Exhibit 19

Pump Station Nos. 3 and 4 Preliminary Study

for

Acme Improvement District

ACME IMPROVEMENT DISTRICT

prepared by

MOCK • ROOS
ENGINEERS • SURVEYORS • PLANNERS

August 1996

Mock, Roos & Associates, Inc., 5720 Corporate Way, West Palm Beach, FL 33407

Exhibit 19

ENGINEER'S SIGNATURE PAGE

This *Pump Station Nos. 3 and 4 Preliminary Study* report was prepared and assembled by a team of Professional Consultants. Mr. Jeffrey Hiscock of Mock, Roos & Associates, Inc. was responsible for the mechanical engineering aspects. Mr. Larry Smith of Resource Management International, Inc. was responsible for the electrical engineering aspects. Mr. Brian Rheault of Bridge Design Associates, Inc. was responsible for the structural engineering aspects. The information provided herein was based, in part, on the information that was available and obtained from Acme Improvement District and other agencies identified herein. The Engineers cannot be responsible for information added or deleted once distributed. As Professional Engineers in the State of Florida, it is our opinion that the information (relevant to the engineers' respective responsibilities) presented in this report is true and factual.

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1.0 Introduction

Acme Improvement District (Acme) authorized Mock, Roos & Associates, Inc, to conduct mechanical, structural and electrical assessments of Stormwater Pumping Station Nos. 3 and 4 for the purpose of conducting a preliminary study. This study is intended to provide the District with recommendations and construction cost estimates to upgrade the pump stations.

Pump Station Nos. 3 & 4 were built in the early 1970's and were designed for flood control of agricultural and undeveloped lands. The existing design (diesel engines and belts) is consistent with pump stations currently serving large agricultural drainage districts in South Florida. The stations are manually operated requiring the presence of one or more persons at any given time of day or night to turn the pumps on and off and to record the pump run times and water levels.

The change in land use over the last 20 years has added a significant amount of impervious area to the drainage basin increasing the volume and rate stormwater runoff which reduces Acme's response time to activate the pumps. Furthermore, the existing mechanical design is vulnerable to failure and difficult to automate. While this type of design serves agricultural districts very well, Acme recognizes that to serve urban land use, a more modern design is necessary that is consistent with other municipal stormwater pump stations. Design upgrades considered in this study include:

- Replacement of aging equipment
- Automation and reliability
- Noise reduction
- Utilization of telemetry
- Emergency Back-up
- Potential increase in capacities

The potential for increased capacities was assessed in an effort to be prepared for water management alternatives resulting from discussions with the South Florida Water Management District (SFWMD). The Everglades Forever Act mandates that waters discharging to the Everglades meet certain water quality standards by the year 2006. As a result, Pump Station Nos. 1 & 2 which serve Basin B may have to be removed or relocated. One possible alternative could include re-routing flow north through Basin A. Such a proposal would require extensive modeling which is not included in this study. This study does include, however, an assessment of the upgradability of Pump Station Nos. 3 & 4 to handle an increase in flow, if required.

2.0 *Description of Facilities*

2.1 Function and Operation

Pump Station Nos. 3 and 4 discharge stormwater from the northern half of Acme directly to the C-51 Canal (see Figure 1 - Location Map). The function of the pumping stations is to provide stormwater protection in the northern 8,990 acres (Basin A) of Acme Improvement District. Photographs and site plans of both pump stations are provided in Figures 2 through 4. The stations were originally designed to remove 0.71 inches of stormwater runoff per day with a total discharge capacity of 120,000 gallons per minute. The pump schedule as permitted by SFWMD is to maintain a water level 11.0 feet NGVD (National Geodetic Vertical Datum) in the canals during the wet season (May through October) and 12.0 feet NGVD during the dry season (November through April).

The stations are permitted by SFWMD under two separate permits. Surface Water Management Permit No. 50-00548-S authorizes operation of the stations based on the pump schedule described above. Right-of-Way Permit No. 50-00548-R authorizes drainage connections to SFWMD's C-51 Canal. The pump stations are not actually located within SFWMD's right-of-way. However, they are referenced in the permit and operation is dependant on the permit. Copies of both permits are provided in Appendix A.

Each pump station consists of a building that houses diesel engines, electrical panels and day tanks. Pump Station No. 3 (see Figure 5 for layout) includes one 60,000 gpm (gallons per minute) pump. Pump station No 2 (see Figure 6 for layout) includes two 60,000 gpm pumps, one of which is used as a backup.

Each pump station also includes a 72 inch gated drainage culvert and a 25,000 gpm electric irrigation pump. The drainage culverts are used to discharge runoff via gravity (when upstream and downstream elevations permit). This feature is used often in lieu of pumping and results in a considerable cost savings in diesel fuel. The irrigation pumps include 100 hp electric motors, belts and pulleys. They are located on the north side of

the pump stations and pump water from the C-51 Canal to Acme's canals. These pumps are not the focus of this study but future alternative designs must consider their presence.

2.2 Mechanical

Pump Station No. 3 consists of one diesel engine with a belt drive unit that powers an axial flow vertical lift pump. The design capacity of the pump is 60,000 gpm. The engine is rated at 275 hp and is manufactured by Perkins.

The belts extend from the engine pulley in a vertical configuration and are twisted to match a horizontal pulley directly above the pump. The pump is located outside the building supported by a platform attached to the south face of the building. The pulley drives a lineshaft connected to the pump propeller. The pumps create a vertical lift of water forcing it through a 54 inch diameter steel discharge pipes located under the building and extending north for approximately 40 feet to the discharge canal. The pipe outlet is equipped with a steel flap gate that prevents water from backflowing into Acme's canals.

A 4,000 gallon aboveground diesel fuel tank serves the pump station's diesel engine. This steel tank is located within a concrete containment area designed to meet DEP Rule 17-762 for secondary containment.. Feed and return lines are located above ground within a secondary containment pipe. These lines are connected to a 50 gallon day tank which, in turn, has feed and return lines to and from the engines. The day tank is used to maintain fuel levels within a specified range. Most diesel engine manufactures recommend that fuel levels be maintained below the fuel injection valves to prevent potential fuel bypass. The tank also includes feed and return pumps in combination with a solenoid valve and check valves can maintain the appropriate level.

Pump Station No. 4 consists of two diesel engines. One of which is connected to a belt drive unit and the other is connected to a right angle gear drive unit. Each drive unit transfers power to an axial flow vertical lift pump that is arranged in a similar configuration as Pump Station No. 3. The design capacity of both pumps is 60,000 gpm and the

engines are both rated at 275 hp. The engine for the belt driven pump was manufactured by Perkins and the engine for the lineshaft/gear driven pump was manufactured by Caterpillar. Both engines are supplied with fuel from an external 4,000 gallon aboveground diesel fuel tank. This steel tank is located within a concrete containment area designed to meet DEP Rule 17-762 for secondary containment. The fuel system design is similar to the design described for Pump Station No. 3.

Both pumps are located outside the building supported by a platform attached to the east face of the building. The pumps create a vertical lift of water forcing it through 54 inch diameter steel discharge pipes located under the building and extending west for approximately 40 feet to the discharge canal. Each pipe outlet is equipped with a steel flap gate that prevents water from backflowing into Acme's canals.

2.3 Structural

Both pump stations were constructed utilizing reinforced masonry walls with a precast double roof system. The fore bays and discharge bays on both pump stations include structural steel headwalls.

2.4 Electrical

Pump Station No. 3 is served with 480 volt, three phase electrical power underground from a Florida Power and Light Company (FPL) pad-mounted transformer. The main panel is served through a 40 amp, 2 pole main breaker (at 480 volts), a 15 kVA, single phase 480:240 volt, dry-type transformer, and a 100 amp, 2 pole manual transfer switch. The manual transfer switch was used in conjunction with an emergency generator that is no longer in place. Therefore, there is currently no backup for the FPL power source. The main panel is rated 100 amp, single phase, three-wire, 120/240 volt, with a 60 amp, 2 pole main breaker. This panel serves one 2 hp, 230 volt sump pump, a 230 volt welder receptacle, 120 volt lighting and receptacle circuits, and other miscellaneous 120 volt loads including engine battery chargers, telemetry system, etc. There is a second 480 volt main

breaker within a size 4 motor starter enclosure which feeds a 100 h.p. electric pump motor used for irrigation.

The main electrical equipment for Pump Station No. 4 is exactly as described above with the exception that Pump Station No. 4 is served with 480 volt, three-phase electrical power overhead from a FPL pole mounted transformer bank.

3.0 Condition of Facilities

3.1 Mechanical

3.1.1 Pumps

The condition of the pumps was determined with testing that was performed by MWI Couch Pump Company. The original design static head, i.e., downstream water level minus upstream water level, is not available (n/a) for the pumps in Pump Station No. 2. An appropriate static head can be estimated, however, based on the control elevation of Acme's canals (13.0 feet) and the estimated high water level of Conservation Area No. 1. The downstream water level in the Conservation Area is maintained normally during the wet season at 17.0 feet. With the exception of a major rain event, a conservative elevation to use is 18.0 feet. There may be occasions when the pumps need to run with upstream elevations that are one foot below the control elevation (to account for head loss in the canals). This results in a maximum static head of 6 feet.

The results of the testing are provided in Appendix B and are summarized below:

Pump Station No. 3	Design Head	Design Flow	Test Results at Design Head
Pump 1	6.5 ft	60,000 gpm	67,000 gpm
Pump Station No. 4			
Pump 1	6.5 ft	60,000 gpm	49,000 gpm
Pump 2	4.5 ft	60,000 gpm	50,000

The results indicate that the pumps in Pump Station No. 4 are currently discharging only 83 percent of their original design capacity. This may be indicative of a problem beyond basic maintenance such as damaged propellers or bent shafts. Assessment and repair by a qualified pump manufacturer would be required.

3.1.2 Engines

The engines have been well maintained by Acme's maintenance staff. Failed engine components of the engines such as cooling systems and PTOs (Power Take-Off) have been replaced with appropriate parts that have solved previous problems. Much of the success is due to the District's long-term employees that have maintained the stations for over twenty years and have learned through experience how to solve problems. One of the three engines have been in operation for 23 years.

The fuel systems at both stations are identical and include external, aboveground, steel tanks located within concrete secondary containment areas. Both systems were constructed in 1995 and show no signs of problems.

3.2 Structural

The pump station buildings are both in good structural condition with no visible signs of structural distress. The steel sheeting headwalls in the fore bays and discharge bays have not been painted and have a significant amount of corrosion. The canal banks at the ends of the headwalls have washed out, and soil from behind the headwalls has been washed away. These banks should be reshaped and erosion protection should be applied.

The steel sheeting should be sandblasted and painted. A concrete pile cap or a steel channel cap should be added to the existing steel sheeting for structural reinforcement.

The trash racks in the fore bays do not fully protect the pump intake manifolds. The trash racks should be redesigned and configured to properly protect the pump intake manifolds.

3.3 Electrical

At both pump stations the main panels and manual transfer switches appear to be near the end of their service lives. The 40 amp main breakers, dry-type transformers, and size 4 motor starters (with associated main breakers) appear to be in good condition. Both

stations make use of old fluorescent lighting fixtures with four, F40T12 lamps each to provide light within them. The telemetry systems at each station appear to be in good condition, however, they are currently nonfunctional.

4.0 Alternatives

The first alternative, of course, is for the stations to remain exactly as they are currently designed. Operating and maintenance costs would steadily increase over the next five to ten years. After which time, significant replacement costs would begin on an as needed basis. Remaining with the existing design, however, does not meet any of the objectives (with the exception of emergency back-up) which are intended to upgrade stations from an agricultural type of system to a populated urban type of system. These objectives are as follow:

- Replacement of aging equipment
- Automation and reliability
- Noise reduction
- Utilization of telemetry
- Emergency Back-up
- Potential increase in capacities

There are two basic design alternatives that could achieve the above objectives -- diesel or electric. There are several factors that, once considered, suggest an electric design scenario is more appropriate for these pump stations. These factors, as they relate to each of the above objectives are presented below:

- A diesel design could utilize the existing pumps. However, the pumps are over 23 years old and should be considered for replacement within seven years unless future testing indicates otherwise. Two of the three pumps have shown signs of wear based on the flow test results which were significantly below the rated capacities. As these pumps continue to age, routine overhauling will be less effective and be required more often. Replacement should be considered.

- Automation and the incorporation of telemetry is much simpler with electric pumps and significantly more reliable than mechanical alternatives. Retro-fitting diesel engines for automation requires a mechanical means of slowly engaging the pumps using clutches. Such systems are more prone to breakdown and failure than electrical starters.

- Submersible electric pumps produce significantly less noise than diesel engines. Buildings can be modified to reduce the noise by adding baffle walls around ventilation areas. However, the north and south sides of these buildings do not accommodate the room that would be necessary.

- To incorporate automation to the diesel powered pumps, lineshafts, centrifical clutches and right angle gear drives would be necessary. Such configurations can cause an increase in noise.

- Overall cost is similar considering that utilization of existing equipment in the diesel scenario would be offset by cost of additional equipment and structural improvements necessary for automation and noise reduction, respectively.

- Physically, there is not enough room under the stations' buildings to accommodate additional pumps and discharge pipes. To increase pump station capacities, the additional pumps and discharge pipes would need to be located parallel to and east of the existing pumps and discharge pipes. For a diesel system, this would require extending the existing buildings eastward to house the new engines that would be required. For electric systems the motor is located with the pump and is submerged.

For these reasons electrical design systems are preferable to the existing diesel driven systems and should be considered in the recommended design alternative(s).

5.0 Recommended Design Alternative

5.1 Description

It is recommended that Pump Station Nos. 3 and 4 be modified to include two 60,000 gpm 200 horsepower electric submersible pumps at each station to replace the aging pumps and diesel engines. It should be noted that the stations' function and appearance would remain virtually unchanged. The new pumps and pump canisters would simply replace the old pumps and manifolds that are located on the south side of the pump stations. One engine would remain in each building to serve a generator for back-up power. The buildings would also house new control panels and motor control centers.

