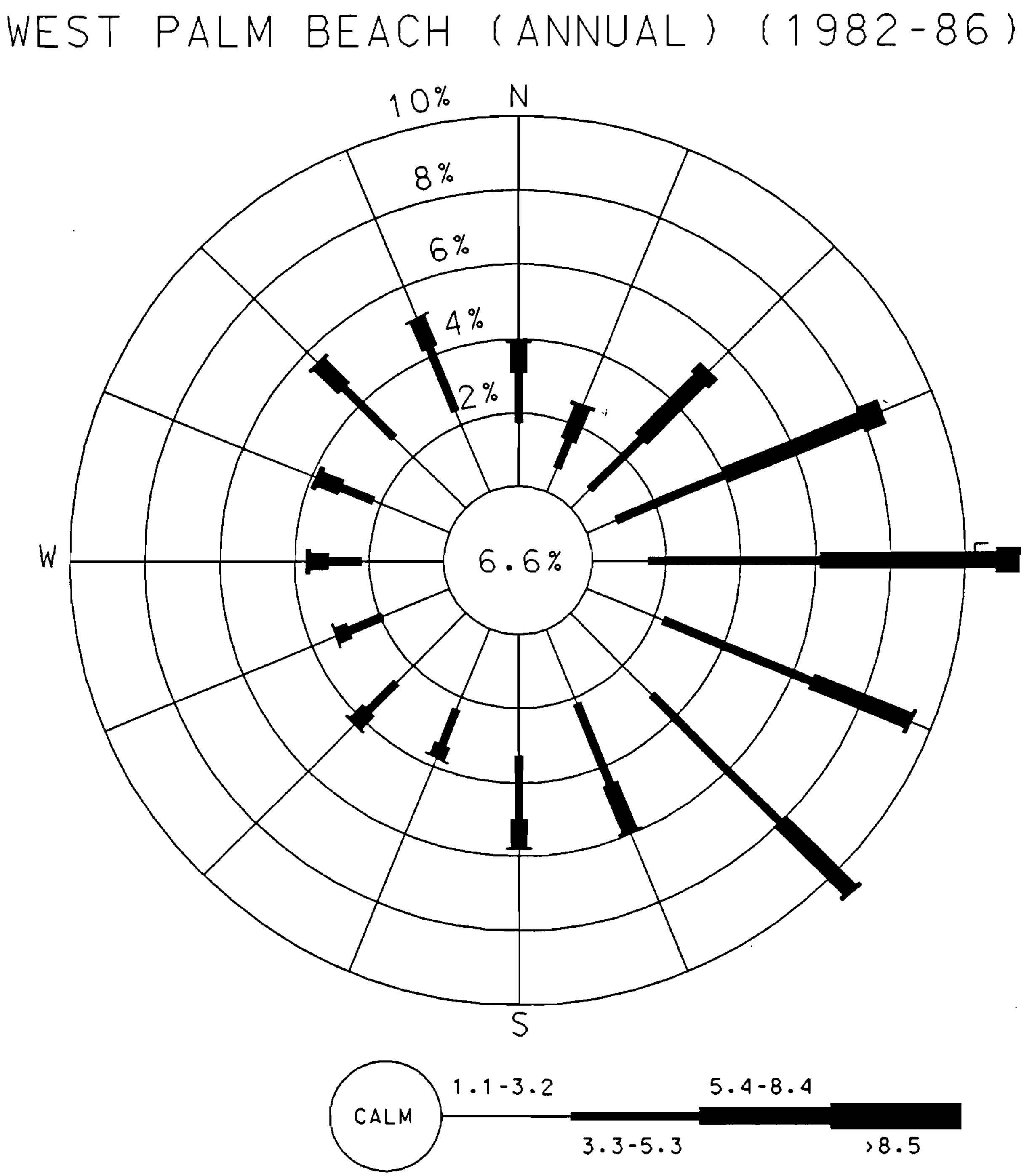

Figure 2.3.7-2.

WINDROSE WEST PALM BEACH—ANNUAL

Source: Bechtel, 1990

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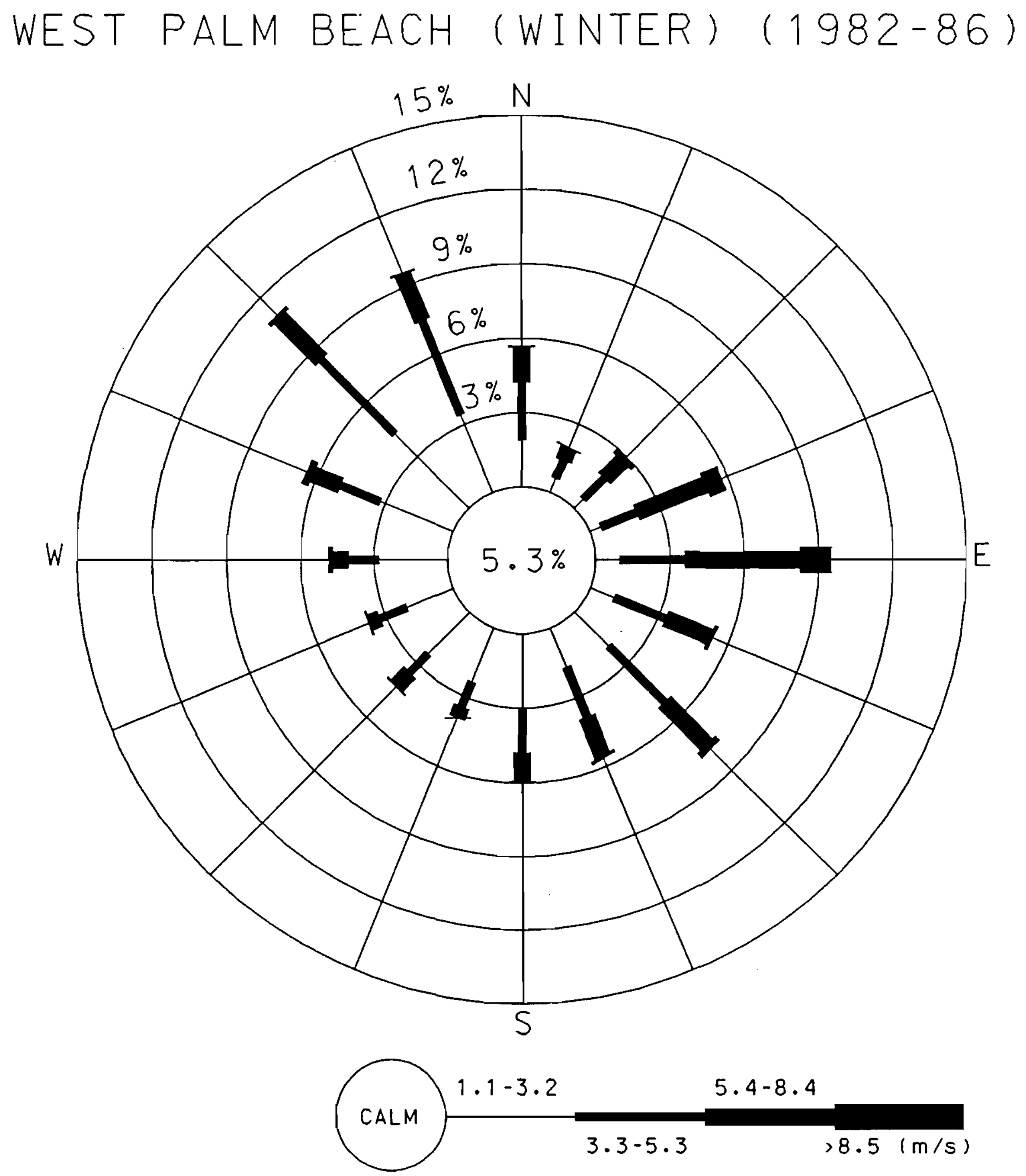

Figure 2.3.7-3.

WINDROSE WEST PALM BEACH—WINTER

Source: Bechtel, 1990

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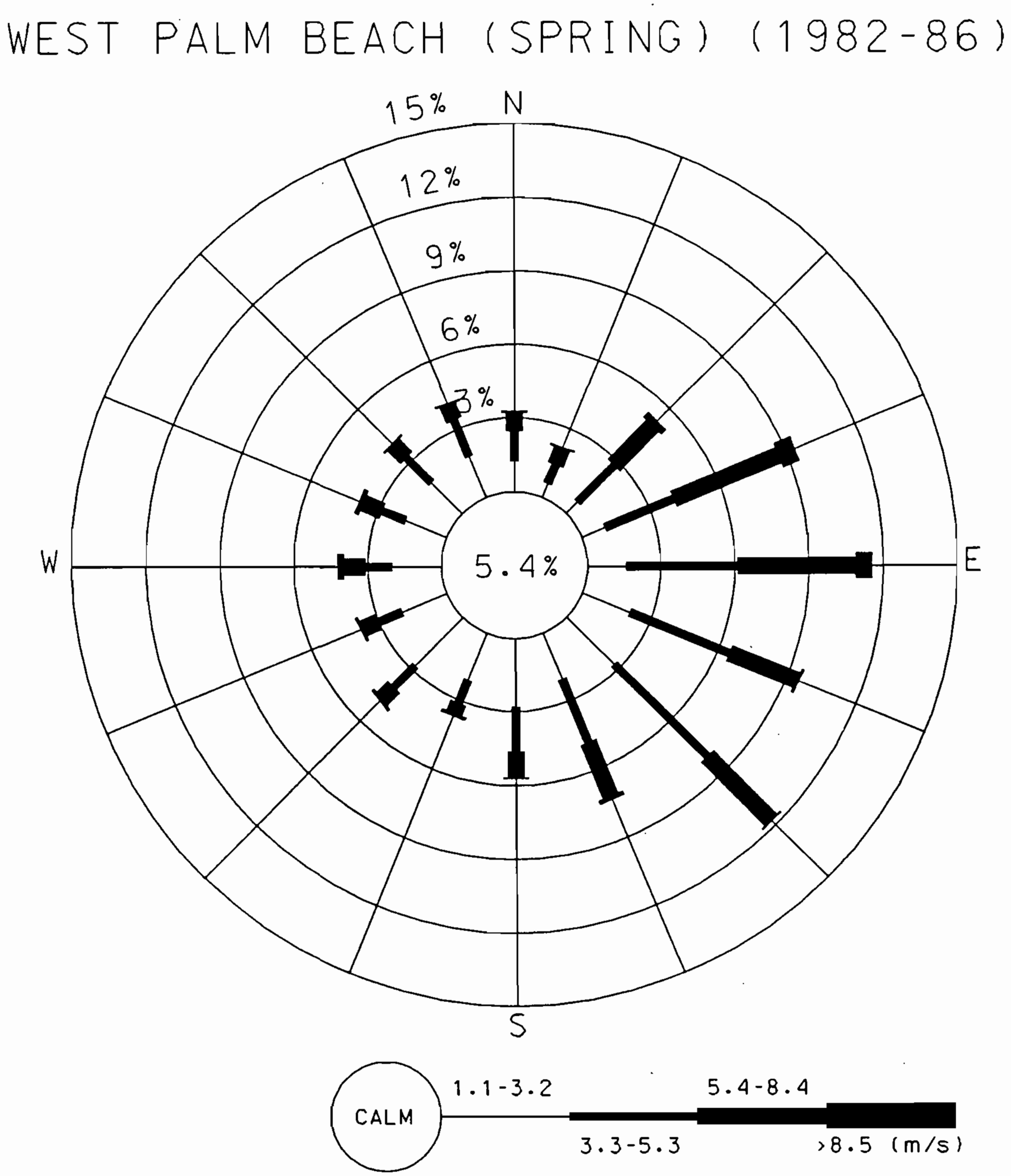

Figure 2.3.7-4.

WINDROSE WEST PALM BEACH—SPRING (1982-86)

Source: Bechtel, 1990

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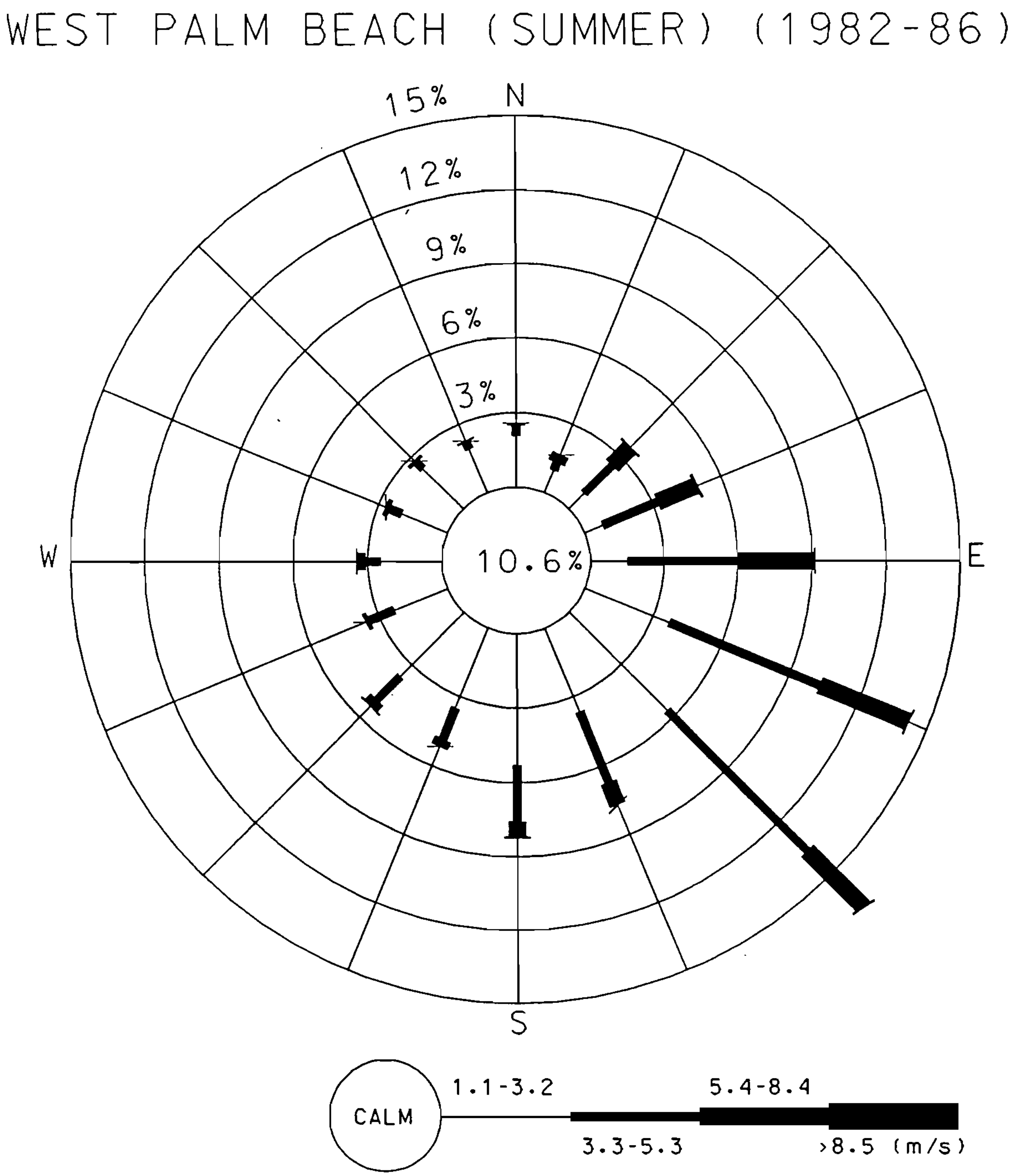

Figure 2.3.7-5.

