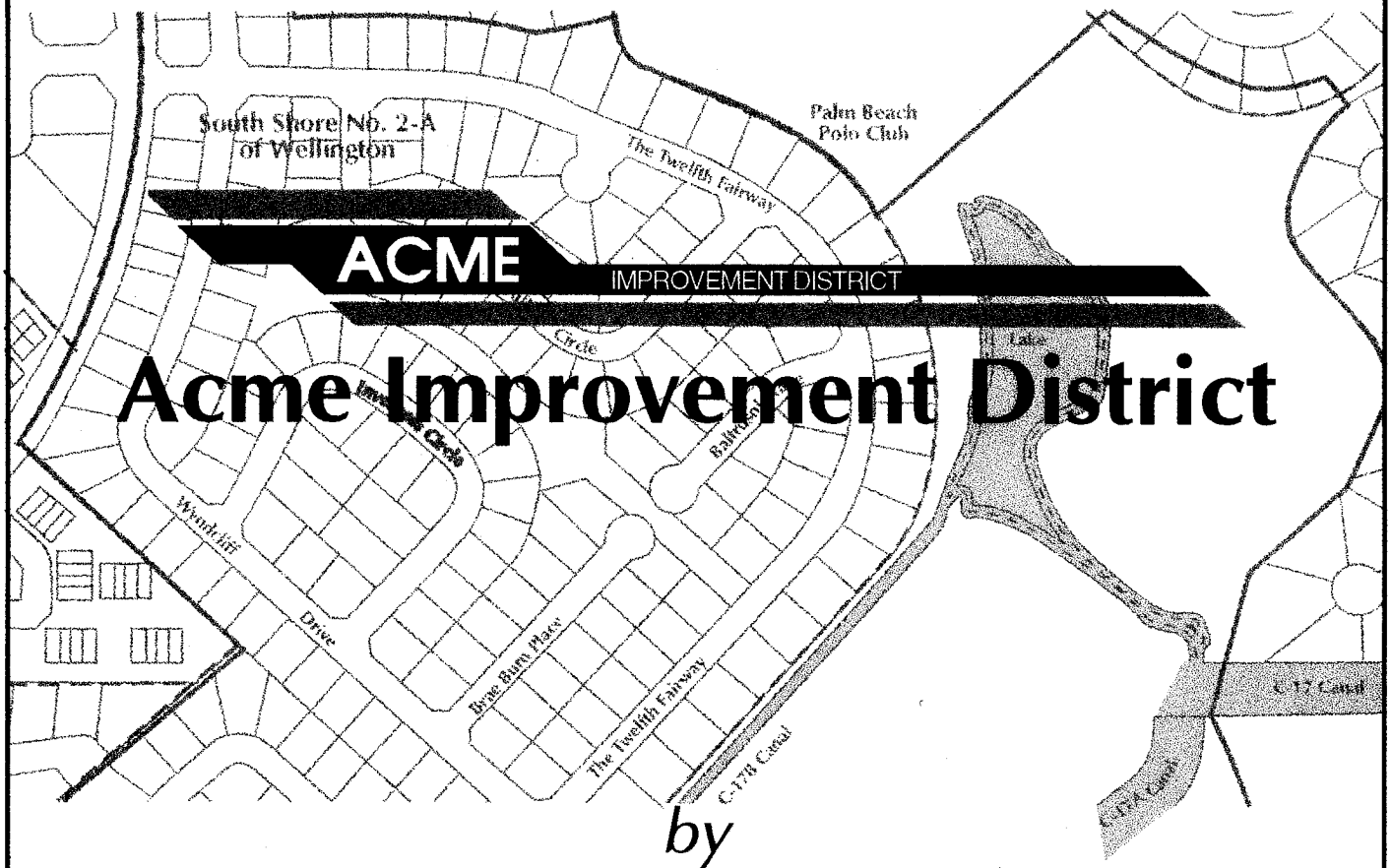
The Twelfth Fairway

Drainage Study

prepared for



by

Mock, Roos & Associates, Inc.

MOCK • ROOS

ENGINEERS • SURVEYORS • PLANNERS

District Engineer's Signature Page

This *Drainage Study* was prepared and assembled under my direct responsible charge. Appropriate information pertinent to the preparation of this report was furnished by Acme Improvement District Staff. As a Professional Engineer in the State of Florida, it is my professional opinion that this report is true and factual.

Tracy O. Bennett, P.E.

Tracy O. Bennett

(District Engineer's Signature)

(Date and Engineer's Seal)

(Copies of this report are not valid unless signed, dated, and embossed with Engineer's seal.)

Table of Contents

The Twelfth Fairway Drainage Study

I. Introduction

A. General

The Acme Improvement District (Acme) was created in 1953 as the Acme Drainage District by Chapter 59-994, Special Acts of Florida and operates according to provisions of Chapter 298, Florida Statutes and Chapter 59-954, Special Acts of Florida, as amended. Acme was created "to preserve and protect water resources for sanitary or agricultural purposes or when the same may be conducive to public health, convenience or welfare." Several revisions to Acme's enabling legislation were completed which expanded Acme's boundaries and added new powers. Acme has the authority to construct and maintain public utilities including water and sewer, drainage, irrigation, roadways and related activities. Acme's location in relation to eastern Palm Beach County is shown in Figure 1.

B. Authorization

On October 16, 1995, portions of Acme Improvement District received over 9 inches of rainfall. Stages within Acme's canal system reached elevations above 16 feet NGVD. Severe roadway flooding and minimal residential flooding were reported in the South Shore 2A development along and adjacent to the roadways of the Twelfth Fairway, Wyndcliff Drive, Inverness Circle, Brae Burn Place and other roadways (refer to Figures 2 & 3). Consequently, on October 23, 1995, Acme's Board of Supervisors authorized the District Engineer, Mock, Roos & Associates, Inc., to perform an analysis of the Twelfth Fairway area stormwater drainage system and to develop recommendations to lessen the severity and duration of flooding.

C. Purpose and Scope

The purpose of this study is to evaluate the performance of the existing Twelfth Fairway area drainage system (see Figure 4) and recommend improvements to the

system to reduce the severity and duration of flooding from future events. The analysis involved reviewing development plans of the Twelfth Fairway area as well as surrounding areas. These plans showed elevations, pipe configurations and restrictions and low areas that may exacerbate flooding conditions and impede flow to Acme's canal system. This information was further verified by a field survey. With rainfall data and computer modeling, the extent of necessary improvements was calculated and applied to the existing system. This report will describe the necessary improvements, levels of protection and the costs associated with implementation.