Currently, only Pump Station No. 4 includes a back-up pump. It is advisable to have one back-up pump per station. Because the canal system is inter-connected, hydrologic/ hydraulic modeling may support the scenario of only one overall back-up pump. It is recommended that the modeling consider the worst case in which a pump failure occurs where there is only one pump available and that two pumps are then activated at the other station. If feasible, the modeling should also determine which station should include the back-up pump. Any station containing more than one pump should be designed through the control panel to alternate usages between the pumps to provide a roughly even distribution of pump run times.

Overall automation should be achieved using the existing telemetry system installed by Dataflow Systems. Modifications will be necessary including the addition of a Program Logic Control (PLC) unit. This module unit contains the conditional criteria that will determine whether and when and pumps should be turned on or off. It is recommended that electrodes within PVC stilling pipes be mounted to the sheetpile headwalls both north and south of the stations to monitor the upstream and downstream water levels at each station. Floats should be used on the upstream side of the stations as an emergency back-up control feature.

It is recommended that the diesel engines for the generator be air cooled and configured to blow the exhaust air directly outside of the buildings. This will improve ventilation and engine efficiency. It is further recommended that small thermostatically controlled wall fans be installed to maintain appropriate ambient room temperatures. These improvements will require minor structural modifications to the buildings.

5.2 Reuse of Existing Facilities

The buildings, fuel tanks, discharge pipes, steel sheetpile headwalls, etc. would all be utilized. The trash rack, however, would need to be relocated further away from the pumps. The Hydraulic Institute Standards1 suggests that the trash rack for these size pumps should be located at least 27 feet away from the pumps. The trash rack is currently located only 14 feet (on average) away from the pump(s). Appropriate setbacks are necessary to avoid the formation of vortexes that can cause the pumps to overload and/or cavitate.

Although the existing pumps and engines are not compatible with the recommended design, there is a potential for reuse of these facilities. The existing pumps would no longer be needed and could be stored as spare pumps for Pump Station Nos. 1 and 2 or they could be sold back to the pump manufacturer. MWI/Couch Pump has indicated that they may buy back the pumps. There is a remote possibility one of the existing diesel engines could be utilized for the emergency generator. However, such a retrofit can create more problems than it solves. It is recommended that a new engine and generator set be purchased as an single unit for each station. Of the three existing engines, two are relatively new (late 1980's). The other engine is over 23 years old. There are two engines of the same size in Pump Station No. 1 that are also over 23 years old. It is recommended that the two newer engines for Pump Station Nos. 3 and 4 be used to replace the older engines in Pump Station No. 1.

5.3 Increasing Capacity

The Everglades Forever Act mandates that waters discharging to the Everglades meet certain water quality standards by the year 2006. As a result, Pump Station Nos. 1 & 2 which serve Basin B may have to be removed or relocated. One possible water management alternative could include re-routing flow north through Basin A. To determine feasibility, such a proposal would require extensive hydrologic/hydraulic modeling and an assessment of the upgradability of Pump Station Nos. 3 & 4 to handle the increase in flow. Hydrologic/ hydraulic modeling is not included in this study but is currently being performed separately.

For the purpose of this study, it is assumed that the total pump capacity of Pump Station Nos. 3 and 4 will increase by the 220,000 gpm which is the current permitted rate of discharge for Basin B. The total pump capacity of 340,000 gpm can then be achieved, conservatively, with six 60,000 gpm pumps(three per station). It is also assumed that only one back-up pump will be needed and would be located at Pump Station No. 3 which is more centrally located than Pump Station No. 4.

5.4 Probable Costs

Probable construction cost estimates were prepared for both of the discharge capacity scenarios (Existing and Increased) at each pump station (see Tables 1 and 2). Additionally, two cost options were developed for each scenario. It is assumed that the Existing Capacity Scenario will be implemented prior to the necessity (if ever) of increasing the capacity. The first option proposes to install electrical components sized only to handle the flow that is needed for the Existing Capacity Scenario. The second option considers installing electrical components sized to handle the ultimate increased capacity during the construction of the Existing Capacity Scenario including installation of a 600 kW generator, as opposed to a 250 kW generator as well as making other electrical design changes.

Exhibit 19

Total Probably Construction, Engineering, Legal and Administrative Costs			
	Pump Station No. 3	***Pump Station No. 4***	***Both Stations***
Existing Capacity Scenario			
Option 1	$695,750	$502,780	$1,198,530
Option 2	$785,450	$592,480	$1,377,930
Increased Capacity Scenario			
Option 1	$651,843	$665,551	$1,317,394
Option 2	$490,843	$504,551	$995,394
Option 1 Total	$1,347,593	$1,168,331	$2,515,924
Option 2 Total	$1,276,293	$1,097,031	$2,373,324

6.0 Summary and Conclusions

Pump Station Nos. 3 & 4 were built in the early 1970's and were designed for flood control of agricultural and undeveloped lands. The existing engine and belt design is consistent with pump stations currently serving large agricultural drainage districts. The stations are manually operated requiring the presence of one or more persons at any given time. The change in land use over the last 20 years has added a significant amount of impervious area to the drainage basin increasing the volume and rate of stormwater runoff which reduces Acme's response time to activate the pumps. The existing mechanical design is also vulnerable to failure and difficult to automate. Acme recognizes that to serve urban land use, a more modern design is necessary that is consistent with other municipal stormwater pump stations serving populated areas.

Overall, the stations are in good condition considering their age which is a result of good maintenance practices. The structural components of the stations are in excellent condition with the exception of the steel sheetpiling which requires cleaning, painting and structural reinforcement. The pump flow tests revealed that two of the pumps are performing at only 83 percent of their original design. This is indicative of worn bearings, bent shafts and/or damaged propeller blades.

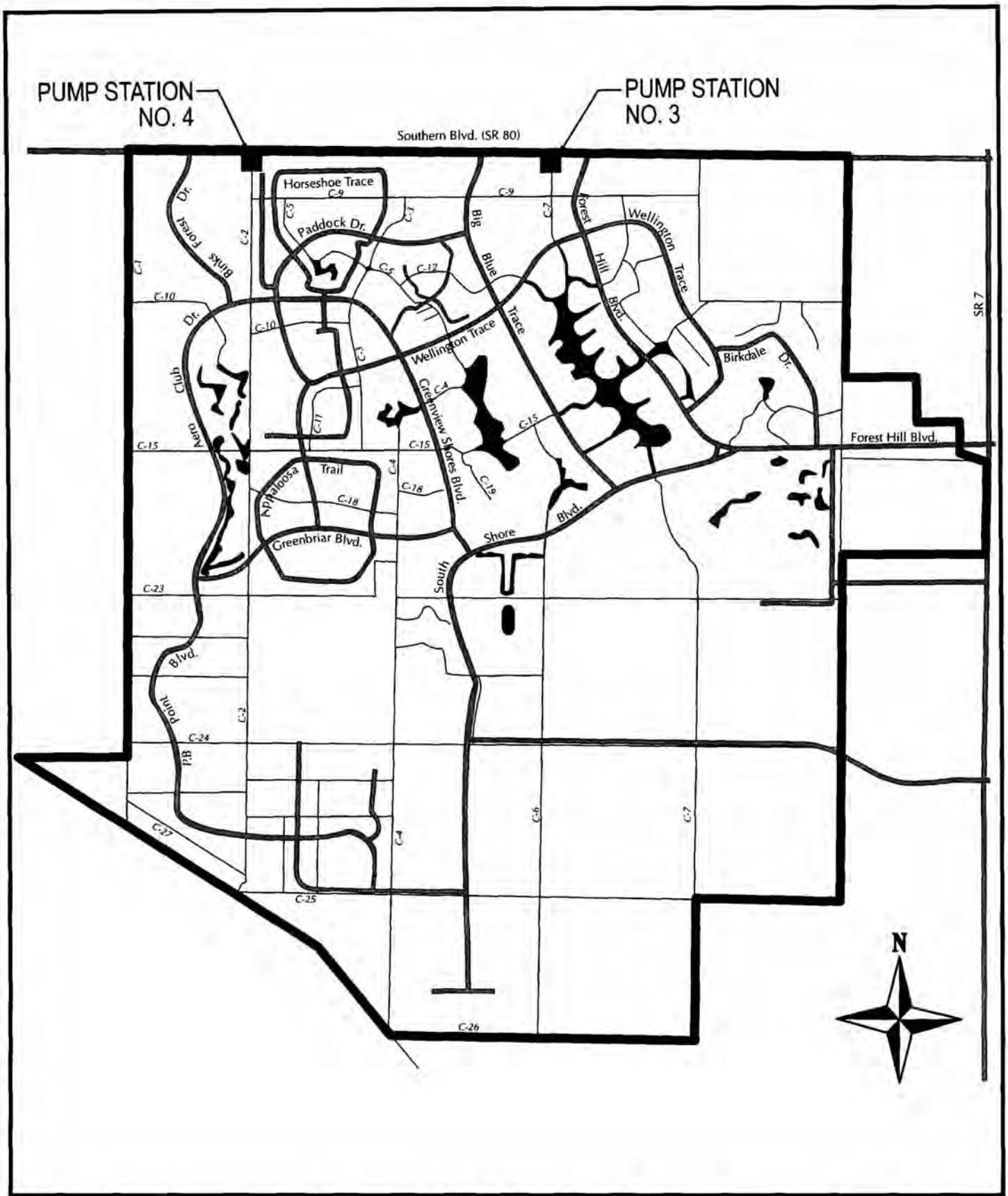
Several factors were examined prior to selecting a design alternative. The best design alternative that satisfies the objectives presented in Section 1.0 includes utilization of electrical submersible pumps. This type of pump is more conducive to automation, runs quieter, and accommodates a future increase in capacity better than a mechanical alternative.

Conceptual pump station layouts and probable cost estimates were prepared for two design scenarios – Existing Capacity and Increased Capacity. Additionally, two cost options were developed for each scenario. It is assumed that the Existing Capacity Scenario will be implemented prior to the necessity (if ever) of increasing the capacity. The first option proposes to install electrical components sized only to handle the flow that is needed for the Existing Capacity Scenario. The second option considers installing electrical components sized to handle the ultimate increased capacity during the construction of the Existing Capacity Scenario.

By planning ahead for increased capacity (Option 2), an estimated total savings of $142,600 can be achieved. However, there is a risk which includes $179,400 if the stations are never modified for increased capacity. Ultimately, the decision should be based on the outcome of hydrologic computer modeling and discussions with SFWMD. The alternatives are currently being analyzed by another consultant for SFWMD.

To-date there has been no indication from SFWMD that they will re-size the proposed Stormwater Treatment Area 1 East (STA 1E) or allow the C-51 Basin to be increased in size by routing Basin B through Basin A. Also, preliminary computer modeling results indicate that the concept of moving water from Basin B through Basin A may be impractable considering the canal improvements and culvert replacements that would be necessary. These preliminary results cast serious doubt over the concept of the Increased Capacity Scenario. For these reasons, it is recommended that Option 1 be adopted when implementing the Existing Capacity Scenario.

Exhibit 19



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Acme Improvement District
Pump Station Nos. 3 and 4 Preliminary Study
Location Map
Figure 1

SCALE:	Not to Scale
DATE:	July 1996
P.A. NO.	95737.00
COMPUTER FILE(S):	G:\acmepump\ PUMPEX01.FH5

Exhibit 19

Pump Station 3

Pump Station 4

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Acme Improvement District
Pump Station Nos. 3 and 4 Preliminary Study
Photographs
Figure 2

SCALE:	Not to Scale
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P.A. NO.	95737.00
COMPUTER FILE(S):	G:\acmepump\ PUMPEX02.FH5

Exhibit 19

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Acme Improvement District
Pump Station Nos. 3 and 4 Preliminary Study
Pump Station No. 3 – Site Plan
Figure 3

SCALE: Not to Scale
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COMPUTER FILE(S): G:\acmepump\ PUMPEX03.FH5

Exhibit 19

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Acme Improvement District
Pump Station Nos. 3 and 4 Preliminary Study
Pump Station No. 4 – Site Plan
Figure 4