WINDROSE WEST PALM BEACH—SUMMER

Source: Bechtel, 1990

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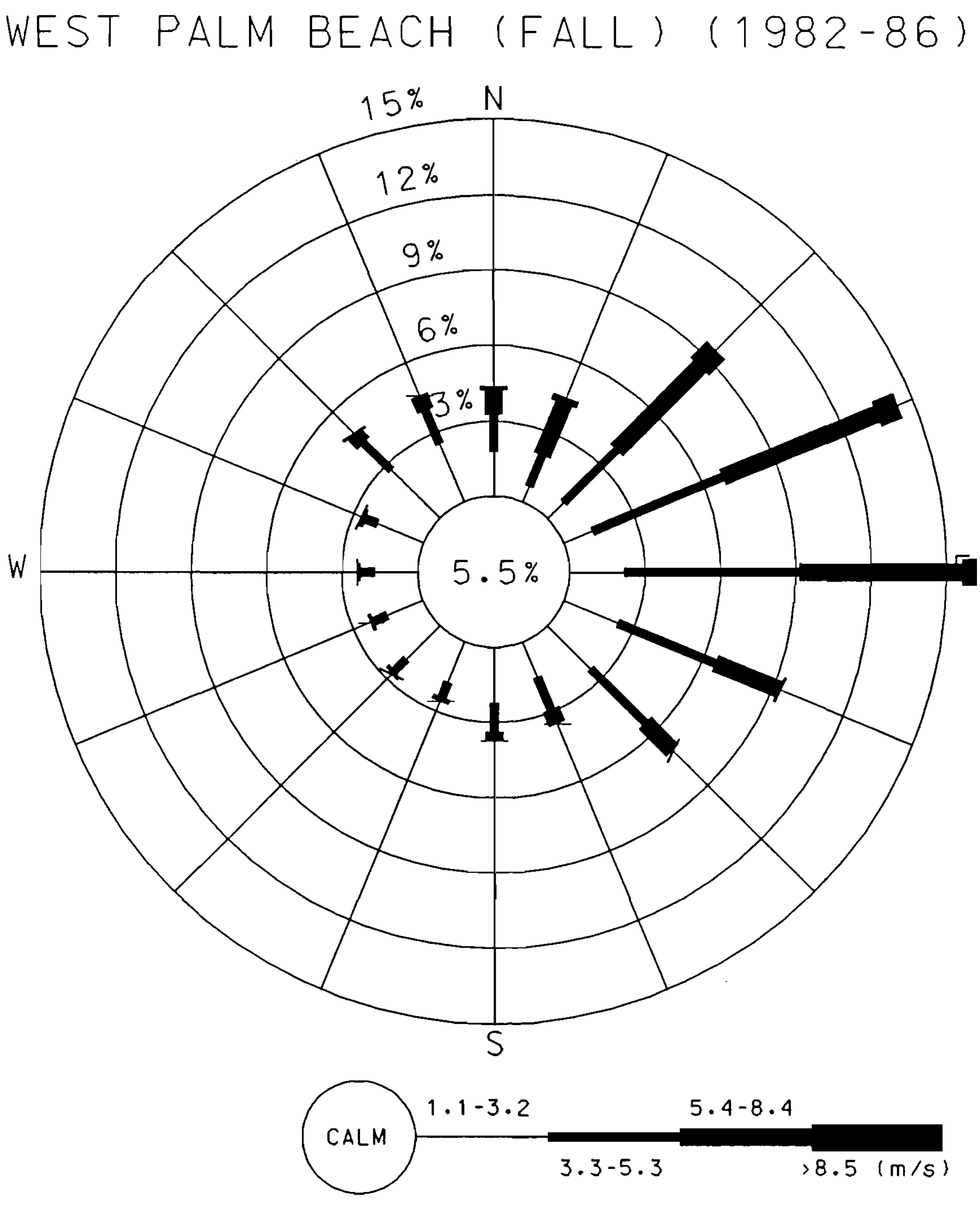

Figure 2.3.7-6.

WINDROSE WEST PALM BEACH—FALL

Source: Bechtel, 1990

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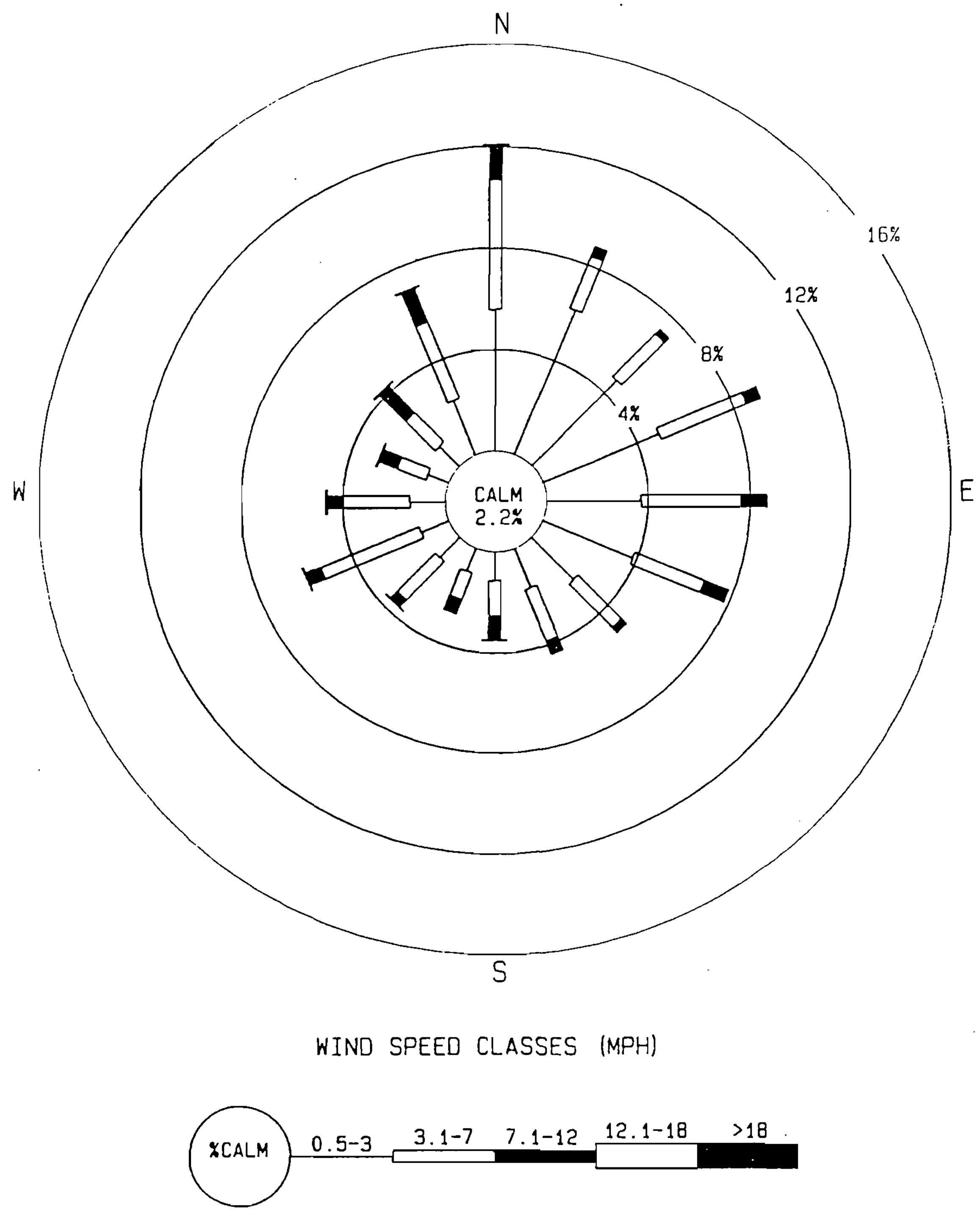

Figure 2.3.7-7.

WINDROSE — MARTIN SITE OCT-1988 THROUGH SEPT-1989

Source: Bechtel, 1990

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an unstable atmosphere is characterized by a sharp decrease in temperature with height. Neutral conditions, which are characterized by moderate decreases of temperature with height, are common in the atmosphere and are associated with moderate diffusion rates. A stable atmosphere is characterized by only slight decreases, or even increases in temperature with height and greatly reduced diffusion rates in comparison with unstable or neutral atmospheric conditions.

The stability classifications presented in this section are based on the Turner (1970) classification scheme, which assigns a stability on the basis of surface wind speed, cloud cover, and solar insolation. Table 2.3.7-4 contains a summary of the joint frequency of occurrence of wind speed and wind direction categories classified for all stability classes based on meteorological data for West Palm Beach for the period 1982 to 1986 (this is referred to as STAR program data). These data indicate a predominance of neutral to stable atmospheric stability conditions.

Mixing Height

An important parameter which describes the regional dispersion capability of the atmosphere is mixing height. Mixing height is the vertical extent of the surface layer within which relatively vigorous mixing of pollutants takes place. Holzworth (1972) has compiled statistical summaries for mixing height at various locations throughout the United States based on twice daily radiosonde measurements. The abundance of moisture from the ocean around southern Florida creates high humidities and low-level cloudiness that absorb heat and generally prevent the mixing height from subsiding below 500 m. Because mixing heights are dependent upon surface temperatures, afternoon levels reach above 1,400 m under intense solar isolation. Lesser diurnal mixing height fluctuations occur at coastal stations in Florida, as compared to inland locations, due primarily to moderating effects of the ocean.

Because of the proximity of the ICL site to Lake Okeechobee, mixing heights are expected to be moderated somewhat by onshore and offshore lake breezes during the warmer months. In the morning, generally high relative humidities and/or low-level cloudiness will inhibit the formation of intense radiation inversions, so that

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 1 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class A
Surface Station No. 12844 Time Period: ANNUAL

Direction	Speed (m/s) 1.5	2.5	4.5	7.0	9.5	>11	Total
N	.0023	.0160	.0000	.0000	.0000	.0000	.0183
NNE	.0023	.0091	.0000	.0000	.0000	.0000	.0114
NE	.0023	.0114	.0000	.0000	.0000	.0000	.0137
ENE	.0000	.0114	.0000	.0000	.0000	.0000	.0114
E	.0000	.0251	.0000	.0000	.0000	.0000	.0251
ESE	.0068	.0137	.0000	.0000	.0000	.0000	.0205
SE	.0091	.0205	.0000	.0000	.0000	.0000	.0297
SSE	.0046	.0114	.0000	.0000	.0000	.0000	.0160
S	.0046	.0205	.0000	.0000	.0000	.0000	.0251
SSW	.0046	.0205	.0000	.0000	.0000	.0000	.0251
SW	.0114	.0205	.0000	.0000	.0000	.0000	.0319
WSW	.0023	.0114	.0000	.0000	.0000	.0000	.0137
W	.0023	.0228	.0000	.0000	.0000	.0000	.0251
WNW	.0000	.0023	.0000	.0000	.0000	.0000	.0023
NW	.0000	.0114	.0000	.0000	.0000	.0000	.0114
NNW	.0023	.0183	.0000	.0000	.0000	.0000	.0205
Total	.0548	.2464	.0000	.0000	.0000	.0000	

Calms = 15. hours

Total Class Obs = .30%

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 2 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class B
Surface Station No. 12844 Time Period: ANNUAL

	Speed (m/s)						
Direction	1.5	2.5	4.5	7.0	9.5	>11	Total
N	.0228	.1141	.0593	.0000	.0000	.0000	.1962
NNE	.0091	.0776	.0639	.0000	.0000	.0000	.1506
NE	.0137	.0730	.1871	.0023	.0000	.0000	.2761
ENE	.0183	.0685	.1666	.0023	.0000	.0000	.2556
E	.0068	.1255	.3081	.0023	.0000	.0000	.4427
ESE	.0114	.1438	.3354	.0023	.0000	.0000	.4929
SE	.0228	.1346	.4290	.0046	.0000	.0000	.5910
SSE	.0137	.0867	.1438	.0023	.0000	.0000	.2464
S	.0342	.0844	.0730	.0000	.0000	.0000	.1917
SSW	.0160	.0844	.0753	.0000	.0000	.0000	.1757
SW	.0160	.1187	.0753	.0000	.0000	.0000	.2099
WSW	.0274	.0707	.1141	.0000	.0000	.0000	.2122
W	.0137	.0776	.0913	.0000	.0000	.0000	.1825
WNW	.0205	.0981	.0616	.0000	.0000	.0000	.1803
NW	.0205	.0867	.0639	.0000	.0000	.0000	.1711
NNW	.0114	.0936	.0776	.0000	.0000	.0000	.1825
Total	.2784	1.5380	2.3252	.0160	.0000	.0000	

Calms = 35. hours

Total Class Obs = 4.16%

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 3 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class C
Surface Station No. 12844 Time Period: ANNUAL

Direction	Speed (m/s) 1.5	2.5	4.5	7.0	9.5	>11	Total
N	.0388	.1506	.3400	.0867	.0023	.0023	.6207
NNE	.0137	.0593	.2350	.1095	.0023	.0000	.4199
NE	.0228	.0685	.5796	.3103	.0205	.0000	1.0017
ENE	.0114	.0958	.6914	.4404	.0319	.0023	1.2733
E	.0091	.1209	1.0382	.6663	.0183	.0000	1.8529
ESE	.0183	.1050	1.2254	.7211	.0068	.0000	2.0765
SE	.0251	.1460	1.5152	.6458	.0114	.0000	2.3435
SSE	.0228	.1187	.6366	.2464	.0114	.0000	1.0360
S	.0730	.2191	.4153	.1118	.0068	.0000	.8260
SSW	.0502	.1004	.3126	.0776	.0000	.0000	.5408
SW	.0388	.1483	.2989	.0936	.0046	.0000	.5842
WSW	.0205	.0958	.2487	.0753	.0068	.0000	.4472
W	.0228	.0936	.2099	.0844	.0114	.0068	.4290
WNW	.0297	.0776	.2556	.0821	.0000	.0000	.4450
NW	.0297	.1164	.3537	.0730	.0091	.0000	.5819
NNW	.0365	.1346	.3423	.0753	.0000	.0000	.5887
Total	.4632	1.8506	8.6984	3.8997	.1438	.0114	

Calms = 99. hours Total Class Obs = 15.07%

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES

Frequency (%) of Wind Speed & Direction for Stability Class D
Surface Station No. 12844 Time Period: ANNUAL