II. Existing Conditions

A. Stormwater Systems

Acme's Basin A stormwater management system consists of a network of interconnecting canals and lakes discharging into the South Florida Water Management District (SFWMD) C-51 Canal through an outfall culvert and two 60,000 gallons per minute (gpm) pump stations. When the stages in the canals and lakes rise one foot above the control elevation (12.0 feet NGVD dry season and 11.0 feet NGVD wet season) the outfall culvert is blocked and the two pump stations are activated. Typically, the wet season is June through October and the dry season is November through May.

The South Shore 2A stormwater system, where the Twelfth Fairway area is located, consists of roadside swales, inlets, greenways and stormwater pipes discharging into three separate Acme Canals (C-14A, C-16 and C-17B). Most of the area north of the Twelfth Fairway discharges into the C-16 Canal. The western half (approximately) of the area south of the Twelfth Fairway discharges west of Wellington Trace and is piped into the C-14A Canal. The eastern half (Greenbriar Circle, Brae Burn Place, Baltrusol Place and the Twelfth Fairway) drains into the C-17B Canal. All three of these canals ultimately drain north into the C-14 canal and discharge through Acme's Pump Station # 3 into SFWMD's C-51 Canal. The location of these canals and direction of the flow is shown in Figure 4.

B. Historical Flooding

Acme has been recording daily rainfall information within its boundaries since 1982. A review of the records indicates that rainfall exceeding 4 inches over a two-day period has occurred seven times between 1982 and January 1996. Table 1 provides information on the date and amount of rainfall received.

Table 1
High Rainfall Events Within Acme

Date	Rainfall Amount in Inches
April 29–30, 1982	4.0
June 22–24, 1986	5.6
July 7–8, 1988	5.5
January 16–17, 1991	10.3
November 8–9, 1992	5.4
August 23–25, 1995	4.2
October 13–17, 1995	12.4

On December 2, 1995 and January 18, 1996 Mock, Roos & Associates met with homeowners in the Twelfth Fairway area to discuss the flooding problems and possible improvements to reduce the severity of the flooding. The residents provided photographs and videos of flooding from the October 1995 storm. Residents recalled that flooding of the roads has occurred at least five times and a minimal amount of residence flooding resulted from at least two storm events (the January 1991 and October 1995 storm events). Water levels during the October 1995 storm were at or slightly above floor elevations of some homes. Water entering the buildings was exacerbated by roadway traffic which created waves. Copies of flood photos are attached as Figure 5.

C. *Development Activities*

South Shore 2A of Wellington was platted in 1975. Plans of the storm drainage and roadway improvements were completed in November 1975 and were designed and constructed in accordance with the requirements of Palm Beach

County. A review of these plans indicated that the minimum roadway elevation is 15.0 feet NGVD. At the time of the project's approval and construction, SFWMD existed only as the Central and South Florida Flood Control District and had no permitting program. As development progressed within Acme however, SFWMD as we know it today was created and a subsequent stormwater permit was required. Acme was issued its SFWMD surface water management permit in March 1978. This permit established a minimum roadway elevation of 16.0 feet NGVD and a minimum building pad elevation of 17.5 feet NGVD (Basin A) and 17.0 feet (Basin B) for all future development within Acme's boundary. These elevations provide the roadways with a 3-year level of flood protection (5.5 inches of rainfall within a 24-hour period) and building pads with a 100-year level of flood protection (13 inches within a 24-hour period). All of South Shore 2A is in Basin A and all of its roadways were constructed prior to the SFWMD permit. Therefore, the roads were built below the subsequently determined minimum of 16.0 feet NGVD, and as a result have less than a 3-year level of flood protection.

D. Field Investigations

On December 2 and December 27, 1995, field inspections were conducted to determine the extent of the existing drainage boundary and flooding as a result of the October storm. On December 2 residents along the Twelfth Fairway, Wyndcliff Drive and Baltrusol Place were contacted to obtain information. The residents indicated that the greenway between Wyndcliff Drive and the Twelfth Fairway was filled with water. Residents also confirmed that Wellington Trace was flooded between Birkdale Drive and Huntington, and across the Wyndcliff Drive roadway drainage swales. This caused the drainage system, which normally discharges into the C-14A Canal, to interconnect with the drainage system which discharges into the C-17B Canal. This interconnection resulted in the water from the C-14A Canal drainage basin flowing to the lower drainage basin of the C-17B Canal, i.e., the Twelfth Fairway area, thus compounding the flooding in this area.

A field survey confirmed that the greenway between Wyndcliff and the Twelfth Fairway is below an elevation of 16.0 NGVD, with the average ground elevation at 15.0 feet NGVD. The centerline elevation of Wellington Trace is 15.8 feet at its intersection with the Twelfth Fairway. North and south of this location the elevation increases to 17.0 feet at Birkdale Drive and adjacent to the greenway. When stages within Acme's canals rise above 16.0 feet, the drainage systems within the Twelfth Fairway area (which outfall to the C-14A and C-17B Canals) become interconnected.

E. Conclusions

Providing increased flood protection for the Twelfth Fairway area will require either increasing the flood protection for the entire Acme drainage boundary or isolating the Twelfth Fairway area (the C-17B Canal drainage basin) and pumping into Acme's canal system.

To provide better flood protection for the Twelfth Fairway area by increasing the protection within Acme's entire system would require either greatly increasing discharge into the C-51 Canal or purchasing land to provide additional water storage areas. Increased discharges into C-51 would require permitting and approval by SFWMD to exceed the allowable discharge. An increase in discharge to lower the flood stages by one foot (from 16 feet to 15 feet NGVD) would certainly be deemed excessive and would not be permitted by SFWMD. Lowering the stages by providing more storage would require the purchase of additional (approximately 150 acres) land within Basin A. This is also not feasible. Isolation of the Twelfth Fairway area appears to be the only viable alternative. The drainage boundary for a pumped system to serve the Twelfth Fairway is shown in Figure 6.

III. Recommended Improvements

A. Stormwater Management Facilities (see Figures 7, 8 and 9)

1. The stormwater runoff from the Twelfth Fairway drains to the C-17B Canal, then to a lake in the Palm Beach Polo Club Golf Course and then to the C-17 Canal. The existing pipe between the lake and the C-17 Canal is a 24" diameter, corrugated metal pipe with a capacity of approximately 1/6 of the calculated runoff. This pipe must be replaced first since any other improvements to the system would still be restricted at this point.