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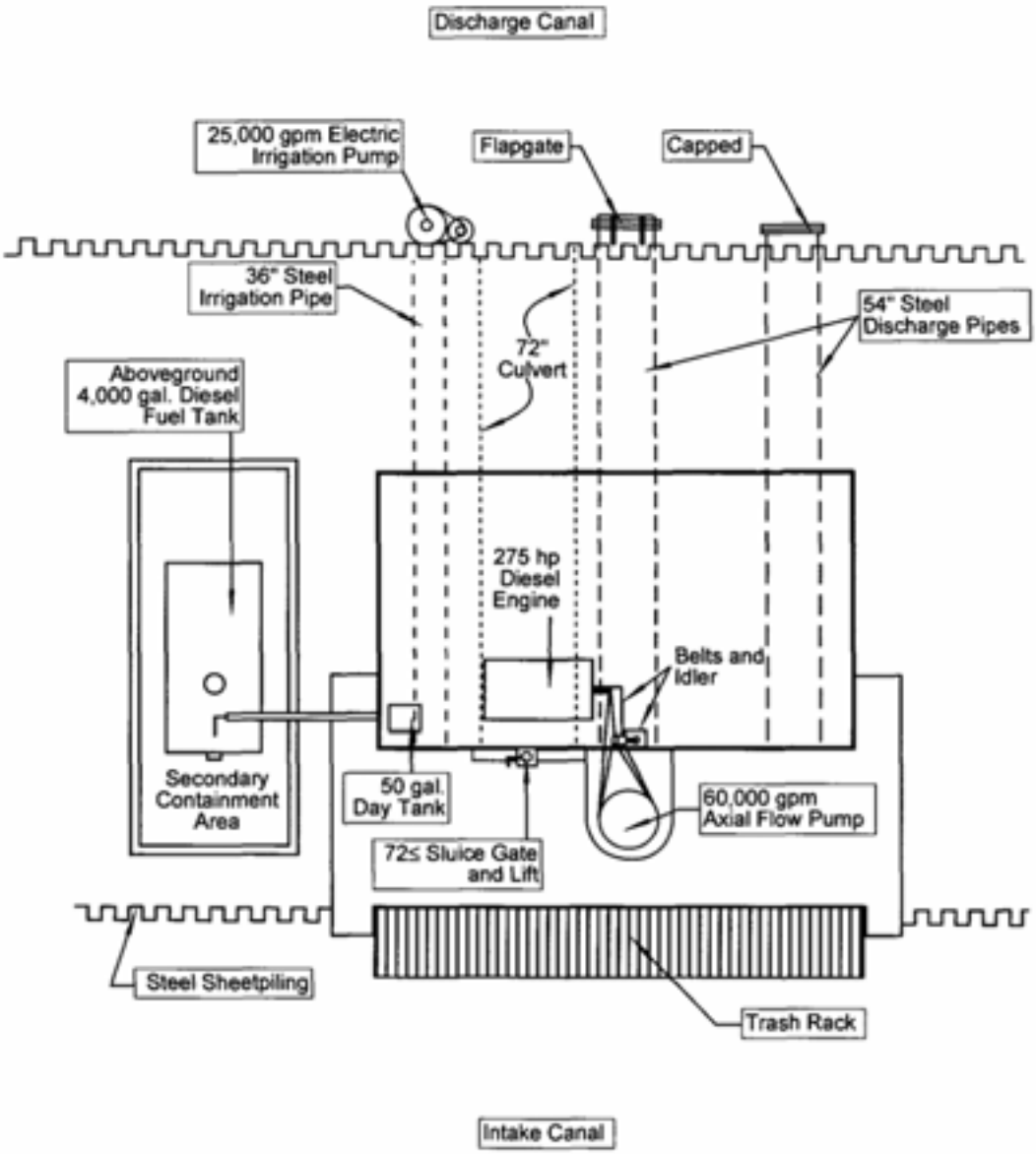

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Acme Improvement District
Pump Station Nos. 3 and 4 Preliminary Study
Pump Station No. 3 – Existing Layout
Figure 5

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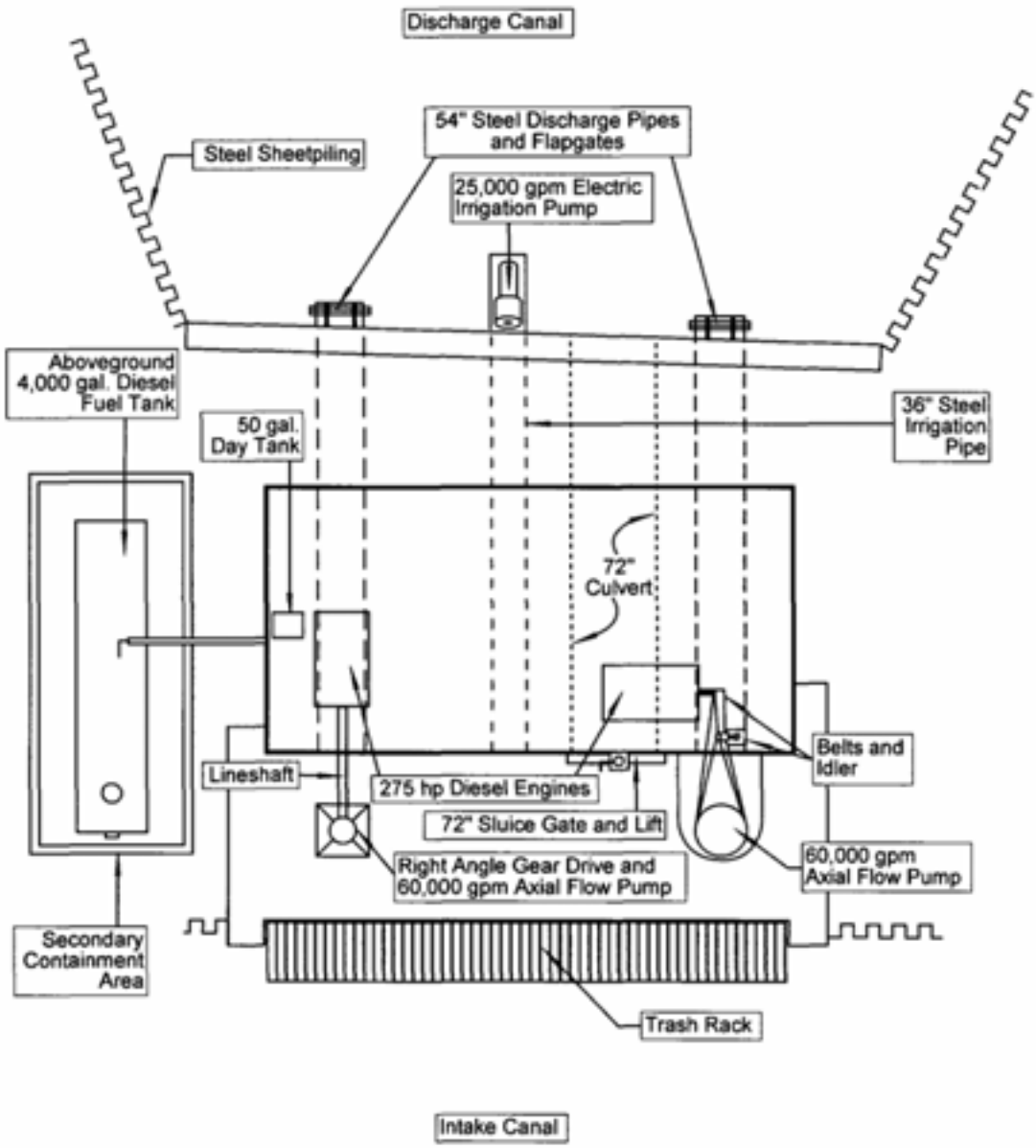

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Pump Station Nos. 3 and 4 Preliminary Study
Pump Station No. 4 – Existing Layout
Figure 6

SCALE: Not to Scale
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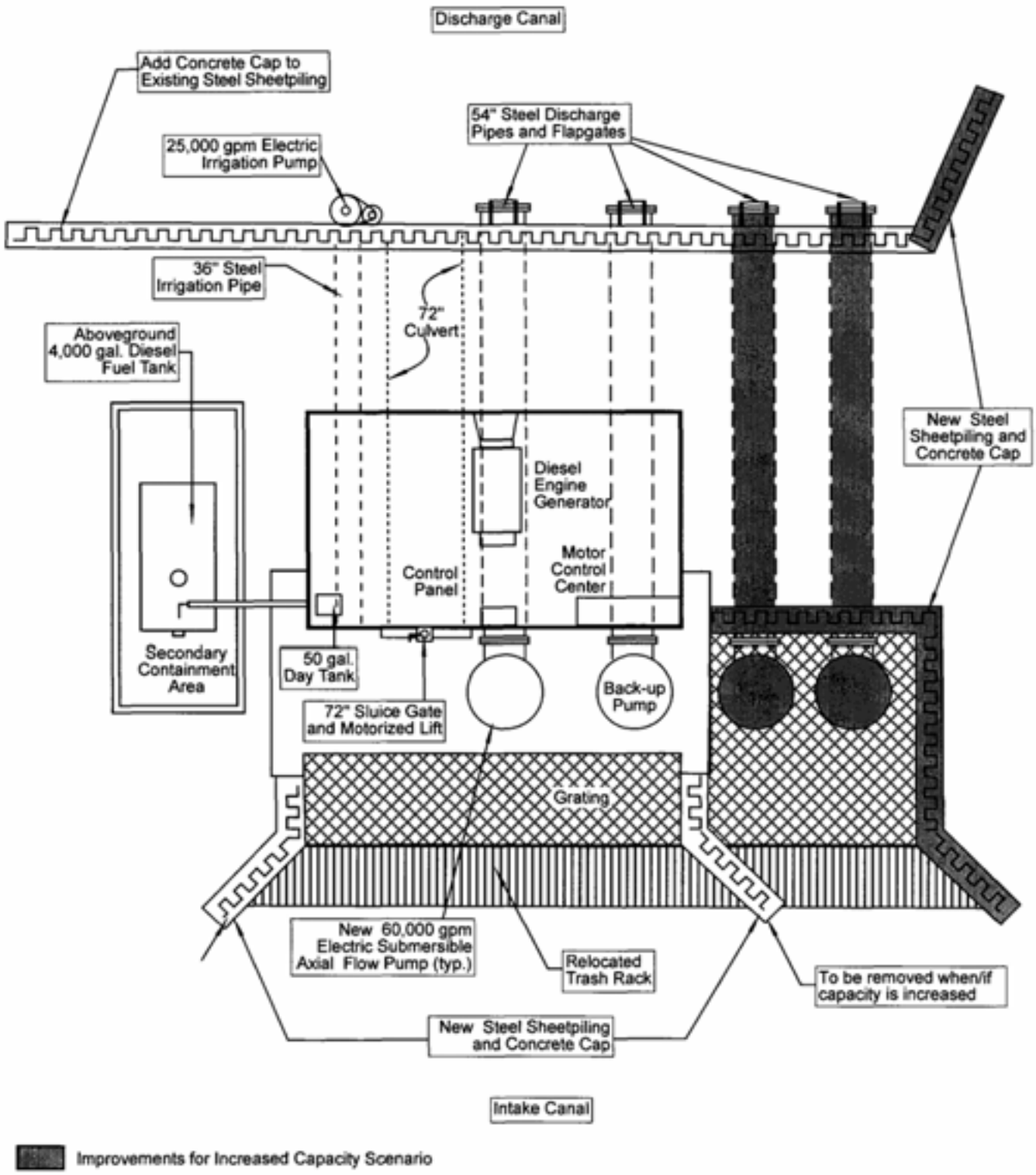

Improvements for Increased Capacity Scenario

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Acme Improvement District
Pump Station Nos. 3 and 4 Preliminary Study
Pump Station No. 3 – Proposed Layout
Figure 7

SCALE:	Not to Scale
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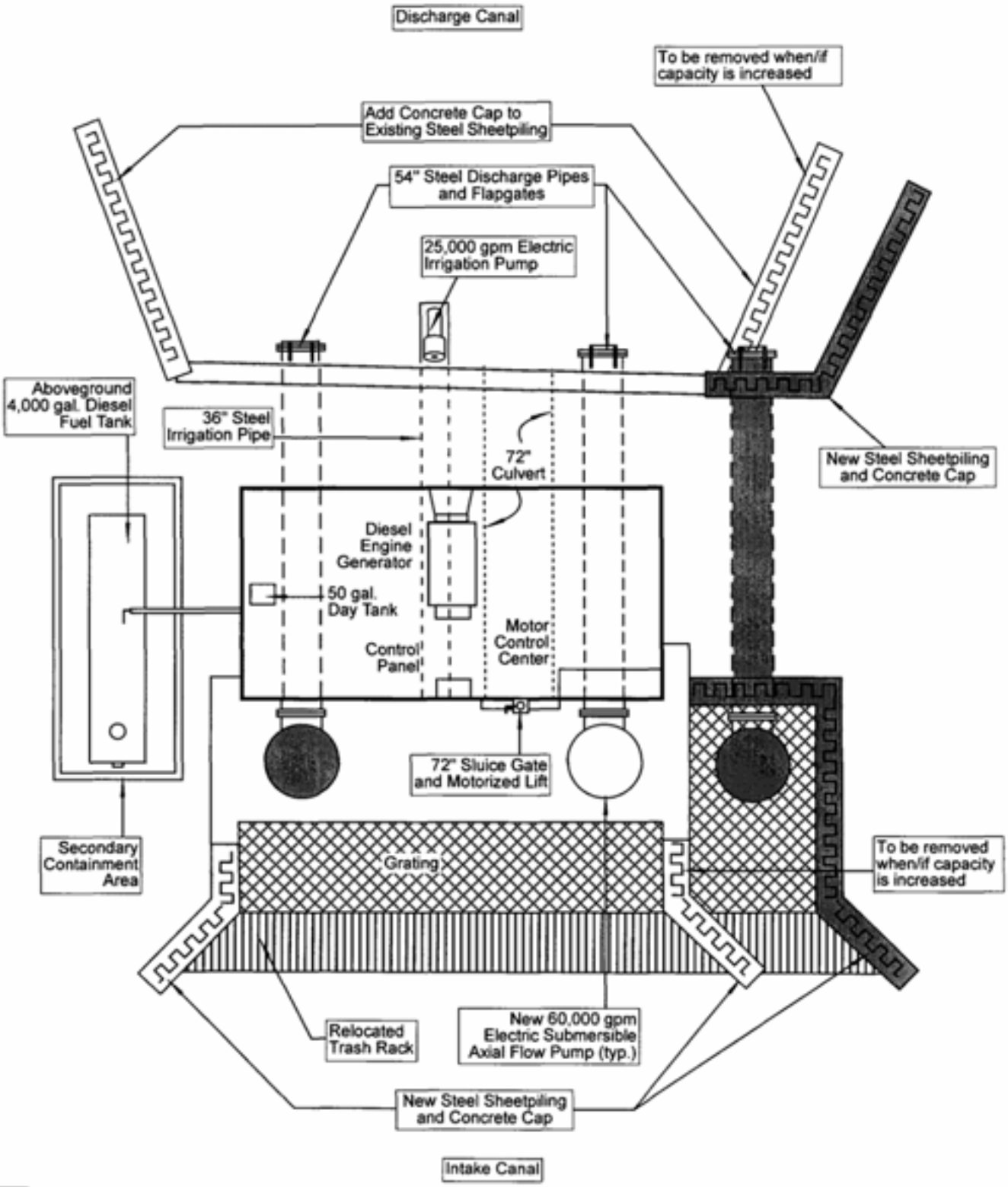
P.A. NO.	95737.00
COMPUTER FILE(S):	G:\acmepump\ PUMPEX09.FH5