	Speed (m/s)						
Direction	1.5	2.5	4.5	7.0	9.5	>11	Total
N	.0548	.3674	.6846	.7142	.0662	.0023	1.8894
NNE	.0388	.1643	.3491	.8397	.0936	.0091	1.4946
NE	.0137	.1506	.6777	1.8985	.3126	.0251	3.0782
ENE	.0114	.1438	1.1615	3.4798	.5066	.0707	5.3738
E	.0274	.2168	1.7114	4.0206	.5454	.0799	6.6014
ESE	.0183	.2738	1.4718	2.0765	.0936	.0000	3.9339
SE	.0297	.4472	1.7251	1.9784	.0913	.0160	4.2876
SSE	.0365	.3217	.9675	1.1409	.0730	.0023	2.5420
S	.0388	.4267	.7918	.6731	.0479	.0000	1.9784
SSW	.0434	.2966	.4404	.2784	.0297	.0023	1.0907
SW	.0548	.3423	.4587	.3834	.0479	.0046	1.2915
WSW	.0411	.2373	.3628	.2715	.0342	.0091	.9561
W	.0411	.2350	.2921	.4039	.0844	.0228	1.0793
WNW	.0342	.2761	.3309	.5089	.1027	.0319	1.2847
NW	.0821	.3605	.7005	.8466	.0639	.0046	2.0582
NNW	.0479	.3377	.8329	.7667	.0274	.0046	2.0172
Total	.6138	4.5979	12.9587	20.2811	2.2202	.2852	

Calms = 161. hours   Total Class Obs = 40.96%

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 5 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class E
Surface Station No. 12844 Time Period: ANNUAL

	Speed (m/s)						
Direction	1.5	2.5	4.5	7.0	9.5	≥11	Total
N	.0525	.3286	.2510	.0023	.0000	.0000	.6344
NNE	.0251	.1232	.1689	.0000	.0000	.0000	.3172
NE	.0114	.1415	.5203	.0023	.0000	.0000	.6754
ENE	.0091	.1574	1.0976	.0137	.0000	.0000	1.2778
E	.0183	.3286	1.5243	.0160	.0000	.0000	1.8871
ESE	.0342	.4632	1.2345	.0114	.0000	.0000	1.7433
SE	.0844	.6982	1.1341	.0137	.0000	.0000	1.9304
SSE	.0434	.4678	.5568	.0046	.0000	.0000	1.0725
S	.0799	.7142	.4381	.0000	.0000	.0000	1.2322
SSW	.0616	.4427	.1734	.0023	.0000	.0000	.6800
SW	.0730	.4472	.2350	.0023	.0000	.0000	.7576
WSW	.0593	.3286	.2282	.0000	.0023	.0000	.6184
W	.0548	.3834	.2829	.0023	.0000	.0000	.7233
WNW	.0776	.4199	.2875	.0046	.0000	.0000	.7895
NW	.0685	.4723	.7553	.0000	.0000	.0000	1.2961
NNW	.0753	.5317	.5636	.0023	.0023	.0000	1.1752
Total	.8283	6.4485	9.4514	.0776	.0046	.0000	

Calms = 288. hours Total Class Obs = 16.81%

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 6 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class F
Surface Station No. 12844 Time Period: ANNUAL

Direction	Speed (m/s) 1.5	2.5	4.5	7.0	9.5	>11	Total
N	.2213	.3834	.0091	.0000	.0000	.0000	.6138
NNE	.0844	.1232	.0000	.0000	.0000	.0000	.2076
NE	.0502	.1757	.0023	.0000	.0000	.0000	.2282
ENE	.0593	.2829	.0068	.0023	.0000	.0000	.3514
E	.1050	.5317	.0068	.0023	.0000	.0000	.6458
ESE	.1666	.9949	.0137	.0000	.0000	.0000	1.1752
SE	.3012	1.2162	.0137	.0000	.0000	.0000	1.5311
SSE	.3788	.6800	.0091	.0000	.0000	.0000	1.0679
S	.4199	1.1318	.0000	.0000	.0000	.0000	1.5517
SSW	.4381	.7986	.0068	.0000	.0000	.0000	1.2436
SW	.4450	.9264	.0023	.0000	.0000	.0000	1.3737
WSW	.3719	.6777	.0205	.0000	.0000	.0000	1.0702
W	.4336	.8443	.0000	.0000	.0000	.0000	1.2778
WNW	.3742	.8123	.0023	.0000	.0000	.0000	1.1888
NW	.5043	.9858	.0068	.0000	.0000	.0000	1.4969
NNW	.3537	.7576	.0114	.0000	.0000	.0000	1.1227
Total	4.7075	11.3226	.1118	.0046	.0000	.0000	

Calms = 2277. hours Total Class Obs = 16.15%

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES

Frequency (%) of Wind Speed & Direction for Stability Classes
Surface Station No. 12844 Time Period: ANNUAL

	Speed (m/s)						
Direction	1.5	2.5	4.5	7.0	9.5	>11	Total
N	.3925	1.3600	1.3440	.8032	.0685	.0046	3.9727
NNE	.1734	.5568	.8169	.9493	.0958	.0091	2.6013
NE	.1141	.6207	1.9670	2.2134	.3332	.0251	5.2734
ENE	.1095	.7599	3.1239	3.9385	.5385	.0730	8.5433
E	.1666	1.3486	4.5888	4.7075	.5636	.0799	11.4549
ESE	.2556	1.9943	4.2808	2.8112	.1004	.0000	9.4423
SE	.4723	2.6629	4.8170	2.6424	.1027	.0160	10.7133
SSE	.4997	1.6863	2.3138	1.3942	.0844	.0023	5.9807
S	.6503	2.5968	1.7182	.7850	.0548	.0000	5.8050
SSW	.6138	1.7433	1.0086	.3583	.0297	.0023	3.7559
SW	.6389	2.0035	1.0702	.4792	.0525	.0046	4.2488
WSW	.5225	1.4216	.9744	.3468	.0434	.0091	3.3178
W	.5682	1.6566	.8762	.4906	.0958	.0297	3.7171
WNW	.5362	1.6863	.9378	.5956	.1027	.0319	3.8906
NW	.7051	2.0331	1.8802	.9196	.0730	.0046	5.6156
NNW	.5271	1.8734	1.8278	.8443	.0297	.0046	5.1068
Total	6.9460	26.0040	33.5455	24.2789	2.3686	.2966	

Calms = 2875. hours
Missed Obs = 0 hours Total Obs = 43824. hours
Total No. of Days Counted = 1826

Notes:
1. Total observation includes calms.
2. The total days counted are for the entire data set.
3. NCDC Wind speed ranges (m/s): 1.5 (0-1.8); 2.5 (1.8-3.3); 4.5 (3.3-5.4); 7.0 (5.4-8.5); 9.5 (8.5-11)
4. Calm is defined as wind speed at 1 m/s or less (for dispersion modeling purpose only).

Source: Bechtel 1990

the layer of air closest to the ground is mixed to several hundred meters. Table 2.3.7-5 presents the seasonally and annually averaged mixing heights for West Palm Beach area.

2.3.7.2 Ambient Air Quality

Preconstruction Monitoring Exemption

Based on the preliminary design, the facility will be a major source of sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter and carbon monoxide (CO) (i.e., has a potential to emit more than 100 tons/year of each of these pollutants). Table 2.3.7-6 gives the emission estimates of the facility. The emissions are based on conservative estimates of maximum exhaust concentrations at the stack.

A preconstruction onsite meteorological/air quality monitoring program is required to satisfy Section 2.3.7 of the DER SCA Instruction Guide and is usually necessary as part of the PSD permit approval process. Representative air quality monitoring data are needed to determine background levels for those pollutants with estimated significant impacts.

Based on the emission estimates and the stack parameters as listed in Table 2.3.7-6, the predicted peak pollutant concentrations reported in Table 2.3.7-7 are well below their corresponding PSD increment limits and NAAQS. Therefore, it is anticipated that the operation of the proposed facility will not exceed the allowable PSD increments for the area, and it also poses no threat to the NAAQS.

A comparison of these peak pollutant concentrations to the de minimis pollutant levels for exemption from monitoring is also given in Table 2.3.7-7. As shown from the table, maximum pollutant concentrations resulting from the operation of the proposed facility are below their corresponding de minimis levels. Therefore, preconstruction monitoring of these pollutants is not required under the regulations. This finding was presented in the Plan of Study for the Indiantown Site Certification Application to the Florida Department of Environmental Regulation (FDER). Subsequent discussions with the FDER have established that the existing

Table 2.3.7-5
MEAN SEASONAL AND ANNUAL MIXING HEIGHTS,
WEST PALM BEACH, FLORIDA

Season	Morning	Afternoon
Winter	700	1130
Spring	840	1380
Summer	970	1400
Autumn	880	1280
Annual	850	1250

Source: Holzworth, G.C., Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Continguous United States. Environmental Protection Agency, Office of Air Programs. Research Triangle Park, N. C. January 1972.

Model Input

See table 3.4.4 — 582 lbs/HR Sulfur × .126 (CONVERSION) = 73.3 g/sec

Stack Diameter = 16' × .3048 (CONVERSION) = 4.88 M

Stack Temp = 358°F — $\frac{358°F - 32}{1.8}$ = 181°C + 273 = 454°K

Exit Velocity = 100 FPS × .3048 = 30.48 MPS

Stack Height = 495 × .3048 = 150.9 M

Table 2.3.7-6
PRELIMINARY PLANT STACK PARAMETERS AND EMISSIONS FOR MONITORING EXEMPTION MODELING ONLY (100% LOAD, COAL-FIRED)

Stack Gas Temperature	140 °F
Stack Gas Flow Rate	1,206,370 ACFM
Stack Height	495 FT

Pollutant	Basis lb/MMBtu	Emissions lb/hr	Emissions tons/yr
SO_2	0.17	582	2549
NO_x	0.17	582	2549
Particulate	0.018	61.6	270
CO	0.11	377	1648
VOC	0.0036	12.3	54

For the purpose of the air quality modeling analysis, particulate emissions of TSP and PM-10 from the plant stack, shown here, are assumed to be the same.

Source: Bechtel, 1990

Pg 2.3.1-1 use 3480 tons/Day of 11800 BTU/LB Coal at full load and 80 °F 2.2% Sulfur 1.16% Nitrogen 12% ASH

% Sulfur × LBS/HR FUEL = LBS/HR Sulfur every LB Sulfur yields 2 lbs SO_2 so double sulfur to get SO_2

$\frac{3480 \text{ T/D}}{24 \text{ HRS/DAY}} \times 2000 \text{ LBS/TON}$ = LBS/HR FUEL = 290000 LBS/HR × .022 = 6380 LBS/HR SULFUR w/o Controls

.17 lbs/MMBTU (11800 BTU/LB × 290000 LBS/HR) = .17 (3.4×10^9 BTU/HR) = 578 LBS/HR Sulfur

= 2532 TONS/HR

Table 2.3.7-7
MODEL PREDICTED PEAK CONCENTRATIONS

Pollutant	Averaging Time	Max. Conc. from the Facility ($\mu g/m_3$)	Monitoring De Minimis Level ($\mu g/m_3$)
CO	8-hour	50.8	575
NO_2	Annual	4.42	14
PM-10	24-hour	0.92	10
SO_2	24-hour	11.6	13
Pb	24-hour	--	0.1

Source: Bechtel, 1990

monitoring data from FPL's Martin site is representative of the proposed ICL site area. Based on this information and the discretion of the FDER (FDER letter, July 23, 1990), the preconstruction ambient air quality monitoring requirement for the proposed ICL is exempted. Detailed discussion of the monitoring exception demonstration can be found in Sections 3.4, 5.2, and 5.3 of the PSD application.

Existing Representative Air Quality Monitoring Data

Per PSD Ambient Monitoring Guidelines, a proposed source, which will be in an area of multi-source emissions and basically flat terrain, may propose use of existing data at nearby monitoring sites to determine its background pollutant concentrations. The existing nearby monitors should be within 10 km of the points of proposed emissions. Air quality data (SO_2, NO_2, CO, TSP, and PM-10) have been collected by FPL and Florida DER in the vicinity of the ICL site.

Since the terrain between the proposed project site and the nearby existing monitors is basically flat, these data will be used to determine the background pollutant concentrations for the proposed site area. The following paragraphs briefly describe the available data.

Historical FPL Martin Site Air Quality Monitoring Network

Background sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and total suspended particulates (TSP) have been collected by FPL at four sites (Nos. 1, 2, 3, and 4) in the vicinity of the Martin Plant (approximately 3 miles northwest of the ICL site) on a once-every-sixth-day basis since October 1973. These data were supplemented in 1979 and 1980 with two sites (Nos. 5 and 6) monitoring SO_2 and NO_2 with continuous analyzers and a seventh site (No. 7) monitoring TSP. Only about 1 year of continuous SO_2 and NO_2 monitoring data exists at Site Nos. 5 and 6. The other once-every-sixth-day monitoring sites continue to operate with bubbler type samplers for SO_2 and NO_2 and standard high volume samplers for particulate matter. Figure 2.3.7-8 shows the location of the existing FPL air quality monitoring sites.

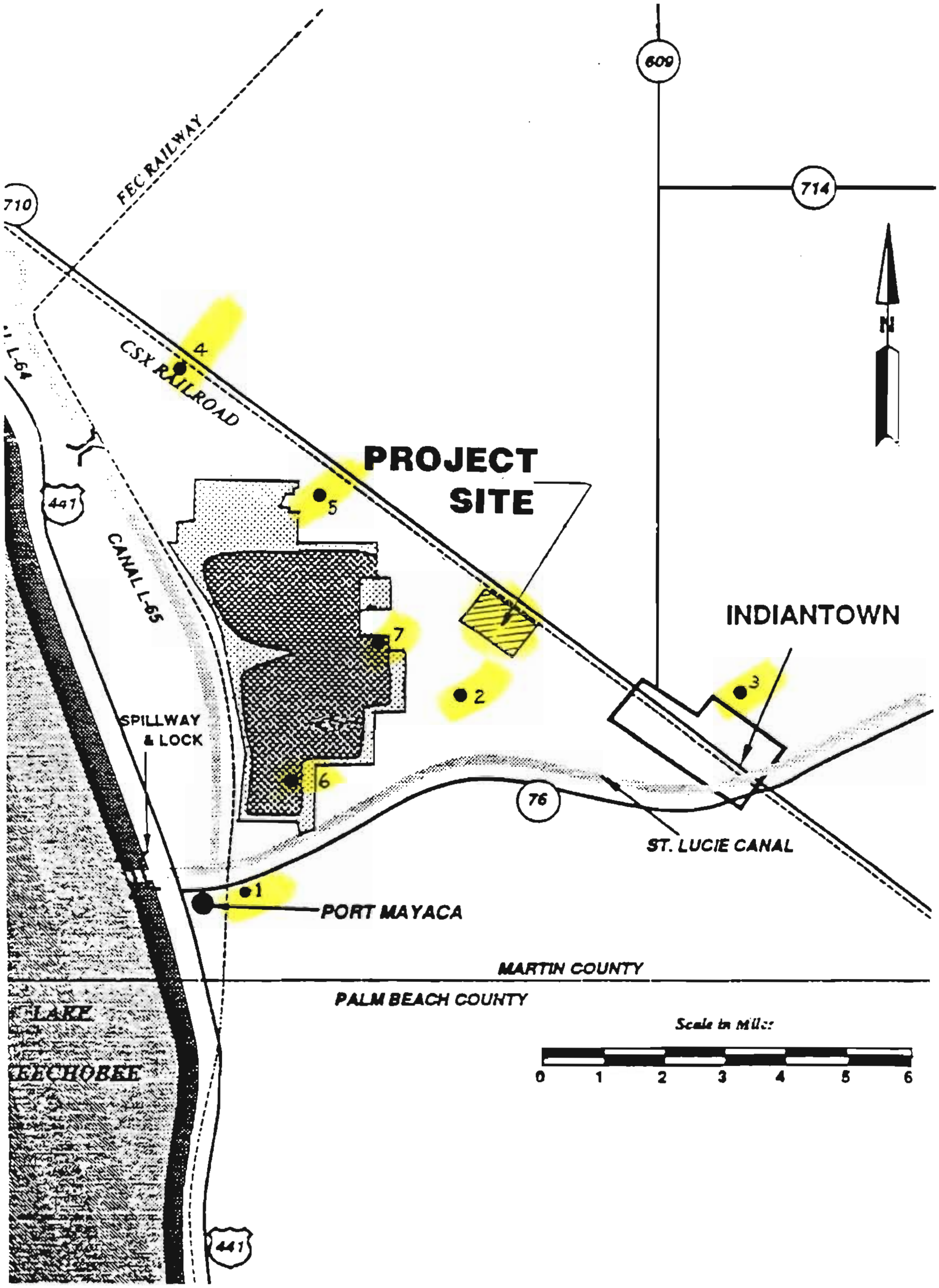

Figure 2.3.7-8.