2. Pipes at the east end of the system which connect the greenway to the C-17B Canal are undersized and must be replaced. The outfall shown in Figures 7, 8 and 9 is preliminarily designed assuming that an easement between the homes of appropriate width for construction is available.

3. To isolate the Twelfth Fairway drainage basin from the surrounding areas, the drainage system currently flowing west to the C-14B Canal must be severed at Wellington Trace, replaced with larger pipes and redirected to the east. Then, Wellington Trace must be raised approximately one foot at its intersection with the Twelfth Fairway. This will eliminate the interconnection through the greenway and along Wyndcliff Drive. The redirected system will discharge into the greenway through either an underground pipe system (Option I) or through a lowered and enlarged swale (Option II). The greenway system will be connected to the enlarged piped system discharging to the C-17B Canal.

4. A pump station needs to be installed within the C-17 Canal. The pump station could be located anywhere along the C-17 Canal from the Palm Beach Polo Club easterly to the C-8 Canal. However, locating the pump station at the intersection of the C-17B, C-17A and the C-17 Canals

reduces the contributing drainage area, thus decreasing the pump size and providing increased flood protection for the Twelfth Fairway area.

Figures 8 and 9 provide information on the size of appropriate stormwater improvements for the Twelfth Fairway. These improvements include replacement of the golf course crossing, preliminary sizing of the stormwater pipe collection system and the pump station.

B. Level of Flood Protection

Results of computerized flood routings (model simulations) of the proposed improvements, for various rainfall events are shown in Table 2.

Historically, the roadways have been flooded in rainfall events exceeding 4 inches in 24 hours. The aforementioned stormwater drainage system improvements will provide flood protection within the drainage boundary depicted in Figure 7 as long as the stages in Acme's stormwater system, particularly the C-14A Canal, are below the elevation of Wellington Trace and other boundary locations. If Wellington Trace is not raised, this is equivalent to approximately a 3-year level of flood protection for the area's roadways (5.5 inches in 24 hours). By raising Wellington Trace approximately one foot and raising the swales of Wyndcliffe Drive that are approximately 50 feet north of the Twelfth Fairway, an increased roadway protection level of 5 years (7 inches in 24 hours) could be achieved.

For those buildings within the Twelfth Fairway system that are at or above an elevation of 16.3 feet NGVD, the proposed improvements may provide a building flood protection level for a 100-year, 1-day storm event.

The recommendations described are a practical solution to the Twelfth Fairway drainage problem and will provide a higher level of flood protection than currently exists. It must be pointed out, however, that in the event of a storm severe enough to raise the stage of the Acme canal system above approximately 17 feet NGVD,

the Twelfth Fairway area will no longer be isolated and the levels of protection described will not apply, although the duration of flooding would be less.

Table 2

Storm Frequency (Year)	24 Hour Rainfall (Inches)	Stage within Twelfth Fairway area (Feet - NGVD)
3	5.5	12.8
5	7.0	14.2
10	8.5	15.5
25	10.0	15.9
100	13.0	16.3

C. *Cost of Improvements*

Two options were considered for implementing the necessary stormwater improvements.

1. Option I involves constructing an underground drainage system through the greenways (see Figure 8).

2. Option II would result in substantial cost savings by substituting a combination of a pond and a drainage swale for the section of underground pipe system within the greenway (see Figure 9).

In both cases, implementation of the improvements can be phased in as funds are available. Costs of improvements and a phasing plan of a completely piped system is provided in Table 3. Phase I includes replacement of the golf course crossing; Phases II and III involve construction of the internal drainage improvements within the Twelfth Fairway area, including raising Wellington Trace; and Phase IV is the construction and installation of a pump station. The cost estimate for the pump

station includes steel sheet piling across the canal, a building to house the pumps and controls, an electric pump with diesel backup, a fuel tank and telemetry to monitor water levels and activate the pump. The total probable construction cost, including fees and construction contingencies, is conceptually estimated at $780,000. As this program moves forward, the cost estimate will require adjustments based on more detailed information and construction plans. The costs could also be affected by negotiations with Palm Beach Polo Golf Club for an easement and replacement of the existing 24″ diameter pipe at the golf course crossing.

Electing manual pump station operation can reduce costs, but would be operationally less efficient.

The cost of Option I can be reduced by replacing the 54″ RCP shown in Figure 7 (redline) with a pond and a swale section within the greenway (Option II). A pond is needed to provide an area to collect sediments from the stormwater pipe system and to provide a transition to the swale section. Table 4 provides a phase program for implementation of this option. The total probable cost of Option II including fees and construction contingencies is conceptually estimated at $622,000.

Table 3
Engineer's Estimate of Probable Construction Cost
12th Fairway - Drainage Improvements - Option I
Acme Improvement District
Our Ref. No. 95731.00

Item No.	Item	Qty.	Unit	Unit Price	Total Est. Price
A.	Phase I - Replace Pipe at Golf Course				
1	Mobilization	1	LS		$5,000
2	Removal of Existing Pipe	1	LS		3,000
3	Furnish and Install 54" RCP - Class III	170	LF	130.00	22,100
4	Grading and Compacting	1	LS		2,500
5	Sod Replacement	450	SY	3.00	1,350
6	End Treatment	2	EA	600.00	1,200
	SUBTOTAL				**$35,150**
	20% Engineering Fees and Construction Contingency				$7,030
	TOTAL Phase I				**$42,180**
B.	Phase II - Construction of Drainage System Improvements Part 1				
1	Mobilization	1	LS		$5,000
2	Maintenance of Traffic	1	LS		5,000
3	4" Concrete Sidewalk	15	SY	30.00	450
4	12" Compacted Subgrade	100	SY	2.00	200
5	6-1/2 " Limerock Base, Primed	100	SY	9.00	900
6	1 1/2" Type S-III ACSC	100	SY	5.00	500
7	Sodding	3500	SF	0.50	1,750
8	Inlets - Type H	4	EA	3,000.00	12,000
9	Manholes - 6' Diameter	3	EA	2,000.00	6,000
10	Sleeve for exist. pipes 18"-24"	200	LF	20.00	4,000
11	48" RCP Class III	1280	LF	105.00	134,400
12	54" RCP Class III	250	LF	130.00	32,500
13	Concrete Endwall @ C-23 Canal	1	LS		1,000
14	Grading/Paving & Pipe Removal	1	LS		1,200
15	Utility Conflicts	1	LS		30,000
	SUBTOTAL				**$234,900**
	20% Engineering Fees and Construction Contingency				$46,980
	TOTAL Phase II				**$281,880**