Exhibit 19



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Acme Improvement District
Pump Station Nos. 3 and 4 Preliminary Study
Pump Station No. 4 – Proposed Layout
Figure 8

SCALE:	Not to Scale
DATE:	July 1996
P.A. NO.	95737.00
COMPUTER FILE(S):	G:\acmepump\ PUMPEX09.FH5

Table 1: Acme Improvement District
Probable Cost Estimate
Pump Station No. 3

Description	Quantity	Unit	Unit Cost	Total
Existing Capacity Scenario				
Mobilization	1	LS	$20,000	$20,000
Grading and Compacting	1	LS	$5,000	$5,000
Riprap	1	LS	$5,600	$5,600
Seed and Mulch	1	LS	$1,400	$1,400
Sheetpile Sandblasting and Painting	1	LS	$35,000	$35,000
Sheetpile and Concrete Cap	40	LF	$850	$34,000
Concrete Cap only	88	LF	$100	$8,800
Building Improvements Including Exhaust Louvers	1	LS	$18,000	$18,000
Grating/Trash rack	1	LS	$28,000	$28,000
60,000 gpm Pump, 200 hp Motor and Canister	2	EA	$145,000	$290,000
54" Flap Gate	1	EA	$5,200	$5,200
Pump Motor Starter	2	EA	$14,000	$28,000
250 kW Standby Generator and Transfer Switch	1	LS	$62,000	$62,000
Telemetry Improvements	1	LS	$24,000	$24,000
Controls Including Level Sensors and Control Panel	1	LS	$28,000	$28,000
Electrical Service	1	LS	$12,000	$12,000
Engineering, Legal and Administrative Fees @ 15%				$90,750
			Option 1 Total	**$695,750**
Electrical Upgrades to Accommodate Future Pumps (Option 2)				$89,700
			Option 2 Total	**$785,450**
Increased Capacity Scenario				
Mobilization	1	LS	$15,000	$15,000
Excavation, Grading and Compacting	1	LS	$2,500	$2,500
Relocate/Replace Fence	1	LS	$1,600	$1,600
Sheetpile Removal	18	LF	$120	$2,160
Sheetpile and Concrete Cap	72	LF	$800	$57,600
Grating/Trash rack Addition	1	LS	$16,000	$16,000
60,000 gpm Pump, 175 hp Motor and Canister	2	EA	$145,000	$290,000
54" Corten Steel Pipe	84	LF	$90	$7,560
54" Flap Gate	2	EA	$5,200	$10,400
Pump Motor Starter	2	EA	$12,000	$24,000
Control and Telemetry Upgrade	1	LS	$10,000	$10,000
600 kW Standby Generator and Transfer Switch	1	LS	$120,000	$120,000
Electrical Service Upgrade	1	LS	$10,000	$10,000
Engineering, Legal and Administrative Fees @ 15%				$85,023
			Option 1 Total	**$651,843**
Electrical Credit if Pumps are Already Accommodated (Option 2)				-$161,000
			Option 2 Total	**$490,843**
			Option 1 Grand Total	**$1,347,593**
			Option 2 Grand Total	**$1,276,293**

Table 2: Acme Improvement District
Probable Cost Estimate
Pump Station No. 4

Description	Quantity	Unit	Unit Cost	Total
Existing Capacity Scenario				
Mobilization	1	LS	$20,000	$20,000
Grading and Compacting	1	LS	$5,000	$5,000
Riprap	1	LS	$5,600	$5,600
Seed and Mulch	1	LS	$1,400	$1,400
Sheetpile Sandblasting and Painting	1	LS	$35,000	$35,000
Sheetpile and Concrete Cap	40	LF	$850	$34,000
Concrete Cap only	52	LF	$100	$5,200
Building Improvements Including Exhaust Louvers	1	LS	$18,000	$18,000
Grating/Trash rack	1	LS	$28,000	$28,000
60,000 gpm Pump, 175 hp Motor and Canister	1	EA	$145,000	$145,000
Pump Motor Starter	1	EA	$14,000	$14,000
250 kW Standby Generator and Transfer Switch	1	LS	$62,000	$62,000
Telemetry Improvements	1	LS	$24,000	$24,000
Controls Including Level Sensors and Control Panel	1	LS	$28,000	$28,000
Electrical Service	1	LS	$12,000	$12,000
Engineering, Legal and Administrative Fees @ 15%				$65,580
			Option 1 Total	**$502,780**
Electrical Upgrades to Accommodate Future Pumps (Option 2)				$89,700
			Option 2 Total	**$592,480**
Improvements for Increased Capacity				
Mobilization	1	LS	$20,000	$20,000
Excavation, Grading and Compacting	1	LS	$2,500	$2,500
Relocate/Replace Fence	1	LS	$1,600	$1,600
Sheetpile Removal	45	LF	$120	$5,400
Sheetpile and Concrete Cap	82	LF	$800	$65,600
Grating/Trash rack	1	LS	$16,000	$16,000
60,000 gpm Pump, 175 hp Motor and Canister	2	EA	$145,000	$290,000
54" Corten Steel Pipe	36	LF	$90	$3,240
54" Flap Gate	2	EA	$5,200	$10,400
Pump Motor Starter	2	EA	$12,000	$24,000
Control and Telemetry Upgrade	1	LS	$10,000	$10,000
600 kW Standby Generator and Transfer Switch	1	LS	$120,000	$120,000
Electrical Service Upgrade	1	LS	$10,000	$10,000
Engineering, Legal and Administrative Fees @ 15%				$86,811
			Option 1 Total	**$665,551**
Electrical Credit if Pumps are Already Accommodated (Option 2)				-$161,000
			Option 2 Total	**$504,551**
			Option 1 Grand Total	**$1,168,331**
			Option 2 Grand Total	**$1,097,031**

Exhibit 19

Exhibit 19

South Florida
Water Management District

SURFACE WATER MANAGEMENT PERMIT NO. 50-00548-S

(NON-ASSIGNABLE)

DATE ISSUED: March 16, 1978

AUTHORIZING:

CONSTRUCTION AND OPERATION OF A WATER MANAGEMENT SYSTEM SERVING 18,200 ACRES OF RESIDENTIAL/AGRICULTURAL LANDS BY CANALS, LAKES, 1-100,000 GPM AND 1-120,000 GPM PUMP STATIONS DISCHARGING INTO L-40 BORROW CANAL AND 2-60,000 GPM PUMP STATIONS DISCHARGING INTO C-51.

LOCATED IN: PALM BEACH COUNTY, SECTION --- TWP. 43/44S RGE. 40/41E

ISSUED TO:

Acme Improvement District
P. O. Box 248
Loxahatchee, Florida 33470

This Permit is issued pursuant to Application for Permit No. 27833 09227-B dated February 27, 1976 September 20, 19 77. Permittee agrees to hold and save the South Florida Water Management District and its successors harmless from any and all damages, claims, or liabilities which may arise by reason of the construction, operation, maintenance, or use of any work or structure involved in the Permit. Said application, including all plans and specifications attached thereto, is by reference made a part hereof.

This Permit may be revoked or modified at anytime pursuant to the appropriate provisions of Chapter 373, Florida Statutes.

This Permit does not convey to Permittee any property rights or privileges other than those specified herein, nor relieve the Permittee from complying with any law, regulation, or requirement affecting the rights of other bodies or agencies. All structures and works installed by Permittee hereunder shall remain the property of the Permittee.

Within thirty (30) days after the completion of the construction of any work or structure relative to this permit, the Permittee shall file with the District a written statement of completion on the appropriate form provided by the Board.

SPECIAL CONDITIONS ARE AS FOLLOWS:

SPECIAL CONDITIONS ON ATTACHED SHEET ARE A PART OF THIS DOCUMENT.

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SOUTH FLORIDA WATER MANAGEMENT

Exhibit 19

SPECIAL CONDITIONS ARE AS FOLLOWS:

1. THE MAINTAINED STAGE IN UNIT OF DEVELOPMENT #1 SHALL BE +11.0' MSL WITH DISCHARGE BEGINNING AT +12.0' MSL DURING THE WET SEASON AND +12.0' MSL WITH DISCHARGE BEGINNING AT +13.0' MSL DURING THE WET SEASON.

2. THE MAINTAINED STAGE IN UNIT OF DEVELOPMENT #2 SHALL CONTINUE TO BE +13.0' MSL. ANY PROPOSED CHANGE IN THIS STAGE AT A FUTURE DATE SHALL REQUIRE THE MODIFICATION OF THIS PERMIT.

3. THE MINIMUM FINISHED FLOOR ELEVATION IN UNIT OF DEVELOPMENT #1 SHALL BE +17.5' MSL. THE MINIMUM FINISHED FLOOR ELEVATION IN UNIT OF DEVELOPMENT #2 IS +17.0' MSL.

4. THE MINIMUM ROAD GRADE ELEVATION SHALL BE +16.0' MSL IN UNIT OF DEVELOPMENT #1 AND +16.0' MSL IN UNIT OF DEVELOPMENT #2.

5. THE OPERATION PHASE OF THIS PERMIT SHALL NOT BECOME EFFECTIVE UNTIL A FLORIDA REGISTERED PROFESSIONAL ENGINEER CERTIFIES THAT ALL FACILITIES HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE DESIGN APPROVED BY THE DISTRICT. UPON COMPLETION OF CONSTRUCTION OF THE DRAINAGE SYSTEM, THE DISTRICT MUST BE NOTIFIED FOR INSPECTION AND APPROVAL OF THE FACILITIES.

6. WATER QUALITY DATA SHALL BE SUBMITTED TO THE DISTRICT. UPON ISSUANCE OF THIS PERMIT, THE PERMITTEE SHALL CONTACT DISTRICT STAFF TO ARRANGE FOR THE FREQUENCY, LOCATION, AND METHODS OF SAMPLING, AND SPECIFIC PARAMETERS TO BE MONITORED. WITHIN 60 DAYS OF THE ISSUANCE OF THIS PERMIT THE PERMITTEE SHALL SUBMIT TO THE DISTRICT THE DETAILS OF A SUITABLE MONITORING PROGRAM. UPON ACCEPTANCE BY THE STAFF THE MONITORING PROGRAM SHALL BECOME THE RESPONSIBILITY OF THE PERMITTEE, ACME IMPROVEMENT DISTRICT.

7. RECEIPT OF THIS PERMIT DOES NOT EXEMPT THE PROJECT FROM OTHER PERTINENT GOVERNMENTAL REGULATIONS. PERMITS FROM OTHER AGENCIES MAY BE REQUIRED.

8. THE PROPOSED LAND USE IN UNIT OF DEVELOPMENT #1 IS MIXED DENSITY RESIDENTIAL. THE PROPOSED LAND USE IN UNIT OF DEVELOPMENT #2 IS 5 ACRE ESTATE RESIDENTIAL. ANY CHANGE IN LAND USE SHALL REQUIRE MODIFICATION OF THIS PERMIT. THE REMAINDER OF THE DISTRICT SHALL REMAIN IN ITS PRESENT USE OR SHALL REQUIRE THE PRIOR MODIFICATION OF THIS PERMIT BEFORE CHANGE.

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Exhibit 19

SURFACE WATER MANAGEMENT STAFF REVIEW SUMMARY

APPLICATION NO: 27833 & 09227-8

PROJECT NAME: Acme Improvement District

LOCATION: Palm Beach County

DEVELOPER:

ENGINEER: Gee & Jensen

1.	Suitability of land for proposed use	GOOD	FAIR	POOR	NOT APPLICABLE
2.	Water Quantity Impacts	GOOD	FAIR	POOR	NOT APPLICABLE
3.	Water Quality Impacts	GOOD	FAIR	POOR	NOT APPLICABLE
4.	Environmental Impacts	GOOD	FAIR	POOR	NOT APPLICABLE
5.	Water Conservation	GOOD	FAIR	POOR	NOT APPLICABLE
6.	Flood Protection	GOOD	FAIR	POOR	NOT APPLICABLE
7.	Relief from rainstorm inconvenience	GOOD	FAIR	POOR	NOT APPLICABLE
8.	System Maintainability	GOOD	FAIR	POOR	NOT APPLICABLE
9.	Overall use of land with respect to water resource	GOOD	FAIR	POOR	NOT APPLICABLE
10.	Water management system with respect to feasible alternatives	GOOD	FAIR	POOR	NOT APPLICABLE

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Exhibit 19

Application Nos. 27833 & 09227-B for Surface Water Management Permit

Acme Improvement District - Palm Beach County

S T A F F R E P O R T

ABSTRACT

The applicant, Acme Improvement District has presented Application Nos. 27833 and 09227-B for the purpose of obtaining a Surface Water Management Permit for the Acme Improvement District's Unit of Development #1 (primarily Wellington PUD) Unit of Development #2, and the continued management of existing agricultural lands. The entire Acme Improvement District is comprised of a total of 18,200 acres of which 7,400 acres is Unit of Development #1, 1500 acres is Unit of Development #2, and 9300 acres which will be retained in agricultural use. The District is located west of State Road 7, south of State Road 80 and east of Conservation Area #1 in Palm Beach County. Surface water management is by means of canals, lakes, and discharge pump stations. Pump capacity consists of 1-100,000 GPM pump station and 1-120,000 GPM pump station discharging to the L-40 Borrow Canal and to Conservation Area #1 and 2-60,000 GPM pump stations discharging to C-51. Water is also conveyed to C-51 by means of 1-56" x 84" corrugated metal arch pipe and open channel connection to C-51. The staff recommends that conceptual approval be granted for the master drainage plan submitted and that Surface Water Management Permits be issued for Units of Development #1 and #2 (see Figure 1).