FPL AIR QUALITY MONITORING SITES

Source: FPL, 1989

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Florida DER Air Quality Monitoring Network

The area within a 50 km radius of the proposed ICL site (e.g., Martin, Palm Beach, Hendry, Glades, Highlands, Okeechobee, and St. Lucie Counties) has FDER ambient air quality monitoring coverage for particulate matter only. The exception is Palm Beach County where ambient air quality data are also collected for CO, ozone (O_3), NO_2 and SO_2. The available FDER air quality monitoring sites located within this area are listed in Table 2.3.7-8 and shown in Figure 2.3.7-9.

Martin Site Coal Gasification/Combined Cycle (CG/CC) Project Monitoring Data

An onsite PSD air quality monitoring program has been conducted by FPL for the Martin CG/CC project. The monitoring program began in mid-September 1988 and continued for 1 year. The monitoring network consists of two new monitoring sites (see Figure 2.3.7-10) at which SO_2, NO_2, and O_3 were continuously monitored. Fine particulate matter (PM-10) were collected on a once-every-sixth-day basis at the two monitoring sites.

Background Air Quality Level Determination

A summary of the FPL existing ambient air quality monitoring data collected for the Martin site for the period from 1973 through 1988 is presented in Table 2.3.7-9. The highest recorded SO_2 concentration for all applicable averaging period from these FPL stations does not exceed 24 percent of the more stringent Florida State standards. The highest recorded annual average NO_2 concentration is only 16 percent of the applicable standard. The highest TSP measurement (200 $\mu g/M^3$) is a bias value due to an isolated incident which was uncharacteristic of the overall data record for the Martin site area. In general, the existing air quality monitoring data for the Martin site area indicate good background air quality. However, the existing data for SO_2 and NO_2 are based primarily on "bubbler" type samplers and the 1 year of continuous analyzer monitoring data were collected in 1980. They are useful only for providing a general idea of the existing air quality levels in the vicinity of the Martin site.

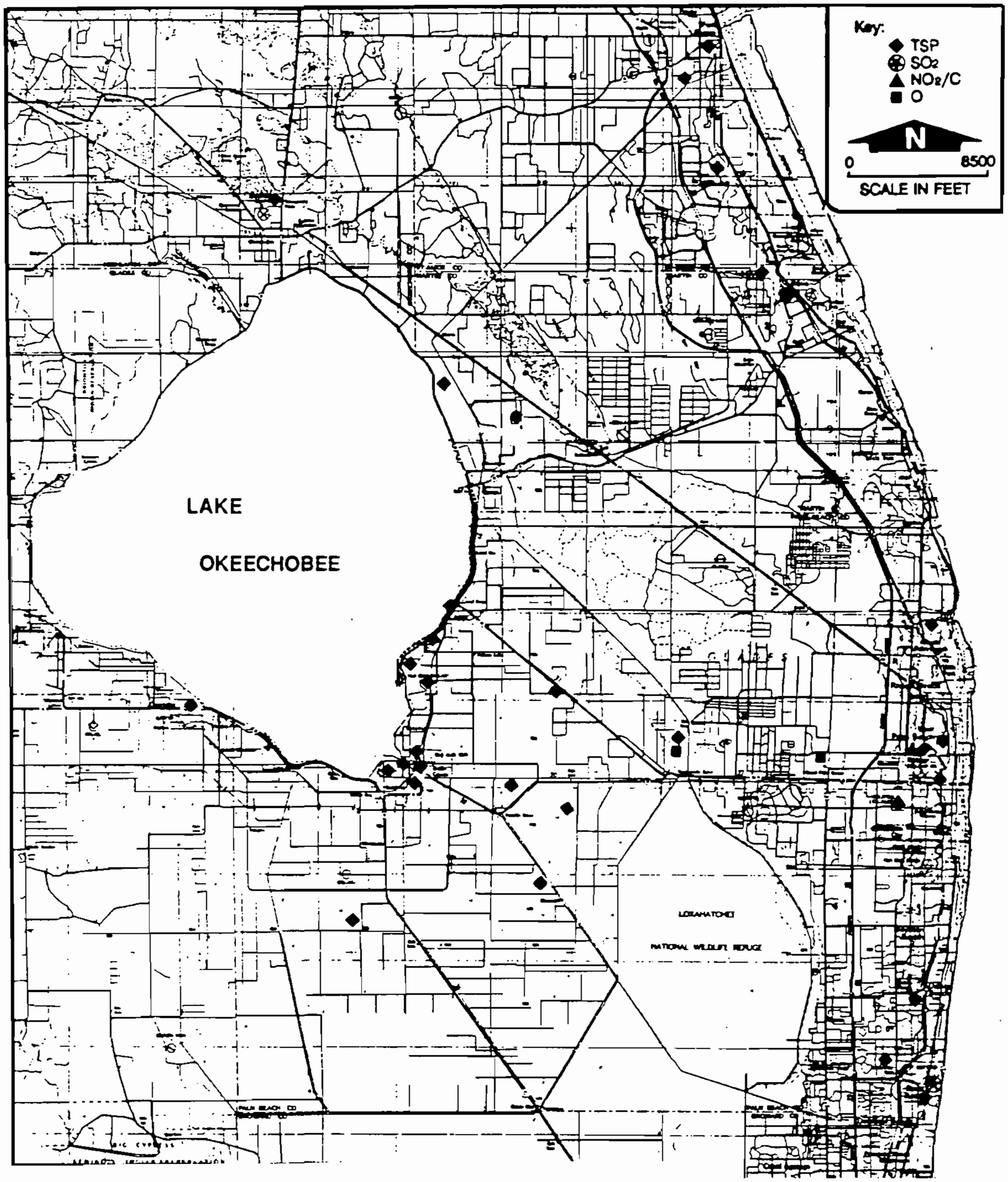

Figure 2.3.7-9.

FDER AIR QUALITY MONITORING SITES WITHIN THE ICL SITE REGION

Source: FPL, 1989

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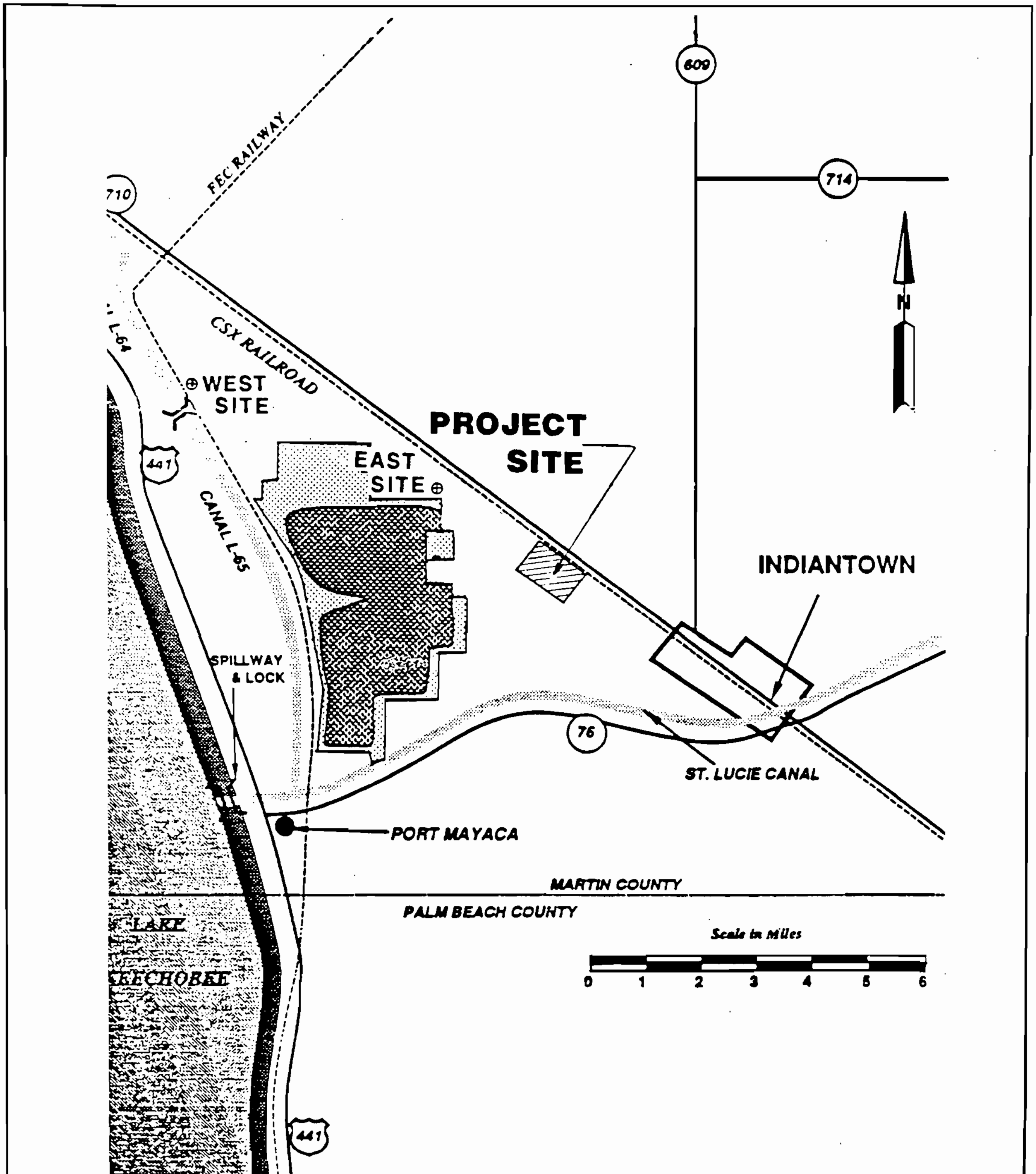

Figure 2.3.7-10
MARTIN SITE PSD MONITORING LOCATION

Source: FPL, 1989

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Table 2.3.7-8
FDER AIR QUALITY MONITORING SITES USED FOR THE ICL SITE VICINITY

County	Site I.D.	TSP	SO_2	NO_2	CO	O_3
Palm Beach	017 J02		x			
	003 G02		x			
	004 G02		x			
	004 G01	x		x	x	
	006 G03					x
	007 G01					x
	004 J02	x				
	005 J02	x				
	006 J02	x				
	006 J09	x				
	007 G01	x				
	001 G01	x				
	002 G01	x				
	003 G01	x				
	001 G01	x				
	002 J03	x				
	005 G01	x				
	006 G01	x				
	008 J02	x				
	009 J02	x				
	010 J02	x				
	011 J02	x				
	012 J02	x				
	013 J02	x				
	014 J02	x				
	015 J02	x				
	001 G01	x				
	003 G01	x				
	002 J02	x				
Martin	004 F02	x				
	002 F01	x				
	002 G01	x				
	002 G09	x				
	003 G01	x				
Hendry	002 F01	x				
	002 J02	x				
Highlands	001 F03	x				
Okeechobee	002 F03	x				
St. Lucie	004 F01	x				
	004 F09	x				
	009 F02	x				
	001 F01	x				
	001 F09	x				

Source: FDER, 1987, 1988, 1989.

Table 2.3.7-9
FPL HISTORICAL AIR QUALITY MONITORING DATA FOR THE MARTIN SITE VICINITY (1973-1988)

Pollutant	Averaging Period	Station Number	Concen.(a) ($\mu g/M^3$)	NAAQS ($\mu g/M^3$)	FAAQS ($\mu g/M^3$)
SO_2	3-hr	5	105	1300	1300
	24-hr	5	61	365	260
	Annual	6	8	80	60
NO_2	24-hr	1	158	-	-
	Annual	5	16	100	100
TSP	24-hr	3	200(c)	150(b)	150
	Annual	-	N/A	60(b)	60

(a) Highest concentration.
(b) Federal secondary standard.
(c) This exceedance occurred in 1986 and was found to be an isolated incident uncharacteristic of the overall TSP monitoring data recorded for the Martin site.

Source: FPL Martin CG/CC PSD Application, 1989.

The FDER air quality monitoring data for the ICL site vicinity for 1988 are summarized in Table 2.3.7-10. The highest recorded CO concentration is equivalent to 55.6 percent of the 8-hour averaging federal and state standards, while the annual average NO_2 recorded value is 25 percent of all the applicable standards. The highest SO_2 measurements for each of the required averaging periods are lower than those recorded by the FPL existing monitors. The highest 24-hour TSP concentration measured at the FDER monitor at Martin County is 103 $\mu g/m^3$ which is 69 percent of the state standard.

One year (October 1988 to September 1989) of PSD air quality monitoring data was collected for the Martin CG/CC project. Results of the data are summarized in Table 2.3.7-11. As clearly shown in the table, data measured by the Martin CG/CC PSD program are in good agreement with those measured in the FPL existing monitoring network and the FDER monitors. The data reported in Table 2.3.7-11 are most current and meet the PSD monitoring data recovery rate and quality assurance requirements.

As shown in Figure 2.3.7-10, the two Martin PSD monitoring sites are approximately 4.2 km (2.5 miles) and 10.2 km (6 miles) west northwest of the proposed ICL site, respectively. Due to the proximity of these PSD monitoring stations to the proposed ICL site and the currentness of the data, the data collected by the Martin CG/CC project are considered to be the most representative data for the ICL site and have been used to determine the background air quality levels for the SO_2, NO_2, and PM-10 pollutants. Background air quality levels for the other criteria pollutants (CO, TSP, and $O_{3)}$ were determined using the existing FDER monitoring data. Background concentration estimates based on data collected at the Palm Beach FDER station, Palm Beach (an urban setting) are considered to be conservative for the ICL site, which is in a rural setting with less area pollution sources. The background air quality levels determined for the proposed ICL site and their corresponding federal/state standards are reported in Table 2.3.7-12. As clearly indicated by the table, the air in the ICL site vicinity is relatively clean, with air pollutant levels well below the applicable ambient air quality standards.