Prepared by:
Mock, Roos & Associates, Inc.
February 19, 1996

Table 3
Engineer's Estimate of Probable Construction Cost
12th Fairway - Drainage Improvements - Option I
Acme Improvement District
Our Ref. No. 95731.00

Item No.	Item	Qty.	Unit	Unit Price	Total Est. Price
C.	Phase III - Construction of Drainage System Improvements Part 2				
1	Mobilization	1	LS		$5,000
2	Maintenance of Traffic	1	LS		10,000
3	4" Concrete Sidewalk	30	SY	30.00	900
4	12" Compacted Subgrade	150	SY	2.00	300
5	6 " Limerock Base, Primed	150	SY	9.00	1,350
6	1 1/2" Type S-III ACSC	150	SY	5.00	750
7	Driveway Replacement	4	EA	250.00	1,000
8	Sodding	1500	SY	2.00	3,000
9	Inlets - Type E	1	EA	2,000.00	2,000
10	Inlets - Type H	1	EA	3,000.00	3,000
11	Manholes - 6' Diameter	3	EA	2,000.00	6,000
12	Sleeves - 18" to 24"	116	LF	20.00	2,320
13	30" RCP - Class III	295	LF	65.00	19,175
14	42" RCP - Class III	394	LF	85.00	33,490
15	48" RCP - Class III	522	LF	105.00	54,810
16	Storm Sewer Abandonment	1	LS	600.00	5,000
17	Grading/Paving & Pipe Removal	1	LS		1,500
18	Utility Conflicts	1	LS		20,000
19	Raising Wellington Trace	1	LS		21,000
	SUBTOTAL			/	**$190,595**
	20% Engineering Fees and Construction Contingency				$38,119
	TOTAL Phase III				**$228,714**
D.	Phase IV - Pump Assembly at C-17 Canal				
1	Mobilization	1	LS		5,000
2	Grading & Compacting	1	LS		5,000
3	Sod Replacement	1	LS		750
4	Fencing	100	LF	40.00	4,000
5	Sheetpile & Cap	40	LF	750.00	30,000

Prepared by:
Mock, Roos & Associates, Inc.
February 19, 1996

Table 3
Engineer's Estimate of Probable Construction Cost
12th Fairway - Drainage Improvements - Option I
Acme Improvement District
Our Ref. No. 95731.00

Item No.	Item	Qty.	Unit	Unit Price	Total Est. Price
6	Shed	1	LS		20,000
7	20,000 gpm Pump & Controls	1	EA	35,000.00	35,000
8	Diesel Engine	1	LS		30,000
9	48" Flap Gate	1	EA	3,100.00	3,100
10	Fuel System	1	LS		33,000
11	Telemetry	1	LS		22,000
	SUBTOTAL				**$187,850**
	20% Engineering Fees and Construction Contingency				$37,570
	TOTAL Phase IV				**$225,420**
	Total PHASES I, II, III & IV				**$778,194**

Prepared by:
Mock, Roos & Associates, Inc.
February 19, 1996

Table 4
Engineer's Estimate of Probable Construction Cost
12th Fairway - Drainage Improvements - Option II
Acme Improvement District
Our Ref. No. 95731.00

Item No.	Item	Qty.	Unit	Unit Price	Total Est. Price
A.	Phase I - Replace Pipe at Golf Course				
1	Mobilization	1	LS		$5,000
2	Removal of Existing Pipe	1	LS		3,000
3	Furnish and Install 54" RCP - Class III	170	LF	130.00	22,100
4	Grading and Compacting	1	LS		2,500
5	Sod Replacement	450	SY	3.00	1,350
6	End Treatment	2	EA	600.00	1,200
	SUBTOTAL				**$35,150**
	20% Engineering Fees and Construction Contingency				$7,030
	TOTAL Phase I				**$42,180**
B.	Phase II - Construction of Drainage System Improvements				
1	Mobilization	1	LS		$10,000
2	Maintenance of Traffic	1	LS		5,000
3	4" Concrete Sidewalk	10	SY	30.00	300
4	12" Compacted Subgrade	130	SY	2.00	260
5	6 " Limerock Base, Primed	130	SY	9.00	1,170
6	1 1/2" Type S-III ACSC	130	SY	5.00	650
7	Sodding	6500	SF	2.00	13,000
8	Inlets - Type H	1	EA	3,000.00	3,000
9	Manholes - 6' Diameter	2	EA	2,000.00	4,000
10	Modification of Existing Structure	2	EA	1,000.00	2,000
11	48" RCP Class III	220	LF	105.00	23,100
12	54" RCP Class III	250	LF	130.00	32,500
13	Modification of Existing Pipe	1	LS		1,000
14	Removal of Existing Pipes	1	LS		2,500
15	Pond and Ditch Excavation/Grading	4500	CY	2.50	11,250
16	End Treatments	2	EA	600.00	1,200
17	Raising Wellington Trace	1	LS		21,000
18	Storm Sewer Abandonment	1	LS		5,000
	SUBTOTAL				**$136,930**
	20% Engineering Fees and Construction Contingency				$27,386
	TOTAL Phase II				**$164,316**