THE APPLICATION

A. Purpose of Application

Acme Improvement District has presented a request by means of Application Nos. 27833 and 09227-B for the issuance of a Surface Water Management

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Permit for Units of Development #1 and #2, and the continued surface water management of the remaining agricultural lands within the District. The District encompasses all of Sections 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 33, 34 and those parts of Sections 30, 31, 32 lying north of Levee L-49 right of way being in Township 44 South, Range 41 East and those portions of Sections 31, 32, 33, 34, 35 lying south of the West Palm Beach Canal right of way being in Township 43 South, Range 41 East and that portion of Section 25 lying north of Levee L-40 right of way being in Township 44 South, Range 40 East, all in Palm Beach County, Florida. Discharge from the district will be by means of pumps, open channel connections and culverts to C-51 and Conservation Area No. 1, via L-40 Borrow Canal.

B. Existing Conditions of Acme Improvement District

Acme Improvement District was formed in 1953 and has developed an extensive water management system serving a mixture of agricultural and residential lands by means of internal lakes and canals with pumped and gravity outfalls to C-51 and L-40 Borrow Canal. In operation the district is segregated into two basins; Basin "A" being 8990 acres discharging to C-51 and Basin "B" being 9210 acres discharging to L-40 Borrow Canal. At this time a large portion of the facilities to be provided within the District are existing. These include the two pump stations through L-40, the two pump stations to C-51, the gravity connection to C-51, a dike around the entire District at elevation +19.0 msl, Lake Wellington and various conveyance canals in Unit of Development #1 and Unit of Development #2. At this time approximately 25% of Unit #1 (Wellington) is either constructed or under construction. The remainder of Unit #1 is presently in agricultural use or sitting idle. Unit of Development #2 and the remainder of the District is presently in agricultural use or sitting idle.

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C. Proposed Facilities

Unit of Development #1

Facilities proposed for Unit of Development #1 include ± 150 acres of additional lake and canal section, various roadways, and tertiary drainage facilities for the individually platted areas. The canal sections to be provided will have bottom widths varying between 4' and 10'; have a bottom elevation between +2.0' msl and +8.0' msl and side slopes of 2 horizontal to 1 vertical. Unit of Development #1 will be served as an integral part of Basin "A: by pump stations #3 and #4. The minimum proposed road grade is +16.0' msl. The minimum proposed finished floor elevation in each of the individually platted areas is +17.5' msl. Land use in Unit of Development #1 will be a mixture of single, family, single family estate, duplex and multi-family residential; with open space and public use areas and commercial service areas (see Figures 2, 3, 4 and 5).

Unit of Development #2

Facilities for Unit of Development #2 will be a combination of canals, swales, culverted structures and roadways to provide drainage and access for the 5 acre estate residential development planned. The plan is to use existing agricultural canals where possible and to supplement with swales or canals where necessary. The swales will have side slopes of 1 vertical to 6 horizontal typical. The canals will have this same side slope down to elevation +12.0 msl and 1 vertical to 2 horizontal side slope below. The bottom width and bottom elevation of both the proposed canals and swales varies and is shown in Figure 6. A total of 4.2 miles of new canal and swale section is proposed for Unit of Development #2. The area will be served as an integral part of Basin "B"

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by pump station #1. The minimum proposed road grade elevation is +16.0' msl. The minimum proposed finished floor elevation is +17.0' (see Figures 2, 3, 4 and 6).

EVALUATION

A. Hydraulic Design

Acme Improvement District is enclosed by a dike at elevation +19.0 and is pumped to both C-51 and Conservation Area #1. Internally the District is divided into Basin "A" and Basin "B". Basin "A" is served by two pump stations discharging to C-51 having a total capacity of 120,000 GPM resulting in a removal rate of .71 inches per day over the 8990 acres of the basin. Basin "B" is served by two pump stations discharging to Conservation Area 1 having a total capacity of 220,000 GPM resulting in a removal rate of 1.27 inches per day over the 9230 acres of the basin. These internal basins are separated by an existing road at elevation -17.0' msl. Overflow structures are proposed through the road to allow water levels to equalize in the basin during severe rainstorm events. The proposed crest elevation of the structures is +13.0' msl (see Figure 3). Estimates of runoff for both Basin "A" and Basin "B" were developed by the SCS "CN Method" as outlined in TR#55. A summary of the hydraulic and hydrologic design characteristics is presented in Appendix A. The proposed regulation stage schedule within Basin "A" is +11.0' msl during the wet season and +12.0' msl during the dry season. Discharge in Basin "A" will begin at elevation +12.0' msl during the wet season and +13.0' msl during the dry season. The regulation stage in Basin "B" will be +13.0' msl during both the wet and dry season.

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B. Water Quality

Runoff from Unit of Development #1 will be routed through a series of

canals and retention lakes before being discharged to C-51. Pump operation will be such that the stage must rise in the system 1.0' before discharge begins. This accounts for the retention of approximately 340 acre-feet of water or approximately 0.5" over the entire unit. Consideration should be given to providing more retention area for water quality (and flood storage area) purposes in future development in the unit. It is felt that the provision of at least .5" of runoff along with the platting of significant areas at low densities and the provision of open space (parks, etc.) should provide adequate water quality treatment of the runoff from Unit of Development #1. Unit of Development #2 is expected to generate only limited quantities of runoff due to the nature of typical development in 5 acre parcels. The quality of the runoff is expected to be improved over that generated from agricultural use. No application of fertilizers is expected and there will not longer be significant areas exposed to erosion as between crop rows in agricultural use.

C. Environmental Considerations

It is the opinion of District staff that based on available data, the potential for environmental impact by the proposed Units of Development #1 and #2, is not considered to be significant. Most of the areas involved are abandoned agricultural lands and have been influenced by artifical drainage facilities over an extensive period of time. The exception is an existing ± 90 acre cypress stand within Unit of Development #1 known as "Big Blue". The stand will be preserved in its existing state and bounded by a 50' wide preservation buffer.

D. Water Supply and Wastewater Treatment

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Water supply and wastewater treatment services for the platted areas

in Unit of Development #1 will be by a variety of sources depending on the individual plat. Water supply for Unit of Development #2 will be by individual wells. Wastewater treatment service will be by individual septic tanks.

E. Land Use Information

The 7400 acres that comprises Unit of Development #1 is a PUD known as Wellington. Individual subdivisions within the development are at various stages of the platting process. A summary of the individual plats is given in Appendix "B".

The remainder of the District is zoned agricultural including that area in Unit of Development #2. The zoning is consistent with the continued agricultural uses and with 5 acre estate tracts in Unit of Development #2.

F. System Operation

Operation and maintenance of the surface water management system will be the responsibility of the Acme Improvement District.

CONCLUSIONS

A. The surface water management system as designed should offer adequate protection for the roads from the three year storm in Units of Development #1 and #2.

B. The surface water management system as proposed for Unit of Development #1 should be adequate to protect the receiving body (C-51) from adverse water quality impacts due to the discharge of excess storm water runoff. The change in land use from agricultural to residential 5 acre estate development in Unit of Development #2 should result in no greater potential

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for degradation of the water quality of the receiving body (Conservation Area #1) than the continued agricultural use of the unit.

C. The drainage system as designed should be adequate to prevent adverse impact to the receiving bodies due to the quantities of water being discharged.

D. The surface water management system as designed should offer adequate protection from the 100 year storm if the minimum finished floor elevation is +17.5' msl in Unit of Development #1 and +17.0' msl in Unit of Development #2.

RECOMMENDATIONS

It is the recommendation of District staff that based on considerations of discharge, environmental impact, and flood protection, a Surface Water Management Permit be issued for the construction and operation of Unit of Development #1 and Unit of Development #2 and the continued agricultural use of the remaining parcels within the District.

It is further recommended that this permit be subject to the following special conditions:

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Exhibit 19

1. THE MAINTAINED STAGE IN UNIT OF DEVELOPMENT #1 SHALL BE +11.0' MSL WITH DISCHARGE BEGINNING AT +12.0' MSL DURING THE WET SEASON AND +12.0' MSL WITH DISCHARGE BEGINNING AT +13.0' MSL DURING THE WET SEASON.

2. THE MAINTAINED STAGE IN UNIT OF DEVELOPMENT #2 SHALL CONTINUE TO BE +13.0' MSL. ANY PROPOSED CHANGE IN THIS STAGE AT A FUTURE DATE SHALL REQUIRE THE MODIFICATION OF THIS PERMIT.

3. THE MINIMUM FINISHED FLOOR ELEVATION IN UNIT OF DEVELOPMENT #1 SHALL BE +17.5' MSL. THE MINIMUM FINISHED FLOOR ELEVATION IN UNIT OF DEVELOPMENT #2 IS +17.0' MSL.

4. THE MINIMUM ROAD GRADE ELEVATION SHALL BE +16.0' MSL IN UNIT OF DEVELOPMENT #1 AND +16.0' MSL IN UNIT OF DEVELOPMENT #2.

5. THE OPERATION PHASE OF THIS PERMIT SHALL NOT BECOME EFFECTIVE UNTIL A FLORIDA REGISTERED PROFESSIONAL ENGINEER CERTIFIES THAT ALL FACILITIES HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE DESIGN APPROVED BY THE DISTRICT. UPON COMPLETION OF CONSTRUCTION OF THE DRAINAGE SYSTEM, THE DISTRICT MUST BE NOTIFIED FOR INSPECTION AND APPROVAL OF THE FACILITIES.

6. WATER QUALITY DATA SHALL BE SUBMITTED TO THE DISTRICT. UPON ISSUANCE OF THIS PERMIT, THE PERMITTEE SHALL CONTACT DISTRICT STAFF TO ARRANGE FOR THE FREQUENCY, LOCATION, AND METHODS OF SAMPLING, AND SPECIFIC PARAMETERS TO BE MONITORED. WITHIN 60 DAYS OF THE ISSUANCE OF THIS PERMIT THE PERMITTEE SHALL SUBMIT TO THE DISTRICT THE DETAILS OF A SUITABLE MONITORING PROGRAM. UPON ACCEPTANCE BY THE STAFF THE MONITORING PROGRAM SHALL BECOME THE RESPONSIBILITY OF THE PERMITTEE, ACME IMPROVEMENT DISTRICT.

7. RECEIPT OF THIS PERMIT DOES NOT EXEMPT THE PROJECT FROM OTHER PERTINENT GOVERNMENTAL REGULATIONS. PERMITS FROM OTHER AGENCIES MAY BE REQUIRED.

8. THE PROPOSED LAND USE IN UNIT OF DEVELOPMENT #1 IS MIXED DENSITY RESIDENTIAL. THE PROPOSED LAND USE IN UNIT OF DEVELOPMENT #2 IS 5 ACRE ESTATE RESIDENTIAL. ANY CHANGE IN LAND USE SHALL REQUIRE MODIFICATION OF THIS PERMIT. THE REMAINDER OF THE DISTRICT SHALL REMAIN IN ITS PRESENT USE OR SHALL REQUIRE THE PRIOR MODIFICATION OF THIS PERMIT BEFORE CHANGE.

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Exhibit 19

APPENDIX A

Basin "A"

Total Area	8,990 Acres
Pump Capacity	120,000 GPM
Removal Rate	.71 inches/day
Schedule of Stages	+11.0' msl wet season +12.0' msl dry season

Rainfall Event Summary

3 Year 24 Hour Storm	+15.5' msl
25 Year 5 Day Storm	+17.2' msl
100 Year 5 Day Storm	+17.48' msl
Minimum Existing Road Grade	+15.0' msl
Minimum Proposed Road Grade	+16.0' msl
Minimum Proposed Finished Floor	+17.5' msl

Basin "B"

Total Area	9,230 Acres
Pump Capacity	220,000 GPM
Removal Rate	1.27 inches/day
Schedule of Stages	+13.0' msl wet season +13.0' msl dry season

Rainfall Event Summary

3 Year 24 Hour Storm	+14.2' msl
25 Year 5 Day Storm	+15.5' msl
100 Year 5 Day Storm	+15.91' msl
Minimum Proposed Road Grade	+16.0' msl
Minimum Proposed Finished Floor	+17.0' msl

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Exhibit 19

APPENDIX B

Name of Project	Number of Acres	Density
Greenview Shores No. 1	116.693	2.536
Greenview Shores No. 2	948.47	.518
Eastwood	99.679	1.85
Eastwood No. 2	59.359	2.88
Paddock Park No. 1	422.38	.60
Paddock Park No. 2	479.34	.37
Palm Beach Little Ranch East	137.707	.25
Pinewood	190.876	.7
Pinewood East	112.77	.76
Saddle Trail Park	647.01	.37
South Shore No. 1	209.94	6.29
South Shore No. 2	132.532	2.4
South Shore No. 3	69.802	1.3
Sugar Pond Manor	793.230	2.47