Table 2.3.7-10
SUMMARY OF FDER AIR QUALITY DATA FOR THE ICL SITE VICINITY

Pollutant	County	Averaging Period	Maximum Concentration 1987	1988	1989	NAAQS	FAAQS
SO2(a)	Palm Beach	3-hr	52	58	68	1300	1300
		24-hr	12	11	27	365	260
		Annual	3	3	8	80	60
NO2(a)	Palm Beach	1-hr	152	137	117	-	-
		Annual	22	25	24	100	100
CO(b)	Palm Beach	1-hr	6	7	7	35	35
		8-hr	4	5	4	9	9
Ozone(b)	Palm Beach	1-hr	0.091	0.107	0.106	0.12	0.12
TSP(a)	Palm Beach	24-hr	251	250(e)	161	260(c)	150
		Annual	50	50	128	75(d)	60
	Hendry	24-hr	650	576(f)	73	260	150
		Annual	42	36	47	75	60
	Highlands	24-hr	50	143	35	260	150
		Annual	20	20	26	75	60
	Martin	24-hr	98	103	78	260	150
		Annual	39	39	40	75	60
	Okeechobee	24-hr	52	72	105	260	150
		Annual	26	26	28	75	60
	St. Lucie	24-hr	457	189(g)	219	260	150
		Annual	72	67(g)	82	75	60
PM-10(a)	Palm Beach	24-hr	-	-	78	150	150
		Annual	-	-	33	50	50
	Hendry	24-hr	-	-	65	150	150
		Annual	-	-	23	50	50

(a) Concentration in $\mu g/m^3$.
(b) Concentration in ppm.
(c) Primary standard specified with a secondary standard of 150 $\mu g/m^3$.
(d) Primary standard specified with a secondary standard of 60 $\mu g/m^3$.
(e) FDER indicated that this exceedance was caused by a fugitive dust event associated with a sugar cane transfer station operated 12/17/88 (Source: Martin CG/CC PSD Application, 1989).
(f) FDER indicated that this exceedance was caused by reentrained particulate matter due to sugar cane harvesting activities and occurred on 12/17/88. (Source: Martin CG/CC PSD Application, 1989).
(g) FDER indicated that these exceedances were due to fugutive dust from a nearby cement plant and an asphalt plant and heavy vehicle traffic on 8/1/88 (Source: Martin CG/CC PSD Application, 1989)

Source: FDER, 1990

Table 2.3.7-11
FPL MARTIN CG/CC PROJECT ONSITE AIR QUALITY MONITORING DATA (OCTOBER 1988 THROUGH SEPTEMBER 1989)

Pollutant	Averaging Period	Monitored Concen. ($\mu g/m^3$)	Site	NAAQS ($\mu g/m^3$)	FAAQS ($\mu g/m^3$)
SO_2	3-hr	61	East	1300	1300
	24-hr	12.6	East	365	260
	Annual	1.3	East	80	60
NO_2	1-hr	62	West	-	-
	Annual	5.4	East	100	100
Ozone	1-hr	165	East	235	235
	Annual	47	Both	-	-
Particulate Matter (PM-10)	24-hr	39	East	150	150
	Annual	13.3	West	50	50

Sources: FPL Martin CG/CC PSD Application, 1989.
Envirosphere Company, Final Data Report for Martin CG/CC, 1989.

Table 2.3.7-12
BACKGROUND AIR QUALITY LEVELS FOR THE ICL SITE VICINITY

Pollutant	Averaging Period	Monitored Concen. ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	FAAQS ($\mu g/m^3$)
SO_2 (1)	3-hr	61	1300	1300
	24-hr	12.6	365	260
	Annual	1.3	80	60
NO_2 (1)	1-hr	62	--	--
	Annual	5.4	100	100
Ozone (1)	1-hr	165	235	235
	Annual	47	--	--
Particulate (1) Matter (PM-10)	24-hr	39	150	150
	Annual	13.3	50	50
TSP (2)	24-hr	105	260	150
	Annual	40	75	60
CO (3)	1-hr	7	35	35
	8-hr	5	9	9

Sources:

(1) FPL Martin CG/CC PSD Monitors, 1989.
Envirosphere Company, Final Data Report for Martin CG/CC, 1989.

(2) FDER monitors at Martin and Okeechobee, highest recorded among the two stations within three year period, 1987-1989.

(3) FDER monitor at Palm Beach, concentration in ppm.

2.3.7.3 Measurement Programs

As discussed in Section 2.3.7.2, preconstruction monitoring was not required because of the availability of representative air quality and meteorological data in the area. The data that were used and their sources are described in Section 2.3.7.1 and 2.3.7.2. This is discussed again in Section 5.6.2.1.

2.3.8 NOISE

2.3.8.1 Measurement Methods

Environmental noise by its nature varies with time. To quantify such a noise level, it is necessary to introduce two terms.

The residual noise level is the quasi-constant noise level that exists in the absence of all identifiable sporadic or intermittent noise events such as automobile pass-bys, aircraft flyovers, dogs barking, etc. This level is usually composed of the cumulative sum of far-off indistinguishable road transportation sources in most environments. The residual level itself varies slowly with time as these sources increase or diminish, which explains the usual drop in residual level during the night and early morning hours when transportation activities are minimal. It has been found that the measurable sound level quantity, L90 in decibels (dB), or the level that is exceeded 90 percent of the time during an interval, serves well to quantify the residual level. The residual level is the best descriptor of community environmental quality.

The true energy average level over a given time interval is defined as Lequivalent, or Leq. Leq is the level over an interval that is equivalent to the perfectly constant level that would contain the same acoustic energy over the same interval. Hence, Leq gives a measure of the true average range of levels, including sporadic and transient noise events.

There are numerous other measures and descriptions defining noise levels, but the two above are those commonly used to describe environmental noise. The common practice time interval for measuring environmental noise is an hour; but, since the level is changing from hour to hour and from day to day, it becomes necessary to measure over longer intervals.

For the ICL site, portable continuous monitors with digital data storage (Larson Davis Model 700) were installed at the two positions shown on Figure 2.3.8-1, and

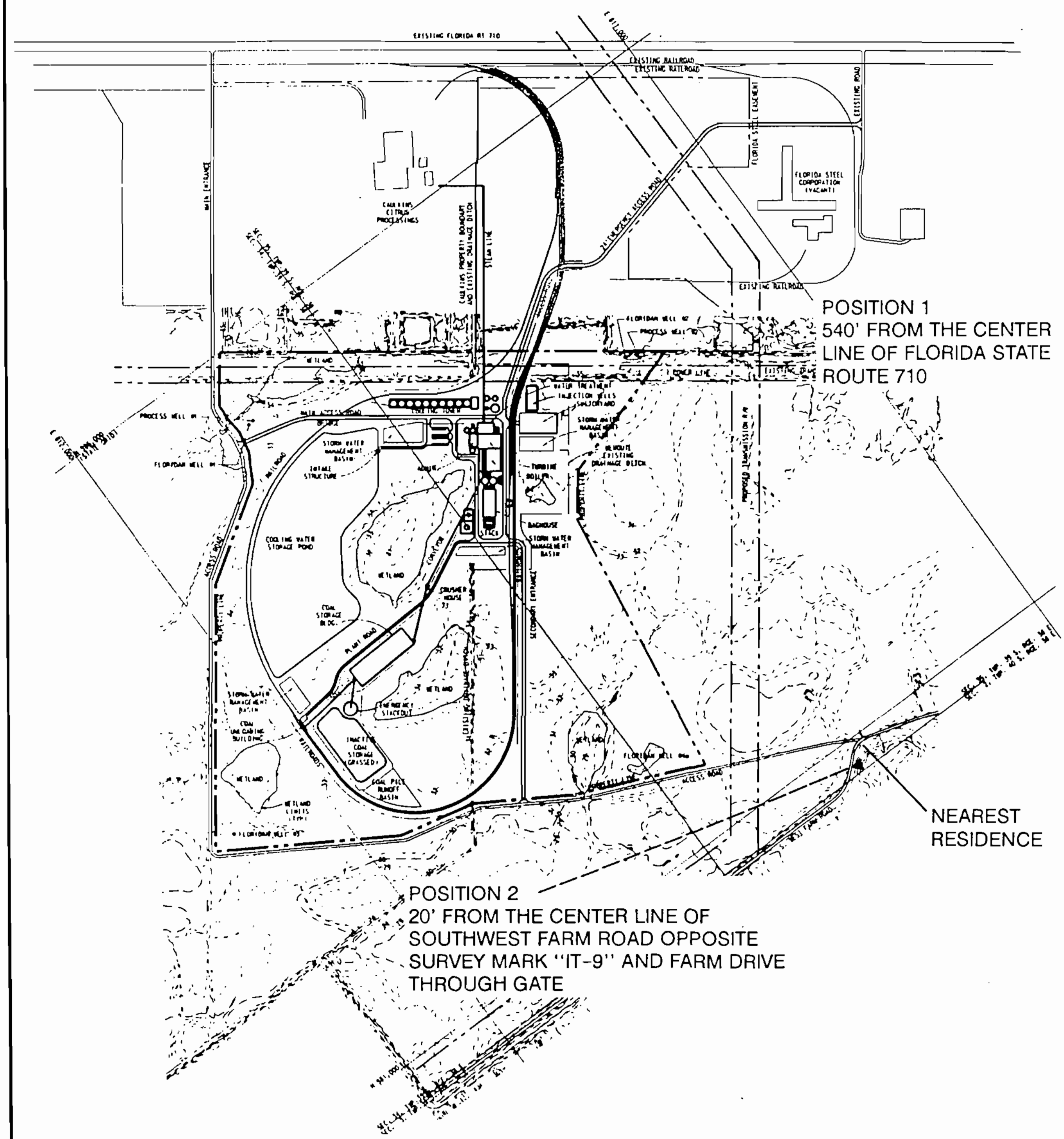

Figure 2.3.8-1.

PLOT PLAN OF SITE SHOWING AMBIENT NOISE LEVEL MEASUREMENT POSITIONS

Source: Hessler & Associates, 1990

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operated over a 36-hour interval from 7:00 p.m. on July 19, 1990, to 7:00 a.m. on July 21, 1990. Additionally, shorter term measurements were made during calm and still weather conditions with a type 1 precision octave band sound level meter (Rion Model NA29E). Fifteen hundred spectra can be measured and stored to form the database to compute the residual L90 level.

2.3.8.2 Ambient Levels

The positions shown on Figure 2.3.8-1 were chosen to characterize the entire project site from State Route 710 to South West Farm Road. State Route 710 is the dominant source of environmental noise in the area. Noise levels at the South West Farm Road position were very quiet, as one would expect in a rural farming land-use location.

The 36-hour data at position 2, South West Farm Road, are presented in graphic format on Figure 2.3.8-2. Residual levels are 35 dBA during calm wind conditions and higher during other times due to field grass and tree "rustle" and bird and insect activity. Mechanical farm equipment and road sounds could be observed at this position from sources many miles away.

Figure 2.3.8-3 is a plot of the frequency spectra at the two positions during calm weather conditions. The spectra are roughly parallel, again indicating that road noise from State Route 710 is the major source of noise in the area.

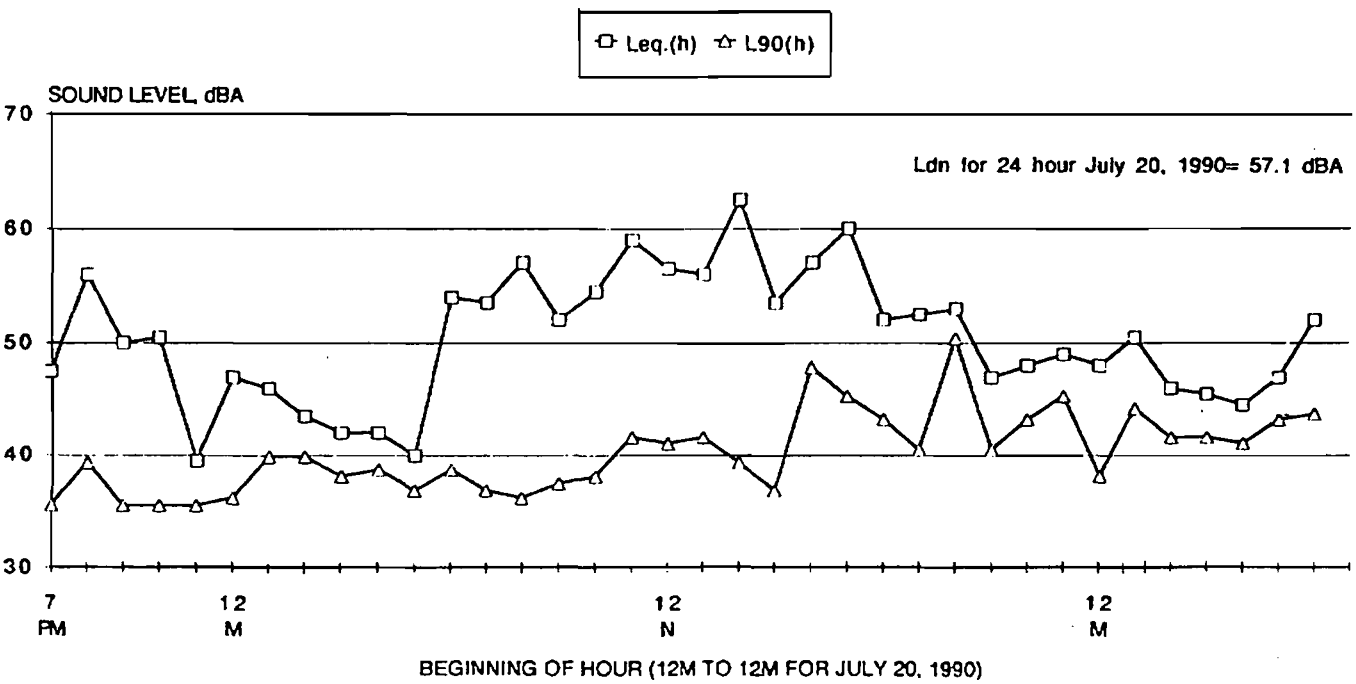

Figure 2.3.8-2.