Prepared by:
Mock, Roos & Associates, Inc.
February 19, 1996

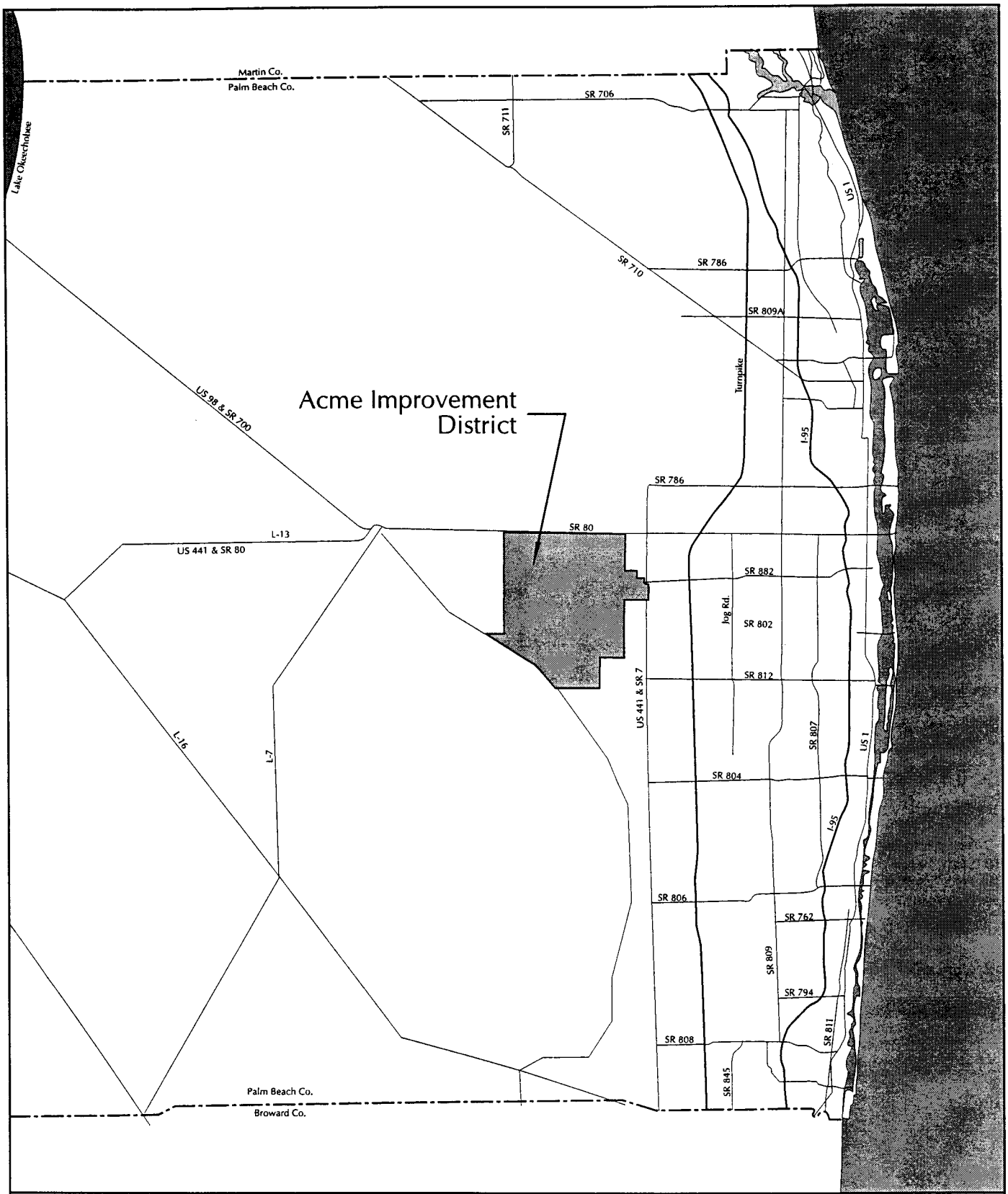
Table 4
Engineer's Estimate of Probable Construction Cost
12th Fairway - Drainage Improvements - Option II
Acme Improvement District
Our Ref. No. 95731.00

Item No.	Item	Qty.	Unit	Unit Price	Total Est. Price
C.	Phase III - Replacing Existing Pipes on West Side				
1	Mobilization	1	LS		$10,000
2	Maintenance of Traffic	1	LS		15,000
3	4" Concrete Sidewalk	35	SY	30.00	1,050
4	12" Compacted Subgrade	120	SY	2.00	240
5	6 " Limerock Base, Primed	120	SY	9.00	1,080
6	1 1/2" Type S-III ACSC	120	SY	5.00	600
7	Driveway Replacement	4	EA	250.00	1,000
8	Sodding	600	SY	2.00	1,200
9	Inlets - Type E	1	EA	2,000.00	2,000
10	Inlets - Type H	1	EA	3,000.00	3,000
11	Manholes - 6' Diameter	4	EA	2,000.00	8,000
12	Sleeves - 18" to 24"	148	LF	20.00	2,960
13	30" RCP - Class III	295	LF	65.00	19,175
14	42" RCP - Class III	394	LF	85.00	33,490
15	48" RCP - Class III	515	LF	105.00	54,075
16	End Treatments	1	EA	600.00	600
17	Pipe Removal	1	LS		5,000
	SUBTOTAL				**$158,470**
	20% Engineering Fees and Construction Contingency				$31,694
	TOTAL Phase III				**$190,164**
D.	Phase IV - Pump Assembly at C-17 Canal				
1	Mobilization	1	LS		5,000
2	Grading & Compacting	1	LS		5,000
3	Sod Replacement	1	LS		750
4	Fencing	100	LF	40.00	4,000
5	Sheetpile & Cap	40	LF	750.00	30,000
6	Shed	1	LS		20,000
7	20,000 gpm Pump & Controls	1	EA	35,000.00	35,000

Table 4
Engineer's Estimate of Probable Construction Cost
12th Fairway - Drainage Improvements - Option II
Acme Improvement District
Our Ref. No. 95731.00

Item No.	Item	Qty.	Unit	Unit Price	Total Est. Price
8	Diesel Engine	1	LS		30,000
9	48" Flap Gate	1	EA	3,100.00	3,100
10	Fuel System	1	LS		33,000
11	Telemetry	1	LS		22,000
	SUBTOTAL				**$187,850**
	20% Engineering Fees and Construction Contingency				$37,570
	TOTAL Phase IV				**$225,420**
	Total PHASES I, II, III & IV				**$622,080**