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Exhibit 19

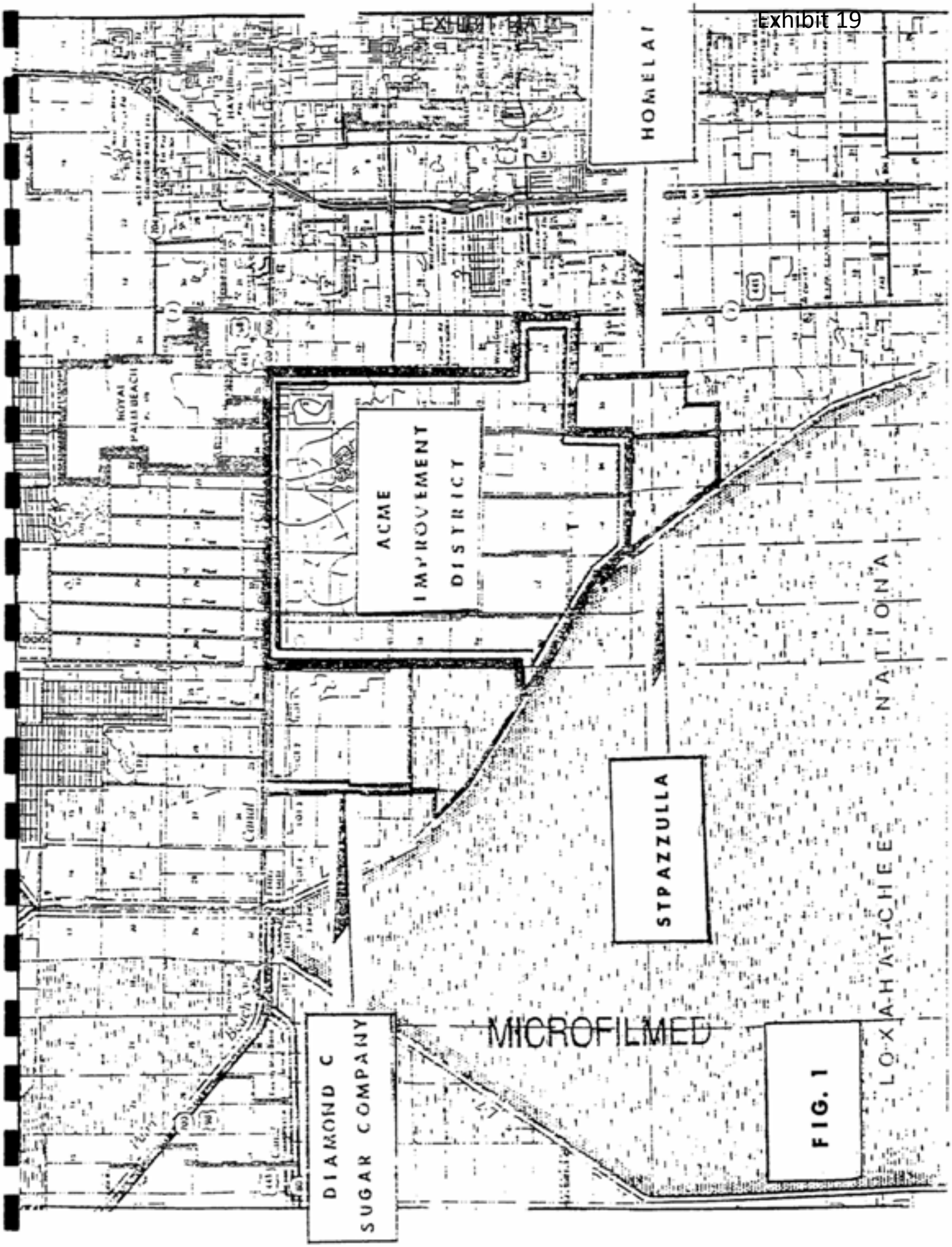

FIG. 1

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Exhibit 19

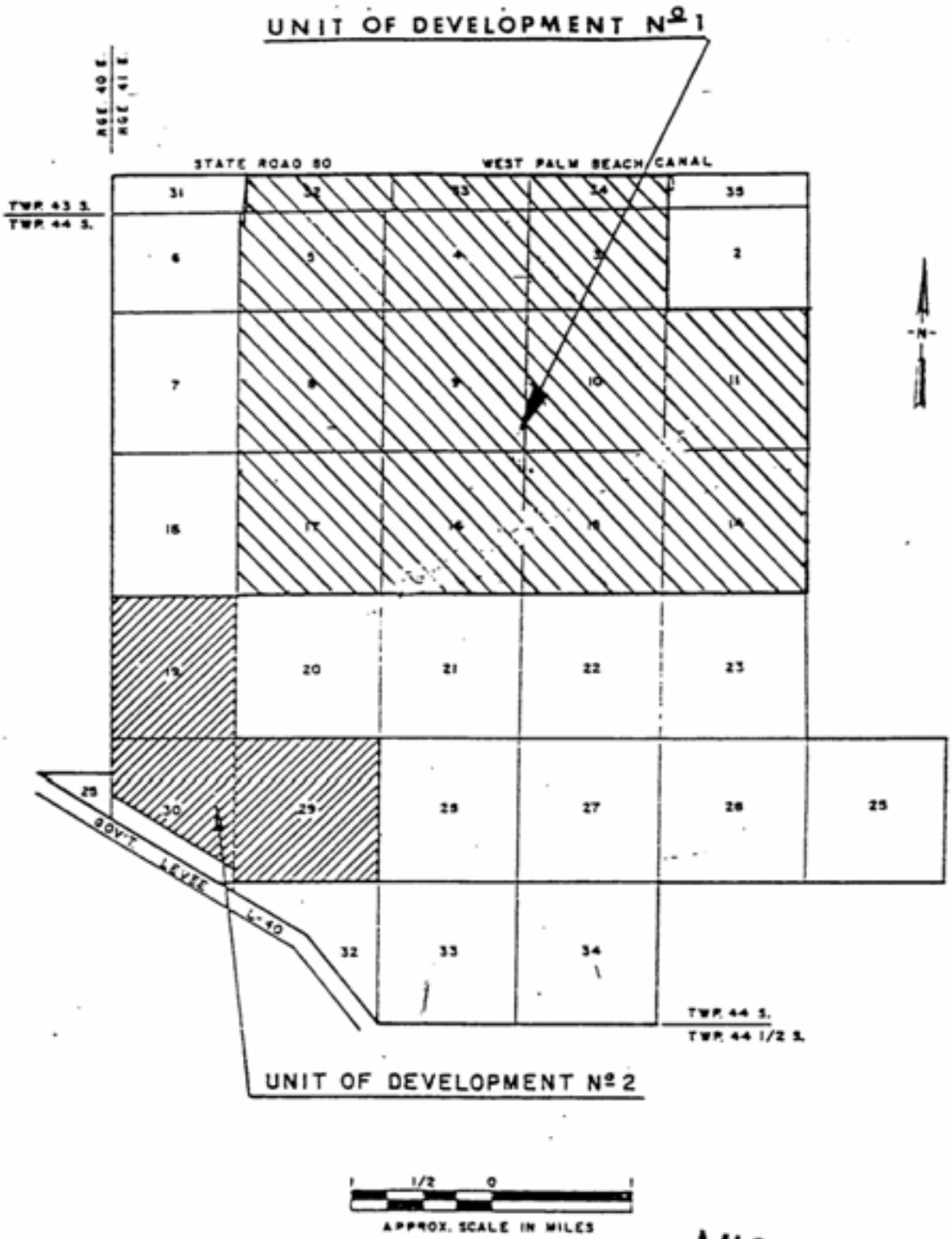

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FIG. 2

LOCATION MAP
ACME IMPROVEMENT DISTRICT

Exhibit 19

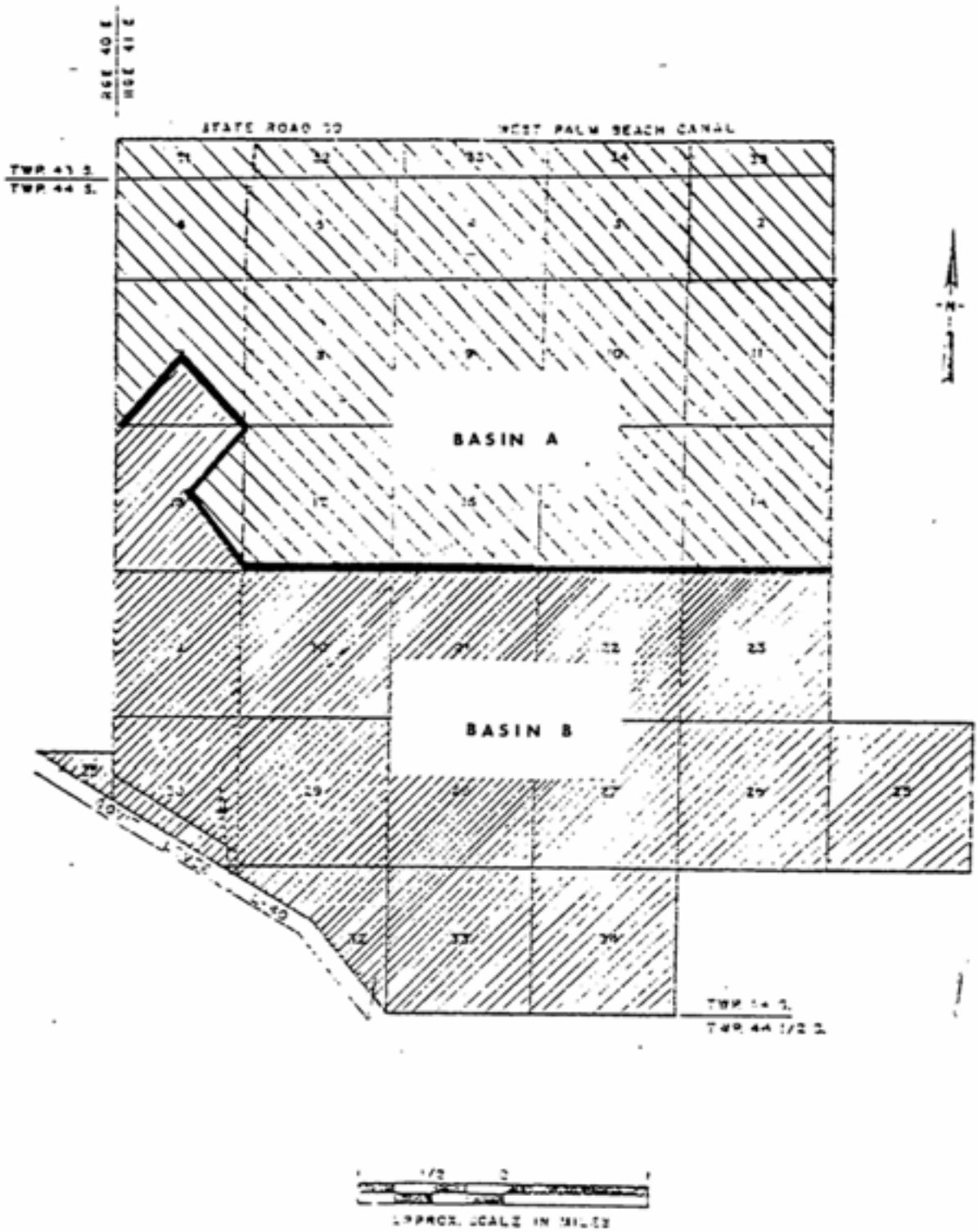

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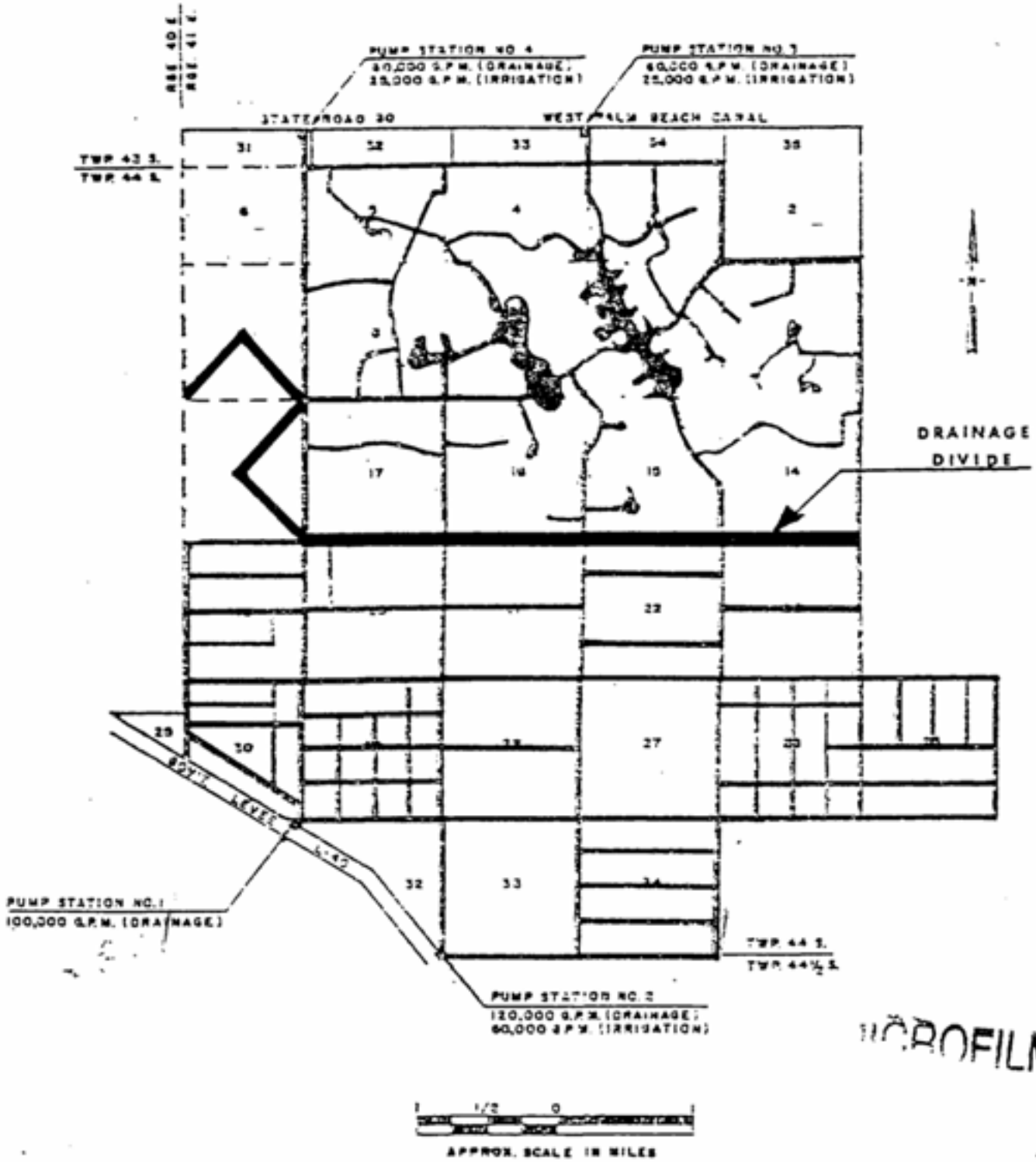
FIG. 3