36 HOUR PLOT OF HOURLY RESIDUAL (L90) AND EQUIVALENT (Leq) ENVIRONMENTAL NOISE LEVEL AT MEASUREMENT POSITION 2 AT ICL SITE

Source: Hessler Associates, 1990

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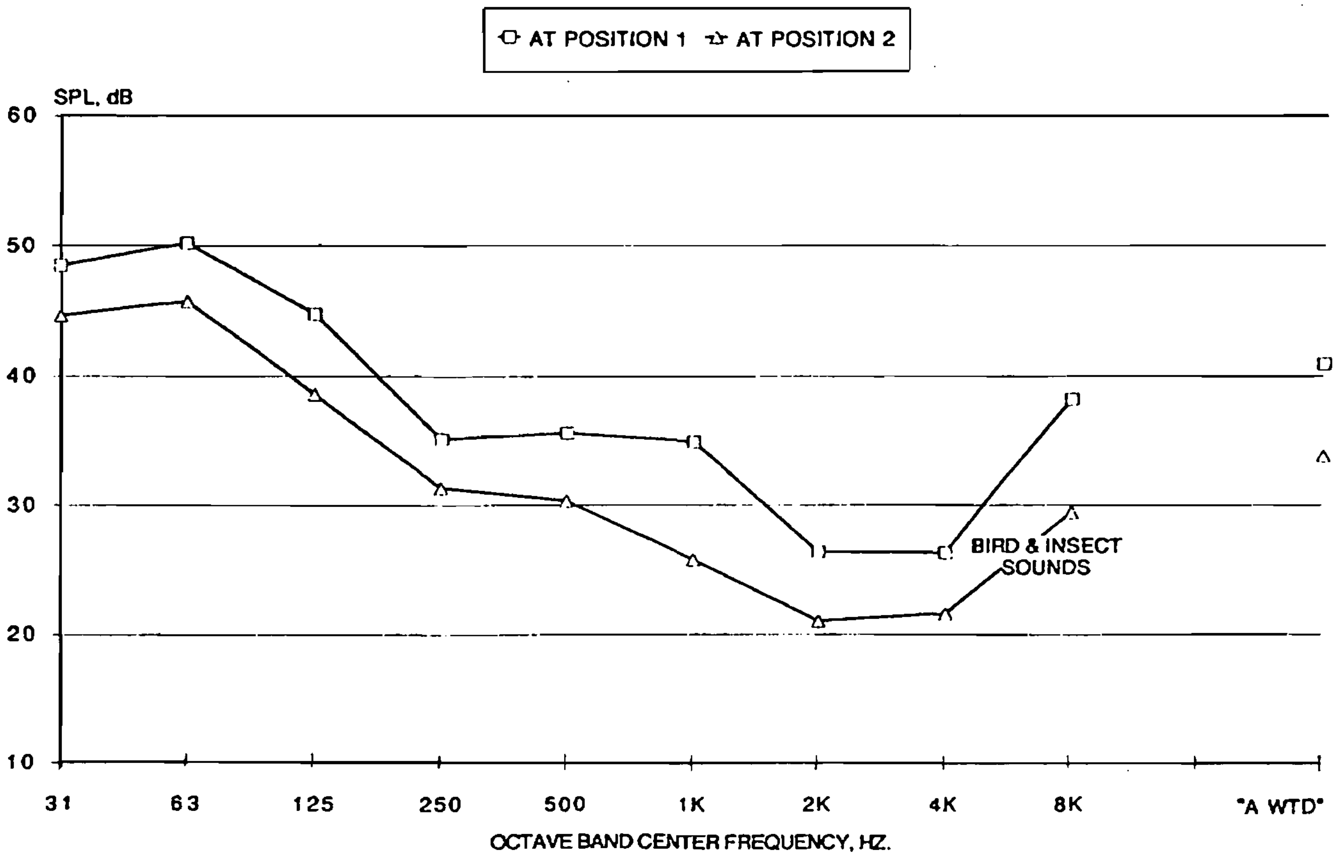

*DATA IS REPRESENTATIVE FOR CALM EARLY MORNING WEATHER CONDITIONS

Figure 2.3.8-3.

RESIDENTIAL (L90) SOUND PRESSURE LEVEL SPECTRA AT TWO POSITIONS AROUND THE ICL SITE*

Source: Hessler Associates, 1990

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

2.3.9 OTHER ENVIRONMENTAL FEATURES

No additional information is required.

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The Project and directly associated facilities

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

BOB MARTINEZ
GOVERNOR

DALE TWACHTMANN
SECRETARY

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Power Generation Facility [X] New[1] [ ] Existing[1]

APPLICATION TYPE: [X] Construction [ ] Operation [ ] Modification

COMPANY NAME: Indiantown Cogeneration, Ltd. Partnership COUNTY: Martin

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) See Table I

SOURCE LOCATION: Street SR 710 City Indiantown

UTM: East 548.019 Km North 2990.692 Km

Latitude 27 ° 2 ' 20 "N Longitude 80 ° 30 ' 45 "W

APPLICANT NAME AND TITLE: ______

APPLICANT ADDRESS: ______

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Indiantown Cogeneration, Limited Partnership

I certify that the statements made in this application for a ______ permit are true, correct and complete to the best of my knowledge and belief. Further I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: ______

______
Name and Title (Please Type)

Date: ______ Telephone No. ______

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

MARTIN SURABIAN, P.E.
BECHTEL CORP.
9801 WASHINGTONIAN BLVD.
GAITHERSBURG, MD
20878-5356

Signed ______________________

____
Name (Please Type)

____
Company Name (Please Type)

____
Mailing Address (Please Type)

Florida Registration No. __________ Date: __________ Telephone No. __________

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

See Attached

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction 7/92 Completion of Construction 12/95

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

	Capital	O & M
Selected Non-Catalytic Reduction System	$ 8,108,000	$ 2,939,400
Spray Dryer Absorber System	$32,271,000	$20,145,000/year
Baghouse	$20,524,000	$ 5,999,000/year

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

No previous permits have been issued

Requested permitted equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 52 ;

if power plant, hrs/yr 8760; if seasonal, describe: ____________________

F. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant? No

   a. If yes, has "offset" been applied? N/A

   b. If yes, has "Lowest Achievable Emission Rate" been applied? N/A

   c. If yes, list non-attainment pollutants. N/A

2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. Yes

3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII. Yes

4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? Yes

5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? No

   a. If yes, for what pollutants? N/A

   b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted.

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

Refer to PSD Permit Application Documentation

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
Selected Non-Catalytic Reduction System	Nitrogen Oxides	37%	N/A	Vendor Quote
Spray Dryer Absorber	Sulfur Dioxide	95%	N/A	Vendor Quote
Baghouse	Particulate	99+%	> 0.1	Vendor Data

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
Coal	290,000 #/hr	-	3422
Natural Gas	350,000 Ft^3/hr	-	358
Fuel Oil	2500 gal/hr	-	341.6

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis: Coal

Percent Sulfur: 2% Percent Ash: 12%

Density: 45 #/Ft^3 lbs/gal Typical Percent Nitrogen: 1.16

Heat Capacity: 11,800 (min.) BTU/lb -- BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______

F. If applicable, indicate the percent of fuel used for space heating. N/A

Annual Average ______ Maximum ______

G. Indicate liquid or solid wastes generated and method of disposal.

Attached

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Main Boiler Stack

Stack Height: 495 ft. Stack Diameter: 16 ft.

Gas Flow Rate: 1123665 ACFM 978063 DSCFM Gas Exit Temperature: 140 °F.

Water Vapor Content: 15 % Velocity: 100 FPS

Auxiliary Boiler Stack (see attached table)

SECTION IV: INCINERATOR INFORMATION - N/A

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Patholog-ical)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Inciner-ated							
Uncon-trolled (lbs/hr)							

Description of Waste ______

Total Weight Incinerated (lbs/hr) ______ Design Capacity (lbs/hr) ______

Approximate Number of Hours of Operation per day ______ day/wk ______ wks/yr. ______

Manufacturer ______

Date Constructed ______ Model No. ______

	Volume $(ft)^3$	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ______ ft. Stack Diamter: ______ Stack Temp. ______

Gas Flow Rate: ______ ACFM ______ DSCFM* Velocity: ______ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[ ] Other (specify) ______

Brief description of operating characteristics of control devices: ________________

____

____

____

____

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

____

____

____

____

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

N/A 1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made. later

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test). Refer to PSD Permit Application Documents

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.) Refer to PSD Permit Application Documents

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency). Refer to PSD Permit Application Documents

6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained. Attached (Fig. 3.4.4-1)

7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map). Attached (Fig. 2.1.0-1)

8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram. Attached (Fig. 3.2-4)

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

[X] Yes [ ] No 40 CFR 60 Subpart Da

Contaminant	Rate or Concentration
See tables in PSD Permit Application	
Documents	

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

[ ] Yes [X] No

Contaminant	Rate or Concentration
Refer to PSD Permit Application Documents	

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
See Table in PSD Permit Application	
Documents	

D. Describe the existing control and treatment technology (if any).

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

5. Useful Life:

6. Operating Costs:

7. Energy:

8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft.

b. Diameter: ft.

c. Flow Rate: ACFM

d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary). Refer to PSD Permit Application Documents

1.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

[1]Explain method of determining efficiency.
[2]Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Costs:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected: See BACT for PSD Permit Application

1. Control Device: 2. Efficiency:[1]

3. Capital Cost: 4. Useful Life:

5. Operating Cost: 6. Energy:[2]

7. Maintenance Cost: 8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

[1]Explain method of determining efficiency.
[2]Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

[1]Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data Air quality impact below the level requiring monitoring (see attached PSD application documents)

1. ______no. sites ______ TSP ______ ( ) SO2* ______ Wind spd/dir

Period of Monitoring ___/___/___ to ___/___/___
month day year month day year

Other data recorded ______________________

Attach all data or statistical summaries to this application.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? [ ] Yes [ ] No

b. Was instrumentation calibrated in accordance with Department procedures?

[ ] Yes [ ] No [ ] Unknown

B. Meteorological Data Used for Air Quality Modeling

1. 5 Year(s) of data from 1 / 1 / 82 (month day year) to 12 / 31 / 86 (month day year)

2. Surface data obtained from (location) West Palm Beach, FL

3. Upper air (mixing height) data obtained from (location) West Palm Beach, FL

4. Stability wind rose (STAR) data obtained from (location) West Palm Beach, FL

C. Computer Models Used

1. ISCST (version 88348) Modified? If yes, attach description.

2. (no modifications) Modified? If yes, attach description.

3. ______ Modified? If yes, attach description.

4. ______ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables. Attached to DER AQ submittal only

D. Applicants Maximum Allowable Emission Data

Pollutant (Main Stack)	Emission Rate	
TSP	7.8	grams/sec
SO^2	73	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time. See PSD Application Documents

F. Attach all other information supportive to the PSD review. See PSD Application Documents

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

see BACT

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

see BACT

3.0 THE PROJECT AND DIRECTLY ASSOCIATED FACILITIES

3.1 BACKGROUND

3.1.1 BACKGROUND

The Indiantown Cogeneration, L.P. (ICL) plans to build a 330 MW cogeneration plant off SR 710 near Indiantown. This project represents an important addition to the available power generation in southern Florida, where power demand is increasing rapidly.

The cogeneration plant will use low sulfur pulverized coal as its fuel to generate process steam to the Caulkins Citrus Processing plant, as well as to generate electrical power for sale to FPL. The arrangement of these facilities is shown in the site plan, Figure 3.1.1-1.

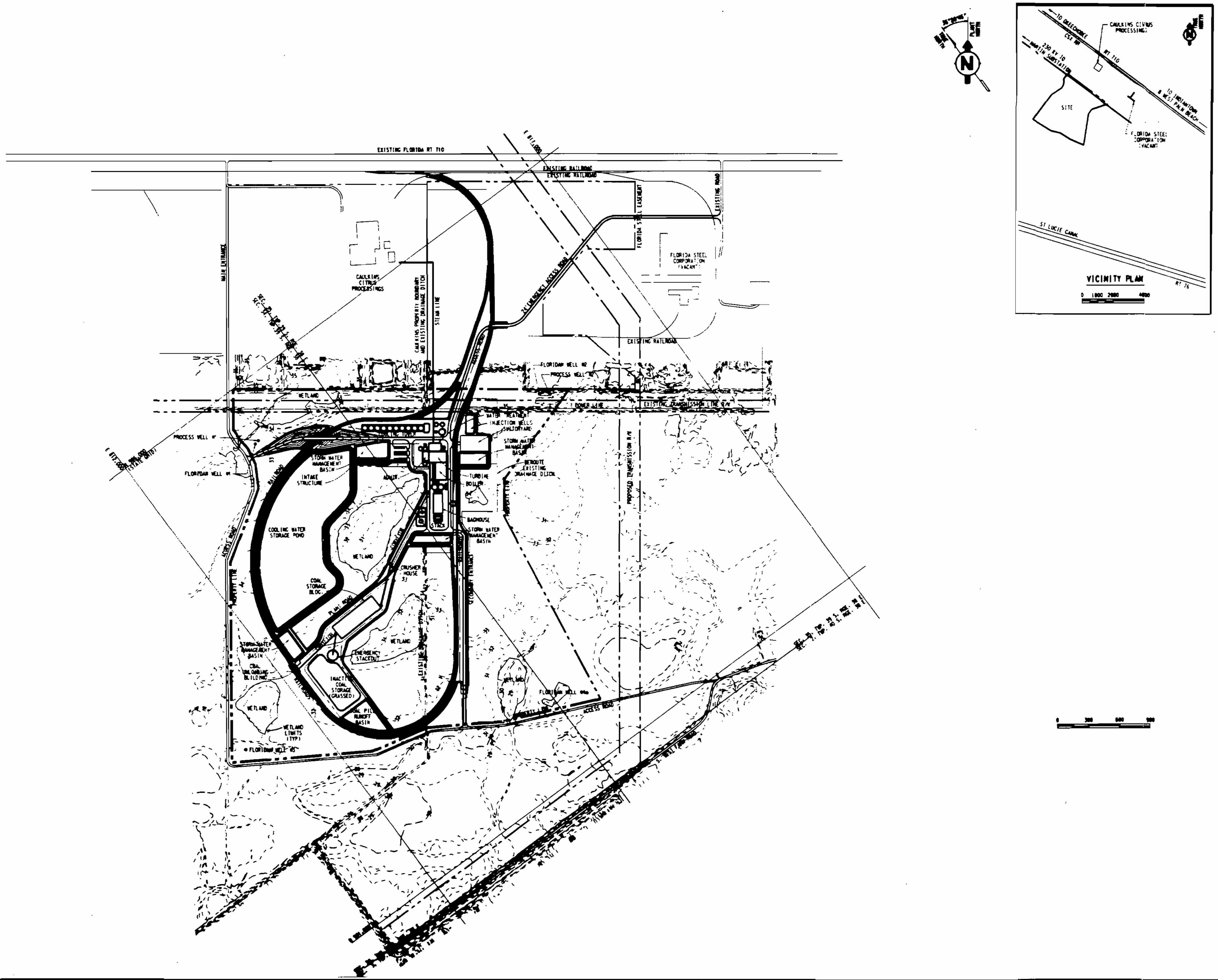


Figure 3.1.1-1.

SITE PLAN

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.

3.1.2 PLANT DESCRIPTION

The ICL cogeneration plant will generate approximately 330 MWe (net) of electrical output when not exporting process steam. Steam generation is accomplished by means of a pulverized coal (PC) reheat boiler, and electrical power generation is provided by means of an extraction-condensing turbine generator.

During the period from November to June, process steam will be supplied to the Caulkins Citrus Processing plant. At the peak of the processing season, up to 225,000 lb/hr of process steam can be supplied to the Caulkins plant. Condensate from the citrus facility will be returned to the plant for reuse. An auxiliary boiler, capable of firing either No. 2 fuel oil or natural gas, will provide startup steam needs for the cogeneration plant and export process steam if required.

SOUNDS GOOD AS H_2O CONSERVATION METHOD!

The PC boiler will be an outdoor natural-circulation type boiler. The principal components of the boiler will include: water-cooled furnace, superheaters, reheaters, economizer, convection pass heat transfer elements, fans and blowers, air preheaters, and induced draft fans. In the furnace section of the PC boiler, the pulverized coal will be mixed with the hot combustion air and ignited in the coal burners. Combustion air will be preheated in an airheater using the exit flue gas to improve overall boiler efficiency.

In general, the boiler and air pollution control systems will be typical of outdoor construction and will not be totally enclosed. However, enclosed buildings will be provided for administration, control, maintenance, and warehousing, and the material handling facilities will be totally enclosed.