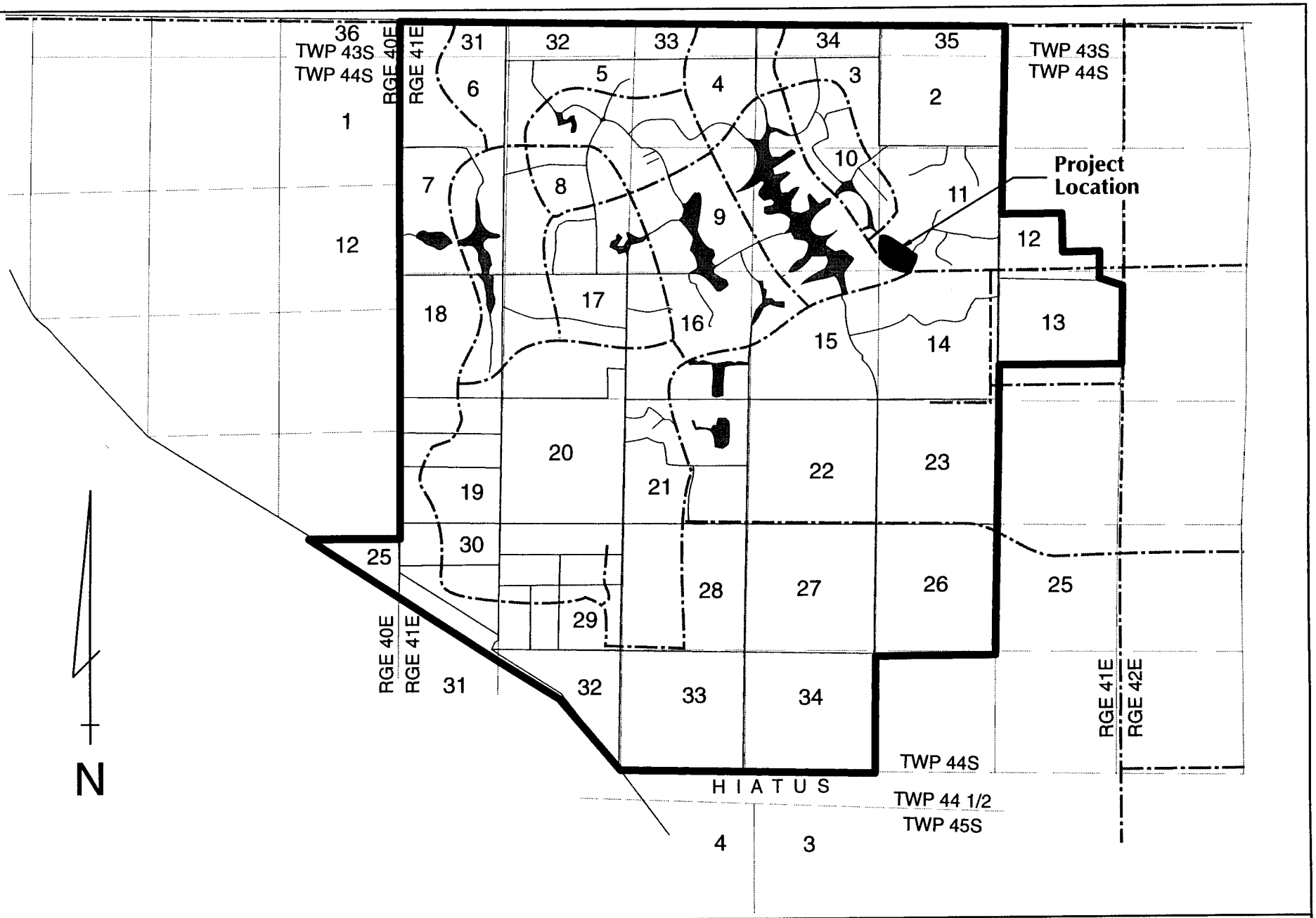
Exhibit 20



MOCK • ROOS
ENGINEERS • SURVEYORS • PLANNERS
Mock, Roos & Associates, Inc.
5720 Corporate Way, West Palm Beach, FL 33407, (407) 683-3113, fax 478-7248