LOCATION MAP
ACME IMPROVEMENT DISTRICT

Exhibit 19



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CANALS, LAKES AND MAJOR PUMPING FACILITIES

IN

ACME IMPROVEMENT DISTRICT

FIG. 4

Exhibit 19

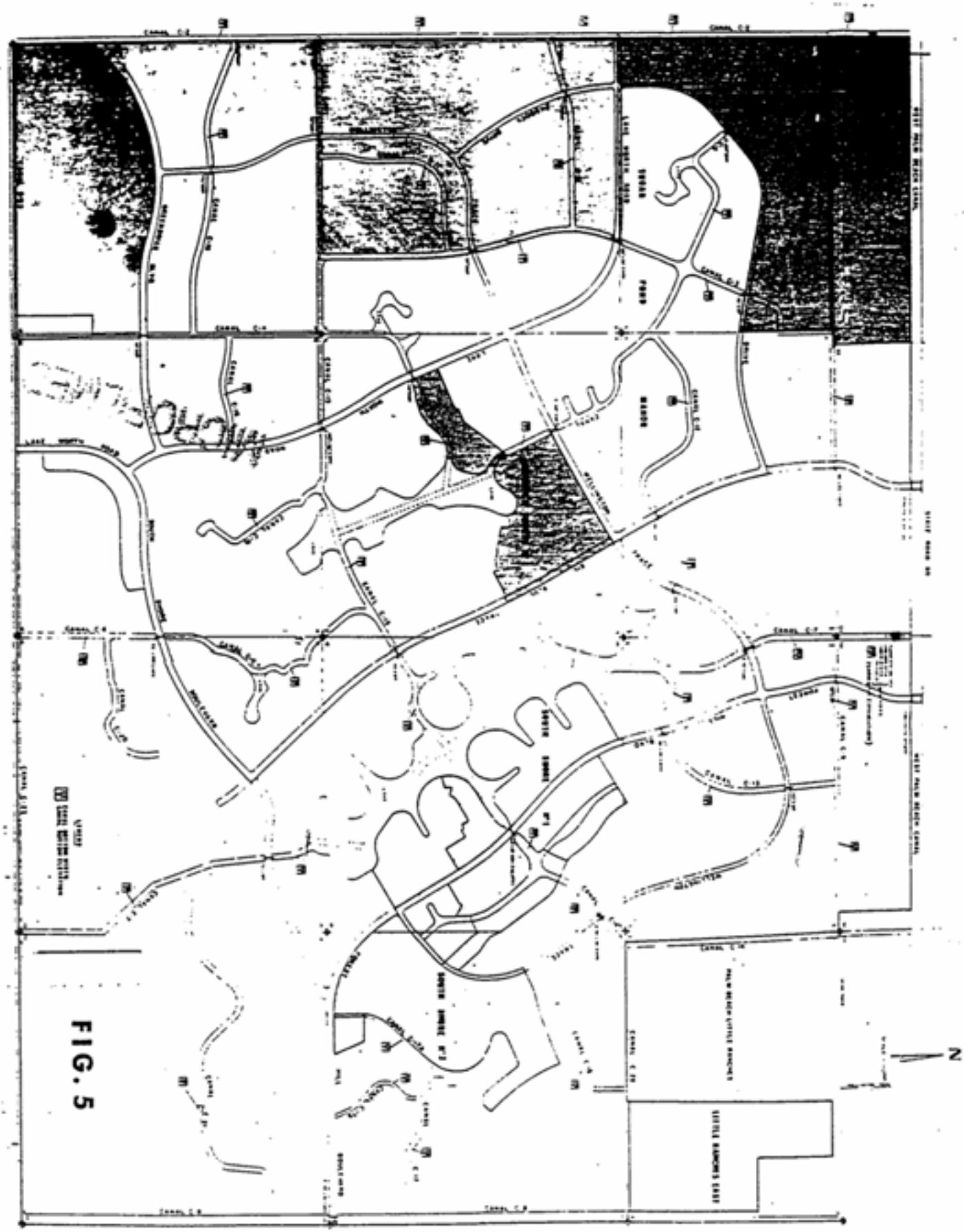
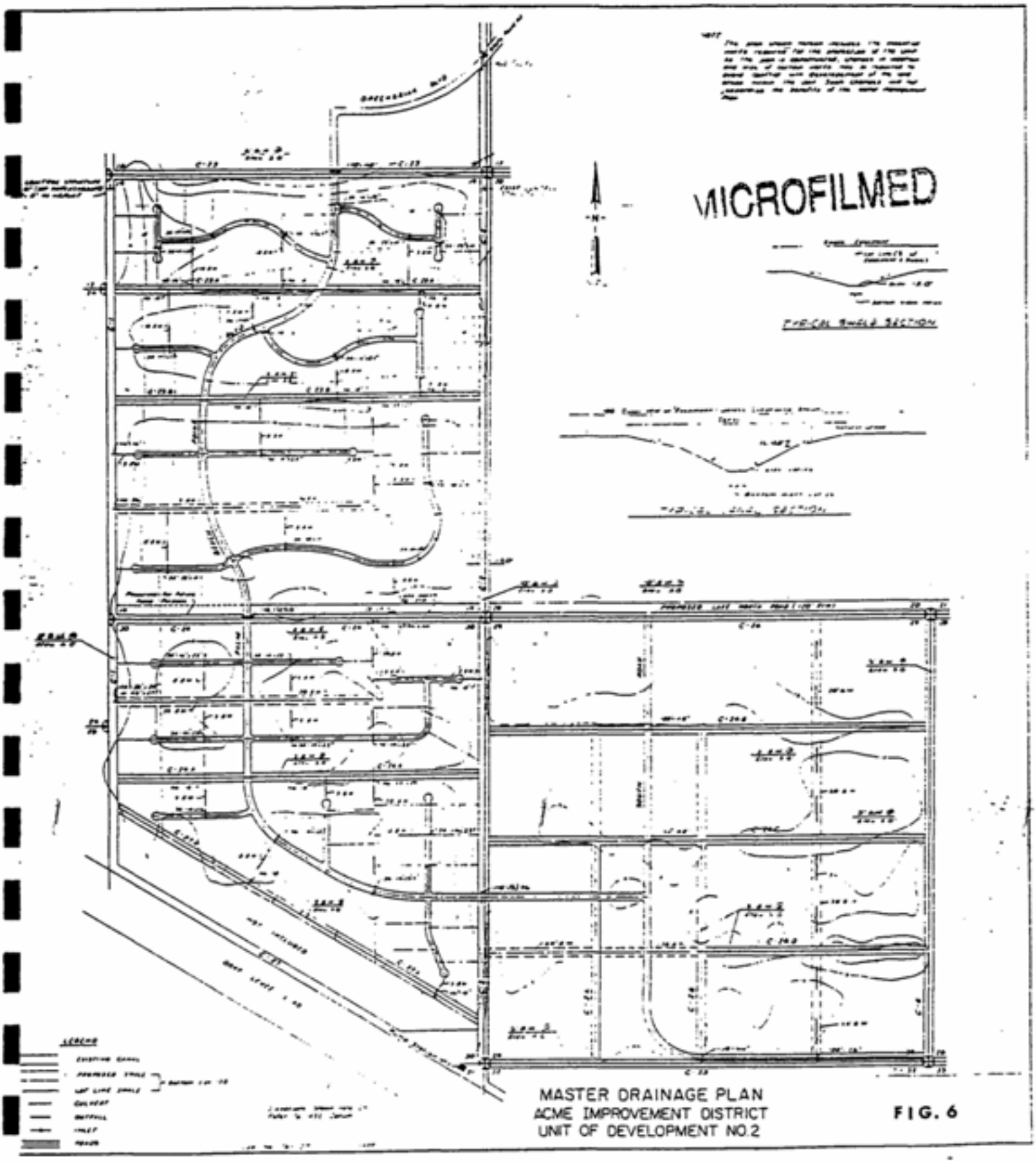


FIG. 5

Exhibit 19



MASTER DRAINAGE PLAN
ACME IMPROVEMENT DISTRICT
UNIT OF DEVELOPMENT NO.2

FIG. 6

Exhibit 19

FORM 507
Rev 5/77

SFWMD PERMIT NO. 50-00548-P

(NON-ASSIGNABLE)

March 16, 1978 DATE ISSUED

AUTHORIZING: 4-OPEN CHANNEL CONNECTIONS THROUGH C-51 SOUTH RIGHT-OF-WAY; 70' WEST OF OUSLEY ROAD BRIDGE (PUMP STATION NO. 4 AT STATION 260+60), 1150' WEST OF FOREST HILL BOULEVARD BRIDGE (PUMP STATION NO. 3 AT STATION 370+20), 1840' WEST OF WELLINGTON ROAD BRIDGE (STATION 422+90), AND 3475' EAST OF WELLINGTON ROAD BRIDGE (STATION 476+00). 1-72" CMP THROUGH L-40 EASTERLY RIGHT-OF-WAY (STATION 1142+50) WITH FOREBAY AND TIE-BACK LEVEES SERVICING PUMP STATION NO. 1, AND A FOREBAY AND TIE-BACK LEVEES CONNECTING TO L-40 S-1 SERVICING PUMP STATION NO. 2 (STATION 1059+50).

LOCATED IN PALM BEACH COUNTY, SECTION ---- TWP. 43/44S RGE. 40/41E

ISSUED TO:
(owner)

Acme Improvement District
P. O. Box 248
Loxahatchee, Florida 33470

This permit is issued pursuant to Application for Permit No. 09227-27833 Dated Sept. 20 19 77 Feb. 27, 1976 and permitee's agreement to hold and save the South Florida Water Management District and its successors harmless from any and all damages, claims, or liabilities which may arise by reason of the construction, operation, maintenance, or use of the work or structure involved in the permit. Said application, including all plans and specifications attached thereto, is by reference made a part hereof. This permit may be cancelled upon thirty (30) days written notice to the permittee or under emergency circumstances as set forth in the District's Rules with which permittee is put on notice. Permittee shall comply with all laws and rules administered by the District. This permit does not convey to permittee andy property rights nor any rights or priveleges other than those specified herein, nor relieve the permittee from complying with any law, regulation or requirement affecting the rights of other bodies or agencies. All structures and works installed by permittee hereunder shall remain the property of the permittee.

WORK PROPOSED, WILL BE COMPLETED ON OR BEFORE ___ 19__ otherwise, this permit is voided and all rights thereunder are automatically cancelled unless an extension to the construction period is applied for and granted.

SPECIAL CONDITIONS ARE AS FOLLOWS:

1. THIS PERMIT REPRESENTS APPROVAL OF THE PROJECT ONLY TO THE EXTENT OF THE DISTRICT'S INTEREST IN THE PROJECT WORKS RIGHT OF WAY. ANY ADDITIONAL APPROVAL OR PERMITS WHICH MAY BE REQUIRED ARE THE SOLE RESPONSIBILITY OF THE PERMITTEE AND MUST BE OBTAINED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
2. THIS PERMIT REPLACES DISTRICT PERMITS 895,81,2333,2678 AND 5392 WHICH ARE ATTACHED HERETO, AND BY REFERENCE MADE A PART HEREOF.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT, BY ITS GOVERNING BOARD

MICROFILMED

Original Signed
By: By John R. Malone
Secretary

Exhibit 19

EXHIBIT 14A

TO THE GOVERNING BOARD OF
CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT
901 EVERNIA STREET, P. O. BOX V, WEST PALM BEACH, FLA. 33402
TELEPHONE (305) 655-3411

FCD
FORM 627
APR 1974

DO NOT WRITE IN THIS BLOCK
APPLICATION NO. 27833
APPLICATION CLASS
CATEGORY NO.
DATE FILED

APPLICANT

Acme Improvement District — Name applicant or user
P. O. Box 248 — P. O. Box or Street Address
Loxahatchee — City
Palm Beach — County
Florida — State
33470 — Zip Code
305/793-0866 — Telephone No.
Name and address of owner if other than applicant

QUANTITY

Maximum quantity of water applied for: 138,700 — 380
Installed Capacity 110,000 Gallons per min. Area To Be Served 18,220 Acres
Maximum period for which application is made Indefinite — Days or years

TYPE

PERMIT FOR THE USE, DIVERSION OR WITHDRAWAL OF WATER
PERMIT FOR OCCUPANCY OF PROJECT WORKS

SOURCE

GROUNDWATER: Well ☐
Other (Specify)
SURFACE WATER: Pump or Culvert Connection to:
Lake ☐ River ☐ Stream ☐ Spring ☐
Other (Specify) C-51 Canal & Conservation

Drainage Connection ☒ Bulkhead-Seawall ☐
Utility Crossing ☐ Beautification ☐
Boat Dock ☐ Fence ☐ Bridge ☐
Other (Specify)

LOCATION

County Palm Beach Section Township Range
Block Lot Subdivision

USE

Private Water Supply ☐ Public Water Supply ☐ Industrial ☐
Agricultural Irrigation ☒ Drainage ☒ Livestock ☐
Mining ☐ Recreational (Swimming Pool, Golf Course) ☐
Other (Specify)

SIX DRAWINGS 8 ½ x 14 ARE REQUIRED

SUPPORT DATA

Appropriate summary sheet, on a form as provided by the District, covering pertinent data attached: YES ☐ NO ☒
*Comprehensive "Engineering Report" attached: YES ☒ NO ☐
*Required for Public Water Supply Use.