One outdoor, drum type, natural circulation PC boiler will generate a total of approximately 2,500,000 lb/hr of steam at 2535 psia and 1005 °F at the superheater outlet and 1005 °F at the reheater outlet.

The boiler will utilize the latest in combustion controls to reduce nitrogen oxides formation. Nitrogen oxides that do form will be further reduced by a selective non-catalytic reduction (SNCR) process where reagent will be injected into the furnace. The reagent will reduce the nitrogen oxides to molecular nitrogen and water.

Flue gas from the air heater will enter the spray dryer absorber (SDA) system. A lime slurry will be injected into the SDA (dry scrubber to react with the hot flue gas. The hot gas will be humidified and cooled in the SDA by spraying with reactant slurry. The system will use calcium hydroxide ash slurry as the absorbing medium. Pebble lime will be slaked in the lime preparation system, diluted, and stored in the lime feed tanks. Feed slurry will be pumped to an atomizing system.

Acid gas concentrations will be reduced substantially during the initial evaporation and drying in the SDA. A smaller removal will occur in the filter cake in the baghouse. Reaction products, consisting of calcium sulfate, calcium sulfite, unreacted calcium hydroxide, and ash, will be removed from the flue gas at the SDA hopper and the baghouse hoppers. The reaction products and ash will be conveyed to a silo equipped with a bin-vent type filter to minimize fugitive dust emissions. Railcars will be loaded from the silo for transporting the ash back to the coal mine.

The bottom ash formed from the coal combustion will be removed from the furnace by a submerged drag chain conveyor for transfer to railcars for hauling back to the coal mine. The majority of the solid waste (bottom and fly ash and reaction products) will be removed by rail, and minor waste (water treatment filter cake) will be removed by truck for offsite disposal.

Lime will be delivered to the site by self-unloading pneumatic railcars or self-funloading trucks. The lime will be pneumatically conveyed to the lime silo which will be equipped with a bin-vent type filter to minimize fugitive dust emissions.

Coal will be delivered by rail, unloaded, and stored in an enclosed storage facility onsite. A grassed inactive pile, sized for 30 days storage at full load, also will be provided.

The exhaust steam from the turbine must be condensed for reuse in the boiler/ turbine cycle. Circulating water will be used between the wet mechanical draft cooling tower and the condenser to cool the steam. A portion of this cooling water will be evaporated in the cooling tower and must be replenished along with the cooling tower blowdown which will be discharged from the circulating water system to prevent solids from building up in the tower.

This cooling tower makeup water will be supplied from the Taylor Creek/Nubbin Slough via a 19-mile pipeline routed along SR 710 in the CSX railway right-of-way (ROW). A cooling water storage pond will be used as a means to extend the use of the Taylor Creek/Nubbin Slough at times when the withdrawal of this water is not possible. The Floridan aquifer will also be used as a backup water source for cooling tower makeup during the dry periods when water from the Taylor Creek/Nubbin Slough is not available.

In order to minimize water use, the process is designed to recycle as much water as practical. The boiler blowdown will be reused in the cooling tower system and not just discharged. Clarifiers and other water treatment systems will be incorporated to cleanup waste streams such that they can be recycled. Even a portion of the wastewater will be injected in the SDA system, thus minimizing the amount of water going to the injection well.

An intake structure will be constructed at the Taylor Creek/Nubbin Slough Canal. Pumps at this structure will supply cooling tower makeup water via a pipeline to the site. The 19-mile long pipeline will have an approximate diameter in the range of 18 to 24 inches, will be buried, and will run along the railroad ROW.

A tie-in from the plant's switchyard will be made to the existing FPL 230 kV transmission line which crosses the northern portion of the site. Therefore, no additional ROWs or transmission line construction will be required.

3.2 SITE LAYOUT

The Plot Plan, Figure 3.2.0-1, depicts the proposed layout of the ICL facilities as they are arranged on the 232-acre site. The site plan (Figure 3.1.1-1) shows that the plant will be located south of the Caulkins Citrus Processing Plant and the vacant Florida Steel Corporation (FSC) plant.

The proposed ICL project with its supporting equipment and facilities is shown on Figure 3.2.0-2. This figure is an architectural rendering of the proposed project.

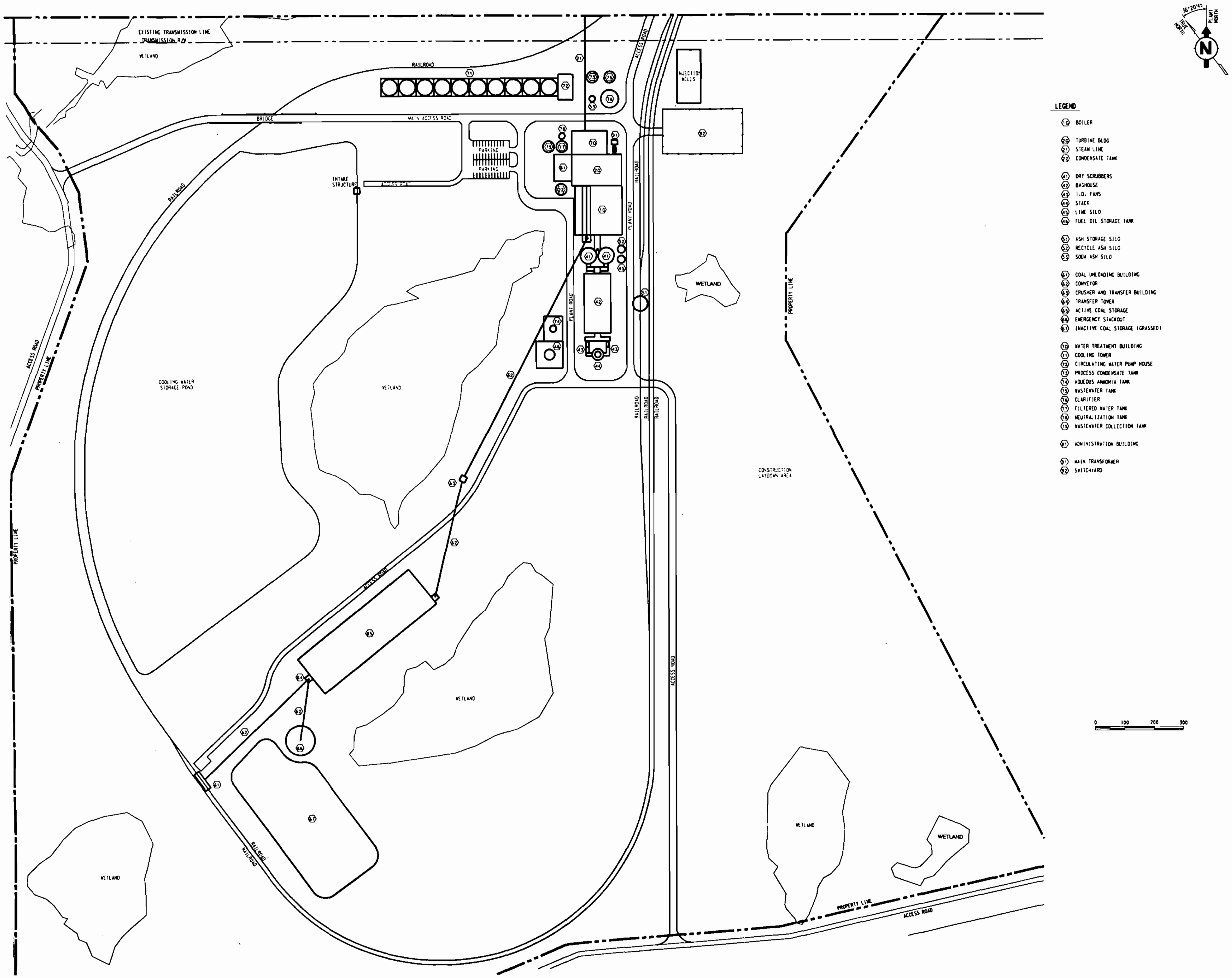
A new rail spur will be added from the existing CSX railroad and will enter the site along an easement located through the western part of the Florida Steel Corporation property that abuts Caulkins property. This spur expands into a coal rail loop that encircles the majority of the site.

The main entrance to and from the site will be provided by an extension of the existing Caulkins access road from SR 710, southward along the west side of Caulkins and the new site boundary. This access road will extend along the west side and south perimeter of the site, connecting to South West Farm Road and serving as a public throughway between South West Farm Road and SR 710. A secondary access road will extend from this new road to the power block area of the site. An emergency access road will also be added along the railroad easement between Caulkins and Florida Steel, which connects to the existing FSC entrance road.

The power block area, encompassing the boiler, turbine, air pollution control equipment, administration building, warehouse/maintenance building, cooling tower and switchyard facilities, will be located on the northeastern portion of the site. The coal unloading and storage facilities will be located in the southwestern portion of the site. Figure 3.2.0-3, entitled Plant Elevation, is a cross sectional view of the power block area.

Figure 3.2.0-1.

PLOT PLAN



Source: Bechtel, 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.

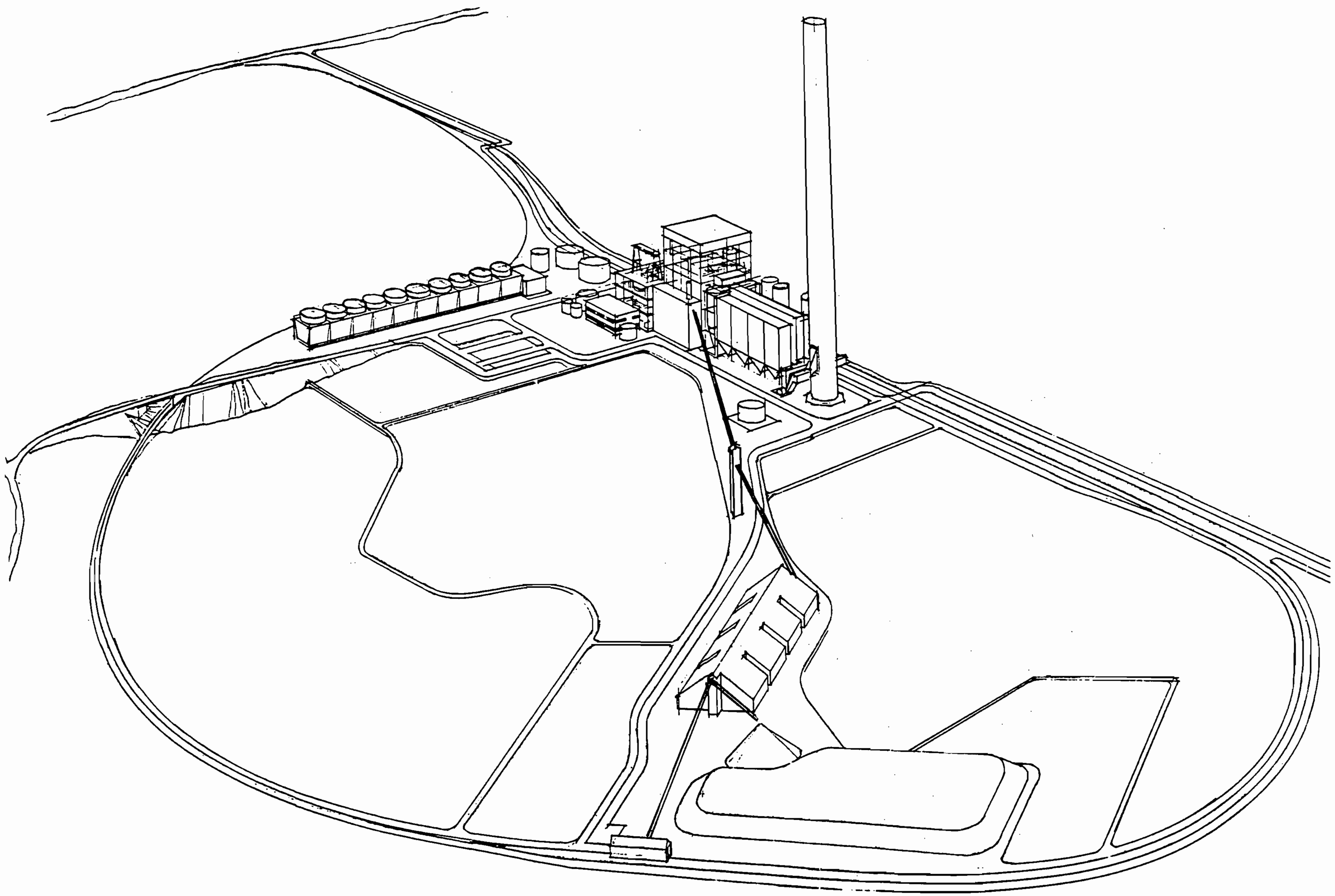


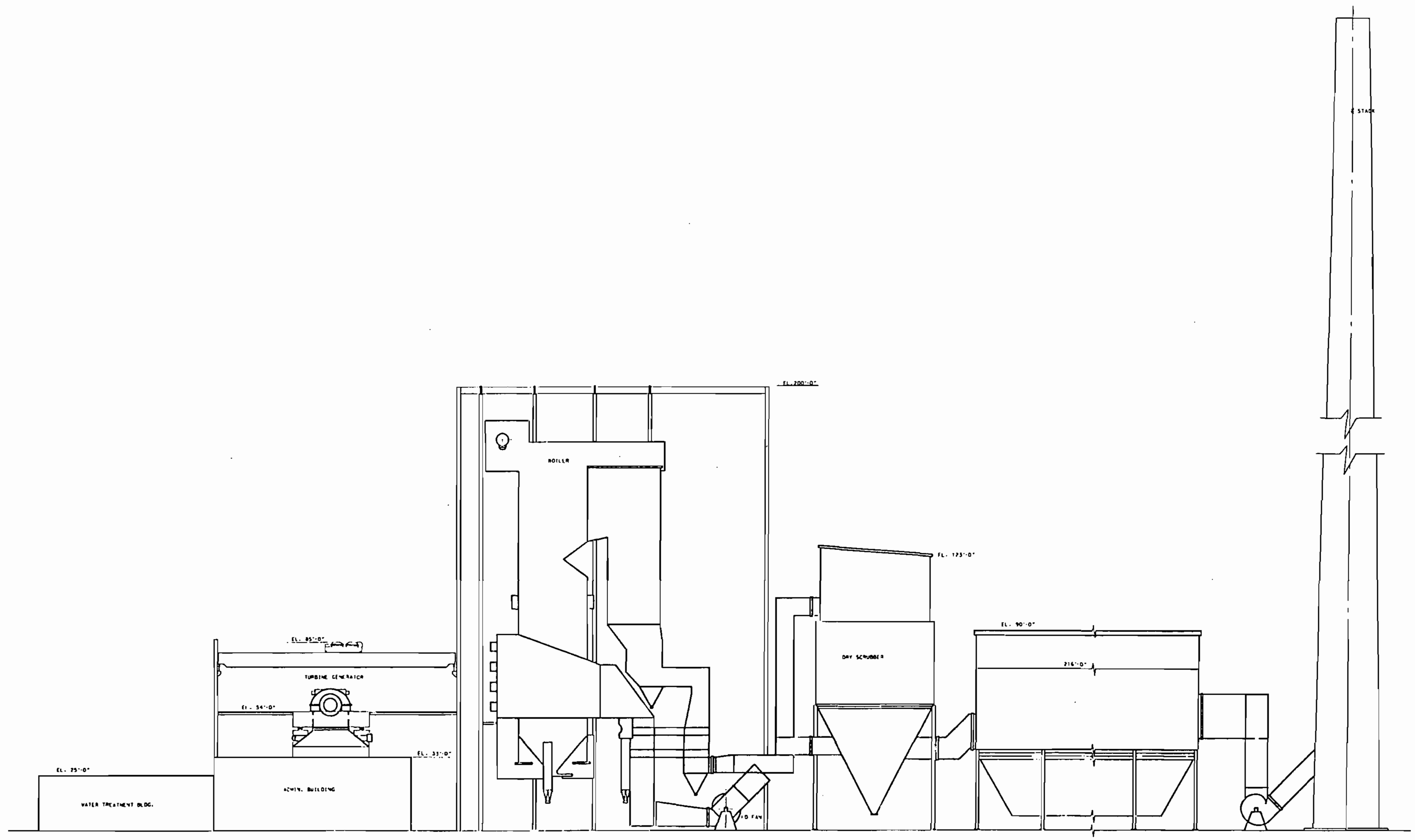
Figure 3.2.0-2.