Acme Improvement District
Location Map
Figure 1

ACME IMPROVEMENT DISTRICT



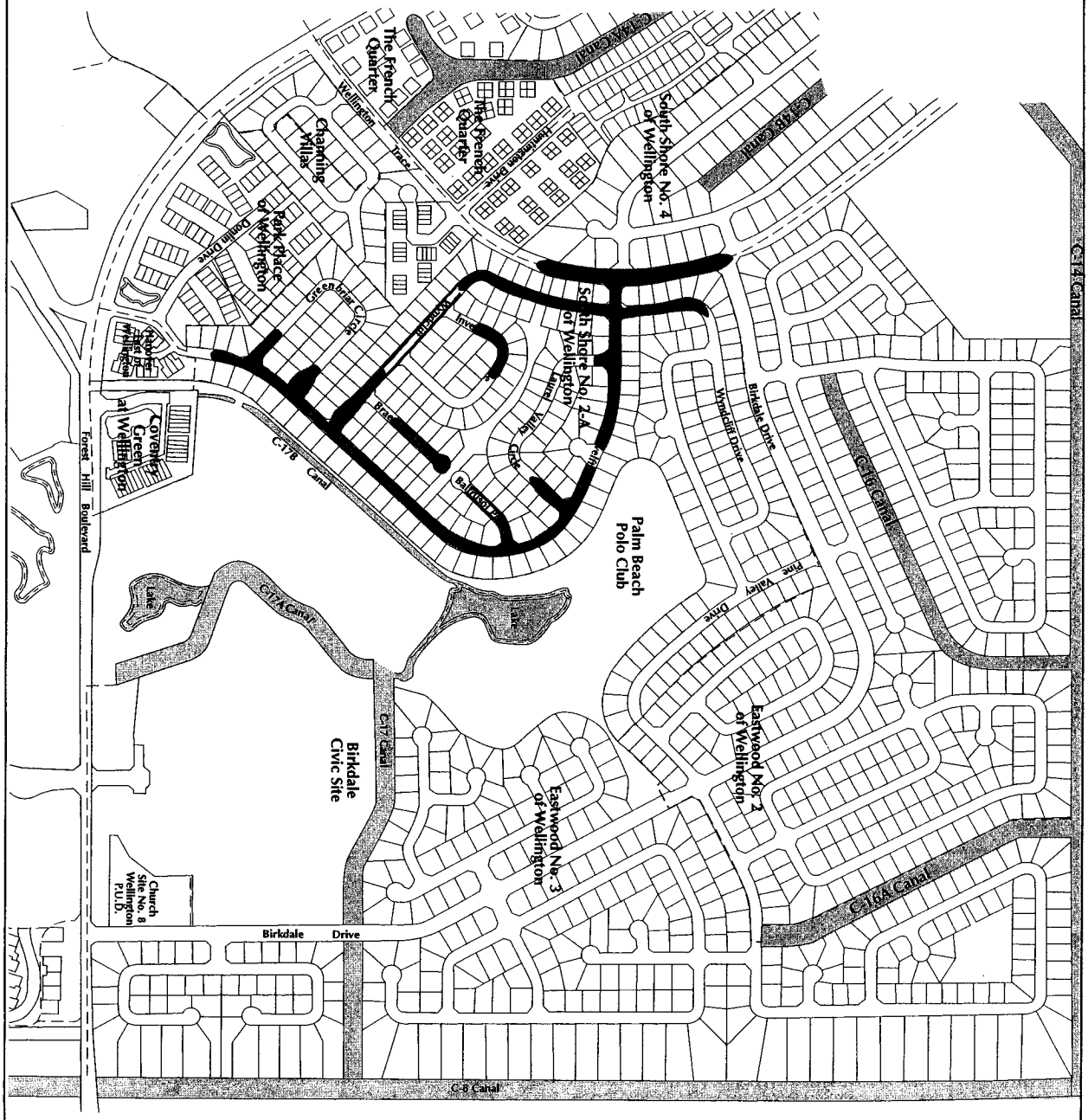
MOCK • ROOS
ENGINEERS / SURVEYORS / PLANNERS

The Twelfth Fairway—Location Map
Figure 2

ACME IMPROVEMENT DISTRICT

Exhibit 20

Exhibit 20



= The Twelfth Fairway Flooded Areas Oct. 17, 1995 Storm

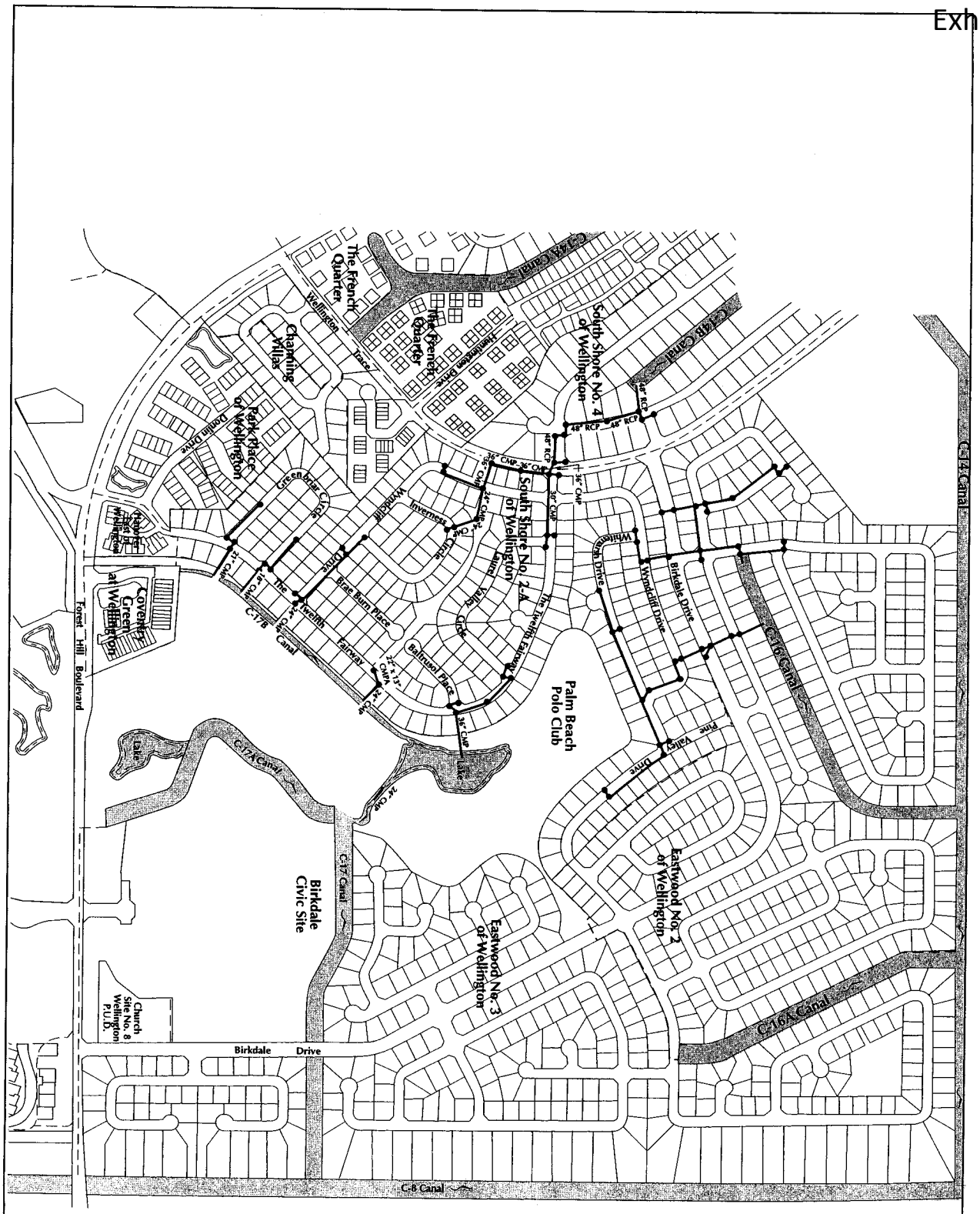
Note: Based on observations of Acme and residents of the area

MOCK ROOS
ENGINEERS SURVEYORS PLANNERS

The Twelfth Fairway—Flooded Areas, October 17, 1995 Storm
Figure 3

ACME

Exhibit 20



MOCK ROOS
ENGINEERS SURVEYORS PLANNERS

The Twelfth Fairway
Existing Drainage System
Figure 4

ACME

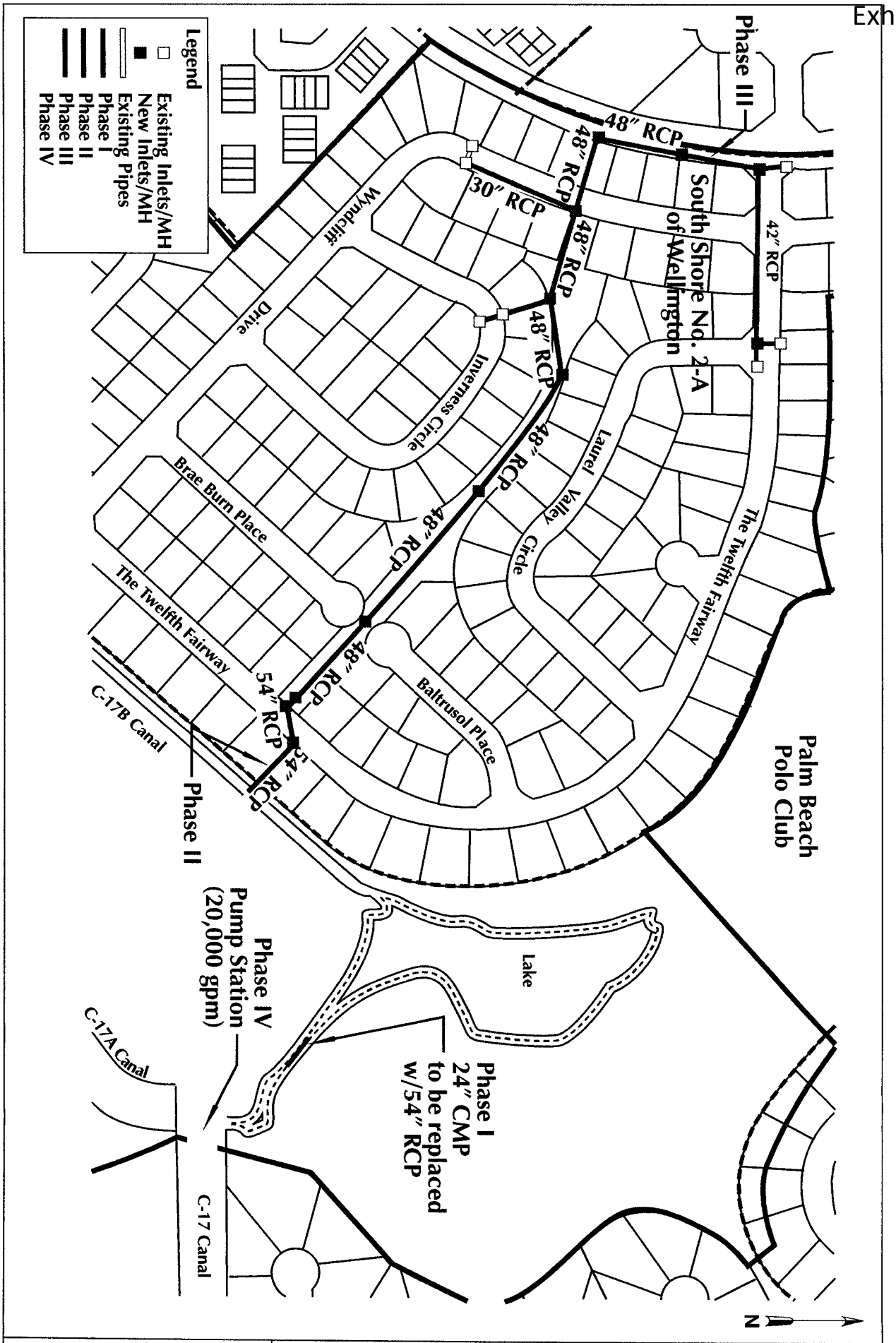
Exhibit 20

MOCK • ROOS
ENGINEERS SURVEYORS PLANNERS

The Twelfth Fairway
Drainage Improvements
Figure 7

ACME IMPROVEMENT DISTRICT

Exhibit 20

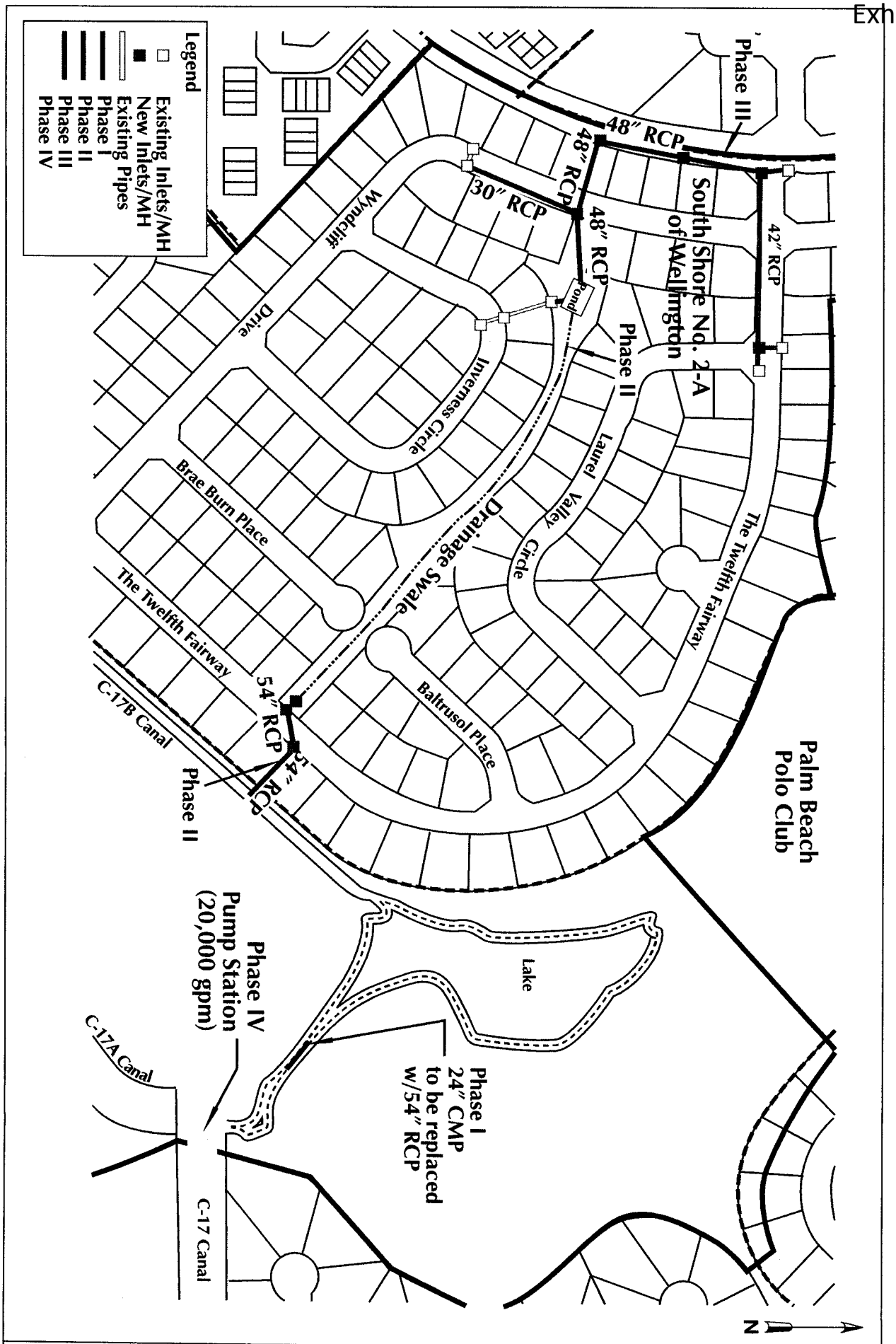


MOCK • ROOS
ENGINEERS SURVEYORS PLANNERS

The Twelfth Fairway—Option 1
Stormwater Drainage System Improvements
Figure 8

ACME

Exhibit 20



MOCK ROOS
ENGINEERS SURVEYORS PLANNERS

The Twelfth Fairway—Option 2
Stormwater Drainage System Improvements
Figure 9

ACME IMPROVEMENT DISTRICT