ARCHITECTURAL
RENDERING

Source: Bechtel, 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.



ELEVATION VIEW
LOOKING PLANT EAST

Figure 3.2.0-3

PLANT ELEVATION

Source: Bechtel, 1990

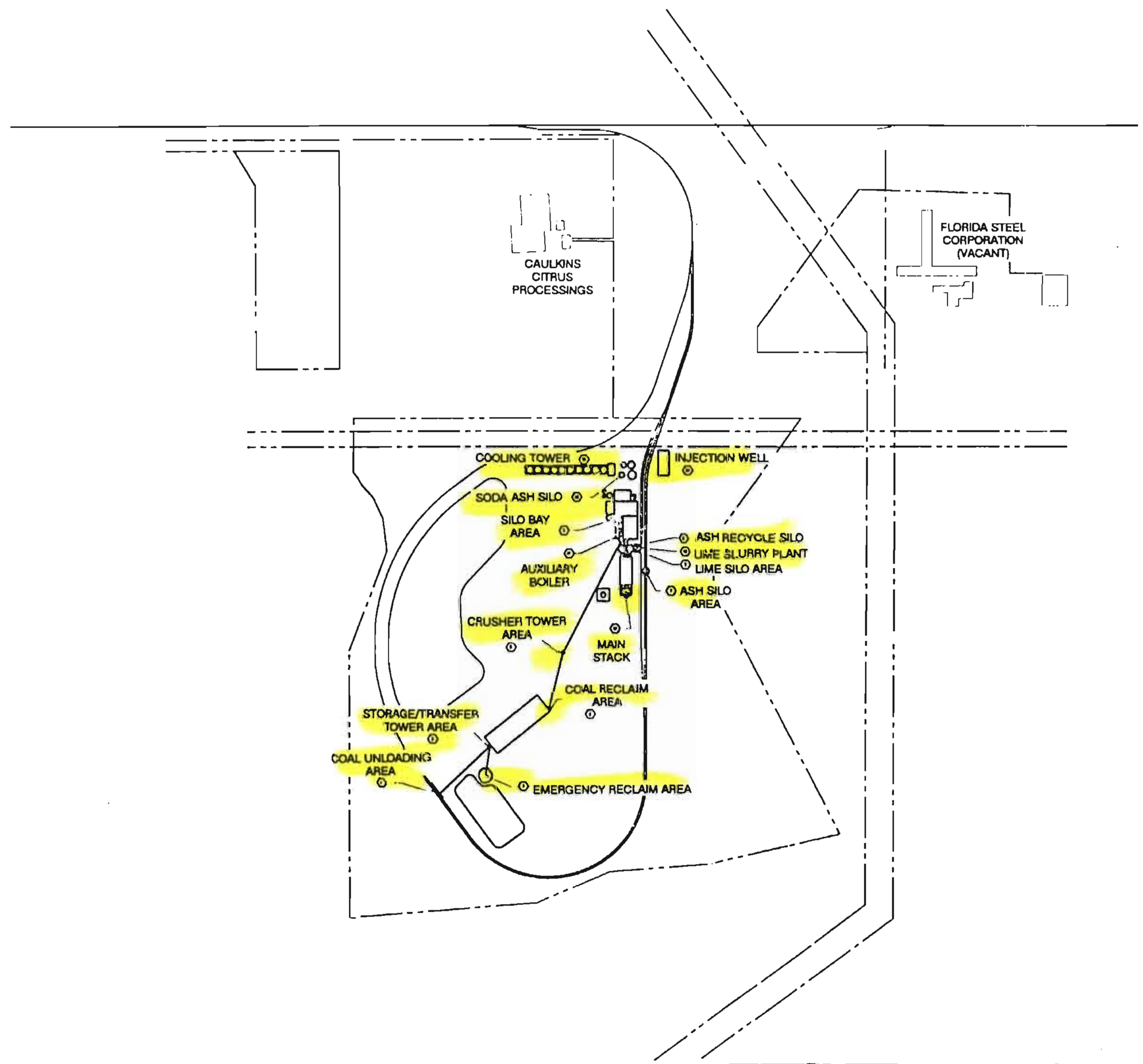
INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.

The Emission Point Diagram, Figure 3.2.0-4, indicates the potential gaseous and liquid wastes points from the plant. Fugitive dust from coal, lime, and ash handling transfer points will be captured by filters. The emissions from the main stack and the auxiliary boiler stack will be controlled per Best Available Control Technology (BACT) requirements. Sanitary wastes will be discharged to the Indiantown wastewater treatment facility. Process wastes will not be discharged from the site, but will be injected into deep wells.

Figure 3.2.0–4

EMISSION POINT DIAGRAM



SOURCE NUMBER	EMISSION POINT	DISCH. ELEV. ABOVE GRADE (FT.)
1	COAL UNLOAD AREA	25
2	STORAGE/TRANSFER TOWER AREA	75
3	COAL RECLAIM AREA	75
4	EMERGENCY RECLAIM AREA	25
5	CRUSHER TOWER AREA	75
6	SILO BAY AREA	180
7	ASH SILO AREA	120
8	ASH RECYCLE SILO	75
9	LIME SILO AREA	120
10	LIME SLURRY PLANT	60
11	AUX BOILER STACK	90
12	MAIN STACK	500
13	SODA ASH SILO	75
14	INJECTION WELL	0
15	COOLING TOWER	56

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BECHTEL
GAITHERSBURG, MARYLAND

INDIANTOWN COGENERATION PROJECT
INDIANTOWN FLORIDA

SITE PLAN
EMISSION POINT
DESIGNATION

JOB NO.	DRAWING NO.	REV.
20524	SK-P-9190	C

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

3.3 FUEL

3.3.1 COAL

3.3.1.1 Coal Supply and Analysis

Coal will be delivered by rail to the ICL site and will serve as the primary fuel for the main boiler. The coal used for environmental licensing purposes is presented in Table 3.3.1-1. The main boiler will use approximately 3,480 tons of 11,800 Btu/lb coal per day at full load and at 80 °F, the design ambient temperature of the facility.

3.3.1.2 Coal Handling and Storage

Coal will be delivered by unit train consisting of approximately 64 standard and 22 special covered-top, 100-ton, bottom dump cars. Three unit trains per week are required. Figure 3.1.1-1 shows the onsite rail loop location.

The unit train locomotive will be used to stage the coal cars at the enclosed coal unloading building. A side-mounted car shaker will be located over the unloading hopper and will be used to enhance the discharge of coal from the cars.

Coal storage will be provided in both active and inactive piles. The active pile will be stored within an enclosed structure which will include a physical barrier (such as a concrete lining) below the pile to protect the groundwater. The pile will be sized for 7 days of coal at full power load. The inactive pile will contain 30 days of compacted coal. This inactive pile will be approximately 25 feet high and will be covered and seeded. A liner will be used under the inactive pile to prevent runoff and leachate from entering the groundwater.

Two 500-tph unloading feeders and one 1,000-tph conveying system will transport the coal from the unloading hopper in the unloading building to the coal storage

Table 3.3.1-1
ULTIMATE ANALYSIS
(WORST CASE FUEL)

COMPONENT	% (AS FIRED)
Carbon	65.37%
Hydrogen	4.63%
Oxygen	4.69%
Nitrogen	1.16%
Sulfur	2.00%
Chlorine	0.15%
Ash	12.00%
Water	10.00%
TOTAL	100.00%
HHV	11,800 Btu/lb

Source: ICL, 1990

building. At the transfer point before the storage building, coal may be diverted to either the storage building or the emergency stackout pile.

The emergency stackout pile will also be lined and will be an outdoor type pile sized to accommodate up to 30 carloads of incoming coal.

The active coal storage will consist of a 24,360-ton longitudinal pile enclosed in an A-frame building. The pile capacity represents a 7-day plant requirement at design conditions. A belt conveyor equipped with a traveling tripper will stack coal on the pile. Coal will be reclaimed from the pile and deposited on a reclaim conveyor at a rate of 800 tph. Reclaimed coal will be conveyed to the crusher tower for size reduction.

The coal reclaim conveyor and the crusher feed conveyor will transfer the coal to the crusher tower, where it will pass under a magnetic separator before being discharged into a surge bin. The crusher feeders will transfer the coal from the surge bin into two crushers. The crushers will reduce the coal feed size from 2" x 0" to 1-1/4" x 0". The coal will then be transferred on the 800 tph plant transfer conveyor that conveys coal to the boiler building.

An 800 tph silo feed conveyor equipped with a traveling tripper will supply coal to four operating coal silos and one spare silo. The total volume of the four operating silos will accommodate approximately 24 hours of full load firing of the boiler.

3.3.2 NATURAL GAS

3.3.2.1 Natural Gas Supply and Analysis

Natural gas supplied by pipeline will serve as one of two alternative fuels for both the auxiliary boiler and for the main boiler light-off and warmup (No. 2 fuel oil is the other alternative fuel). A typical fuel analysis for natural gas is presented in Table 3.3.2-1. The auxiliary boiler will use up to 350,000 cu ft per hour of natural gas (only) at full load.

3.3.2.2 Natural Gas Distribution

The natural gas system will consist of an onsite gas metering station and distribution system fed from a new pipeline that will tie into the main gas transmission line that parallels SR 710.

Table 3.3.2-1
NATURAL GAS[1] ANALYSIS

Ultimate Analysis

Element	Gravimetric Breakdown (%)
Carbon	73.913
Hydrogen	24.047
Oxygen	1.249
Nitrogen	0.773
Sulfur	0.018
	100.000

Proximate Analysis

Component	Gravimetric Breakdown (%)
Volatile Matter	99.920
Fixed Carbon	0
Moisture[2]	0
Ash	0
Sulfur	0.018
	100.000

[1]The heat of combustion of the natural gas is estimated to be 950 Btu/cubic foot.

[2]Actual value is 0.00138 percent.

Source: Bechtel, 1990

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3.3.3 FUEL OIL

3.3.3.1 Fuel Oil Supply and Analysis

No. 2 fuel oil will serve as one of two alternative fuels for both the auxiliary boiler and for the main boiler light-off and warmup (natural gas is the other alternative fuel). Very low sulfur oil will be used to provide SO_2 emissions control. A typical fuel oil analysis for very low sulfur oil is presented in Table 3.3.3-1. The auxiliary boiler will use up to 2,500 gph of No. 2 fuel oil (only) at full load. A startup of the main boiler is expected to use approximately 9,000 gallons of No. 2 fuel oil.

3.3.3.2 Fuel Oil Handling and Storage

The fuel oil system will consist of one fuel oil storage tank, filling pumps to transfer fuel from trucks to the tank, two 100-percent-capacity centrifugal pumps to provide fuel to the main or auxiliary boilers, and associated piping and controls. The fuel oil storage tank capacity is 200,000 gallons, which is sufficient for 3 days' operation of the auxiliary boiler.

The fuel oil transfer and storage system is designed in accordance with the National Fire Protection Association's 1987 Flammable and Combustible Liquids Code (NFPA-30). The fuel oil storage tank is designed in accordance with the Environmental Protection Agency (EPA) Standards of Performance for New Stationary Sources: Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels). Containment walls around the fuel oil storage tank (sized to contain the contents of the tank plus an allowance for precipitation) will be provided.

Table 3.3.3-1
NO. 2 FUEL OIL ANALYSIS[1]

Ultimate Analysis

Element	Gravimetric Breakdown (%)
Carbon	87.26
Hydrogen	12.67
Oxygen	0
Nitrogen	0.02
Sulfur	0.05
	100.00

Proximate Analysis

Component	Gravimetric Breakdown (%)
Volatile Matter	99.395
Fixed Carbon	0.425
Moisture	0.050
Ash	0.050
Sulfur	0.050
	100.000

[1]The heat of combustion of the No. 2 fuel oil is estimated to be 19,130 Btu/lb.

Source: Bechtel, 1990

3.3.4 COAL STORAGE PILES GROUNDWATER PROTECTION/RUNOFF COLLECTION AND TREATMENT

The coal pile runoff collection and storage basin for the grassed-over inactive coal pile will be sized to collect and contain all incident precipitation (9.5 inches) from the 25-year, 72-hour storm event. A coal pile liner will be provided to prevent coal pile runoff and leachate from infiltrating the underlying soils and groundwater. The liner system will be constructed completely above the seasonal high water table, and will consist of a single flexible membrane liner and a drainage layer on top of the liner.

This liner (minimum 60 mil) will be designed to accommodate the stresses, pressures, weather exposure, and potential abrasion associated with its intended use. A typical liner material would be high density polyethylene (HDPE). The drainage layer will be comprised of 8 to 12 inches of granular material above a layer of geotextile and geonet, both on top of the impermeable liner. A layer of granular material (e.g., sand from onsite collection areas) will be provided under the liner to protect it from tearing or perforation. This leachate collection and removal system will be designed to prevent leachate from exceeding a depth of 1 foot above the liner. The drainage layer of the coal pile on top of the liner will convey the runoff and leachate to the collection basin.

The runoff collection basin for the inactive coal storage area will have a liner system similar to that for the coal pile area, except that the geotextile and geonet layers will not be used. The bottoms of the collection basins will be built above the seasonal water table.

Lined drainage ditches and/or pipelines will collect the runoff water from the coal pile and convey it into the collection basin. Coal pile runoff will be pumped at a controlled rate to the wastewater treatment facility for processing (e.g., solids removal, pH adjustment as needed), and recycled within the plant water supply system.

The active coal pile will be located within a building and will have a physical barrier such as concrete or a liner. The emergency coal pile area will be lined to prevent groundwater contamination. It will be designed to be part of the runoff and leachate system that feeds the lined runoff collection basin.

3.3.5 ALTERNATIVE FUELS

The main boiler can only be fired at full load with coal. Both natural gas and No. 2 fuel oil are available, however, for startup of the main boiler and for 100 percent firing of the auxiliary boiler. The auxiliary boiler is sized to provide 100 percent of the process steam needs of the Caulkins Citrus Processing plant (225,000 pounds per hour maximum), in case the main boiler is down. The option to use either natural gas or No. 2 fuel oil provides security against future unavailability or escalations in price of either gas or oil.