In compliance with provisions of Ch. 373, Fla. Statutes, 1973 and applicable rules and regulations of the Central and Southern Florida Flood Control District, application is hereby made for a permit as identified above, and in accordance with support data and incidental information filed with this application and made a part hereof.

MICROFILMED

Applicant's Name (Please type or print)

Applicant's Signature Date

If person other than applicant has completed this form, that person must certify by signature as follows:

In providing this information and making this application I am acting as authorized agent of the applicant.

Gee & Jenson, Engineers-Architects-Planners, Inc.
West Palm Beach, Florida

Signature P.E. 2/27/76 Date

PLEASE DO NOT WRITE IN BLOCKS BELOW

PUBLIC NOTICE

Advertised in Name of newspaper on Date of first notice and Date of second notice
Public Hearing On (if required) Date Time Place

PROCESSING

DEPARTMENT OF HEALTH AND REHABILITATIVE SERVICES
Approved ☐ Disapproved ☐
Report Attached Date
By Name Title

	Reviewed	Approved
Permit Processing		
Technical Section		
Chief of Permits		
Dir. Reg. Div.		

PERMIT ISSUED
NO.
DATE

Exhibit 19

PART C

Right of Way Occupancy Evaluation

Authorization: Four open channel connections through C-51 south right of way; 70' west of Wellington Road Bridge (Pump Station No. 4 at Station 260+60), 1150' west of Forest Hill Blvd. Bridge (Pump Station No. 3 at Station 370+20), 1840' west of Oliver Wellington Bridge (Station 422+90), and 3475' east of Oliver Wellington Bridge (Station 476+00). One 72" CMP through L-40 easterly right of way (Station 1142+50) with forebay and tie-back levees servicing Pump Station No. 1, and a forebay and tie-back levees connecting to L-40 S-1 servicing Pump Station No. 2 (Station 1059+50).

Performance Bond: ☐ Required ☒ Not Required

Insurance: ☐ Required ☒ Not Required

Processor [illegible] Date 3-2-78

Reviewer [illegible] Date 3-2-78

SPECIAL CONDITION:

This Permit replaces former District Permit Nos. 81, 2333, 2678, and 5392 which by reference are made a part hereof.

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Exhibit 19

It is the recommendation of District staff that a Right of Way Occupancy Permit be issued to include the occupancy of District right of way by Pump Station #1 having a discharge capacity of 100,000 GPM and Pump Station #2 having a discharge capacity of 120,000 GPM and an irrigation capability of 60,000 GPM both through L-40, and Pump Stations #3 and #4 having identical capacities of 60,000 GPM discharge and 25,000 irrigation for a total capacity of 120,000 GPM discharge and 50,000 GPM irrigation respectively through the south right of way of C-51. It is further recommended that Permit Nos. 895, 2333, 2678 and 5392 be superceded with the issuance of this permit.

MICROFILMED

Prepared: [illegible]

Checked: S Holloway

Approved: [illegible]
Richard A. Rogers, Director
Resource Control Department

Date: 2/27/78

bar

MICROFILMED

1979

STA REPORT DISTRIBUTION LIST

Exhibit 19

PROJECT WELLINGTON COUNTRY PLACE APPLICATION NUMBER MDO 50-00549R

STANDARD DISTRIBUTION

- X Applicant
- X Applicant's Consultant
- X Pete Rhoads
- X Legal
- X Inspection
- X Engineer, County of PALM BEACH
- X Reviewer

INTERNAL DISTRIBUTION

- X Hall
- X Gleason
- X Goodrick
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- J.B. Jackson
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- Winter (PWS wells only)

DEPARTMENT OF ENVIRONMENTAL REGULATION

- X W.P.B.
- Ft. Myers
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- Ft. Pierce
- Other

EXTERNAL DISTRIBUTION

- Engineer, City of
- Applicant's Agent
- Local Drainage Districts
- Jack Harper, Lee Co. Div. of E.P.S.
- Don Landers, Collier Co. Ag. Agent
- Fred Vidzes, B. C. Basin
- Robert Padrick
- Kissimmee River Coordinating Council
- Dade County DERM
- X see Attached Sheet

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EXHIBIT

Exhibit 19

Brian Barnett
Fresh Water Game Comm.
P. O. Box 1840
Vero Beach, FL 32960

Richard B. Binkley
Palm Beach County Executive Com.
Sierra Club
3627 Avenue De Gien
Delray Beach, FL 33445

Nancy Brown
Tropical Audubon Society
9220 S. W. 166th Street
Miami, FL 33157

Department of Environmental Regulation
P. O. Box 3858
West Palm Beach, FL 33402

Department of Natural Resources
Information Director
202 Blount Street
Tallahassee, FL 32304

Hal Scott
Florida Audubon Society
P. O. Drawer 7
Maitland, FL 32751

L. F. Gainey
Regional Manager
Florida Game & Fresh Water Fish Commission
551 N. Military Trail
West Palm Beach, FL 33406

W. Waynon Johnson, Environmentalist
U. S. Fish Wildlife Service
P. O. Box 95067
Atlanta, GA 30347

John C. Jones
Executive Director
Florida Wildlife Federation
4080 N. Haverhill Road
West Palm Beach, FL 33407

Joseph Carrol
U. S. Fish & Wildlife
1323 - 21st Street
Vero Beach, FL 32960
PH: 562-3909

Thomas Martin
Loxahatchee National Wildlife Refuge

Delray Beach, FL 33445
PH: 732-3684

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Exhibit 19

Exhibit 19

FLOW TEST REPORT
Procedure & Results

ACME IMPROVEMENT DISTRICT

COUCH PUMP COMPANY

REPAIR & MAINTENANCE DIVISION

7775 S.W. 9th Street
Vero Beach, Florida 32968
Phone: (407) 770-0002
Fax: (407) 770-1096

I. FIELD TEST PROCEDURE

II. EXPLANATION OF DISCHARGE EQUATION

III. EQUATION

IV. LIST OF PUMPS

V. CALABRATION REPORTS

VI. CERTIFIED CURVES

FIELD TEST PROCEDURE *for* PUMP CURVE CALIBRATION

PUMP MAINTENANCE

Prior to testing a pump, a visual inspection is made of the pump, pump station, and sump to determine if conditions exist that would adversly effect the test. Fluid levels are checked on the engine and electrical boxes are visually inspected for possible damage prior to startup. During the test procedure, engineering personnel are vigilant for excessive vibration, oil/fuel leaks, noises emanating from the pump, etc. After the test is completed, a final visual inspection is made.

A. MEASUREMENTS USING A PITOT TUBE

1. PROCEDURE FOR DIESEL/NATURAL GAS ENGINE DRIVEN PUMPS

The pitot tube is inserted through a 1" coupling welded to the top of the discharge pipe. The position of the coupling along the pipe is chosen based on site conditions, accessibility, convenience, etc. A "U" tube water manometer is connected to the pitot tube to measure the differential pressure. The pump is started and the pitot tube, manometer, and tubing are purged of air. Engine speed is set for maximum throttle or about 20% over design speed, whichever is less. Speed of the pump is measured using a hand-held photo tach. The water flow is measured using the pitot tube and taking 10 readings across the diameter of the pipe. If the pipe is not full at the pitot tube position, the air gap height is measured. The static water pressure is determined by measuring the height of the static pitot tube line above the sump water surface level. The pump speed is dropped about 10% and the measurements are taken again. This procedure is repeated with the pump running at five different speeds. The flow and total head for each separate speed are calculated. Using the affinity laws the points at different speeds are adjusted to a single speed, usually the design speed. These adjusted points are then plotted and a curve drawn through the five points.

2. PROCEDURE FOR ELECTRIC MOTOR DRIVEN PUMPS

The procedure is very similar to the diesel driven version except that points are not taken at different speeds. They are done at different heads. Only three points are taken because it is usually not practical to get five different heads. Since the points are done at a constant speed, adjustments using the affinity laws are not required.

B. MEASUREMENTS USING A WEIR

When a pitot tube can not be used, normally on a box style pump, then a weir is used. If the pump is engine driven, then different speeds are used for the five points. If the pump is motor driven, then the weir is adjusted to create different static heads.

EXPLANATION OF DISCHARGE EQUATION

From previous pump manufacturing research, development, and testing, a typical axial pump curve would have a profile similar to figure 1.

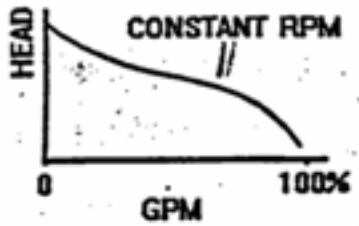


FIGURE 1.

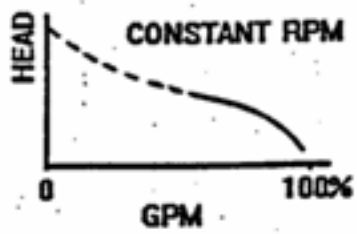


FIGURE 2.

Figure 2 shows the useful, non self-destructive, reasonably efficient range for the pump at normal speed. For operating conditions that fall in this range a second order polynomial equation can be used. For operating pumps at very low speeds (50%) a higher order equation is required to include the dotted portion of figure 2. The third order polynomial is a function of HEAD where the independent variable is HEAD, and the dependent variable GM. The equation includes adjustments for RPM by incorporating the affinity laws:

$$Q1 = \frac{N1}{N} Q \quad \text{, and} \quad H1 = \left(\frac{N1}{N}\right)^2 H$$

The developed equation takes the form:

$$B\left(\frac{N}{RPM}\right) \quad A - \left[\left(\frac{RPM}{N}\right)^2 H - C\right]^{\frac{1}{3}} = GPM$$

Since most calculators and computers can not return the cube root of a negative number the equation becomes:

$$B\left(\frac{N}{RPM}\right)\left[A - \frac{\left(\frac{RPM}{N}\right)^2 H - C}{\left|\left(\frac{RPM}{N}\right)^2 H - C\right|}\right]\left[\left|\left(\frac{RPM}{N}\right)^2 H - C\right|\right]^{\frac{1}{3}} = GPM$$

, where

RPM = original pump / engine curve speed,
N = actual pump / engine curve speed,
H = head input to equation,
A = constant value,
B = constant value, and
C = constant value.

```
GPM = (N/RPM)*(A-(((RPM/N)^2*H-C)/ABS((RPM/N)^2*H-C))*(ABS((RPM/N)^2*H-C))^.333)*B
```

RPM = ORIGINAL PUMP/ENGINE CURVE SPEED

N = ACTUAL PUMP/ENGINE SPEED

H = HEAD INPUT TO EQUATION

A = CONSTANT VALUE

B = CONSTANT VALUE

C = CONSTANT VALUE

RE-ARRANGED: $$B\left(\frac{N}{RPM}\right)\left(A-\left[\frac{\left(\frac{RPM}{N}\right)^2 H-C}{\left|\left(\frac{RPM}{N}\right)^2 H-C\right|}\right]\sqrt[3]{\left|\left(\frac{RPM}{N}\right)^2 H-C\right|}\right)=GPM$$

IF THE TERM UNDER THE RADICAL, (RPM/N)^2*H-C , EQUALS 0, THEN THE EQUATION WILL RETURN AN ERROR OR 0. THEREFORE AVOID THE SITUATION OF $\left(\frac{RPM}{N}\right)^2 H-C=0$ OR $H=C\left(\frac{N}{RPM}\right)^2$.

BY ADJUSTING H SLIGHTLY BY ADDING OR SUBTRACTING AN INSIGNIFICANT AMOUNT. EXAMPLE: $H=4.330\text{ ft}=C\left(\frac{N}{RPM}\right)^2$

now $H=4.331\text{ ft}$

Exhibit 19

Exhibit 19

ACME IMPROVEMENT DISTRICT
STATION # 3
UNIT # 1

SERIAL # 2754
DATE 24 APR 96

PIPE INSIDE DIA 54 INCHES

DESIGN POINT
280 RPM
60000 GPM
7 FT

ENGINE SPEED FOR CURVE 1680 RPM

STATIC HEAD (INCHES)	TEST PUMP SPEED (RPM)	TEST ENG SPEED (RPM)
65.2	248	1488
63.9	229	1374
64.3	212	1272
63	193	1158
65	178	1068

MANOMETER READINGS (INCHES)	14.0	11.7	9.0	8.0	5.0
	21.0	17.0	14.5	8.0	5.2
	18.0	17.5	15.0	8.0	4.8
	15.2	14.5	12.0	7.5	5.8
	11.5	13.5	11.0	7.1	5.0
	9.7	10.7	8.5	6.0	4.0
	10.0	8.5	6.5	4.1	3.3
	9.5	6.5	5.0	3.8	3.0
	9.9	5.0	4.0	3.0	3.0
	7.2	4.1	3.5	3.0	3.5
AVG VEL (FT/SEC)	8.12	7.46	6.73	5.51	4.75
AIR GAP IN TOP OF PIPE (INCHES)	0.0	0.0	0.0	0.0	0.0
FRACTION OF TOTAL PIPE AREA	1.00	1.00	1.00	1.00	1.00
TEST FLOW RATE (GPM)	57953	53258	48012	39318	33905
TEST HEAD (FT)	6.5	6.2	6.1	5.7	5.8

SPEED TO BE USED FOR CURVE 280 RPM

POINTS TO PLOT ON CURVE
DEVELOPED FROM AFFINITY LAWS

SPEED (RPM)	HEAD (FT)	FLOW (GPM)	ST HEAD (FT)	FLOW (GPM)
248	6.5	57953	6.9	65431
229	6.2	53258	8.0	65119
212	6.1	48012	9.3	63412
193	5.7	39318	11.0	57042
178	5.8	33905	13.4	53334

EQUATION COEFFICIENTS

A = 1.2 C = 16.5
B = 20000 N = 280

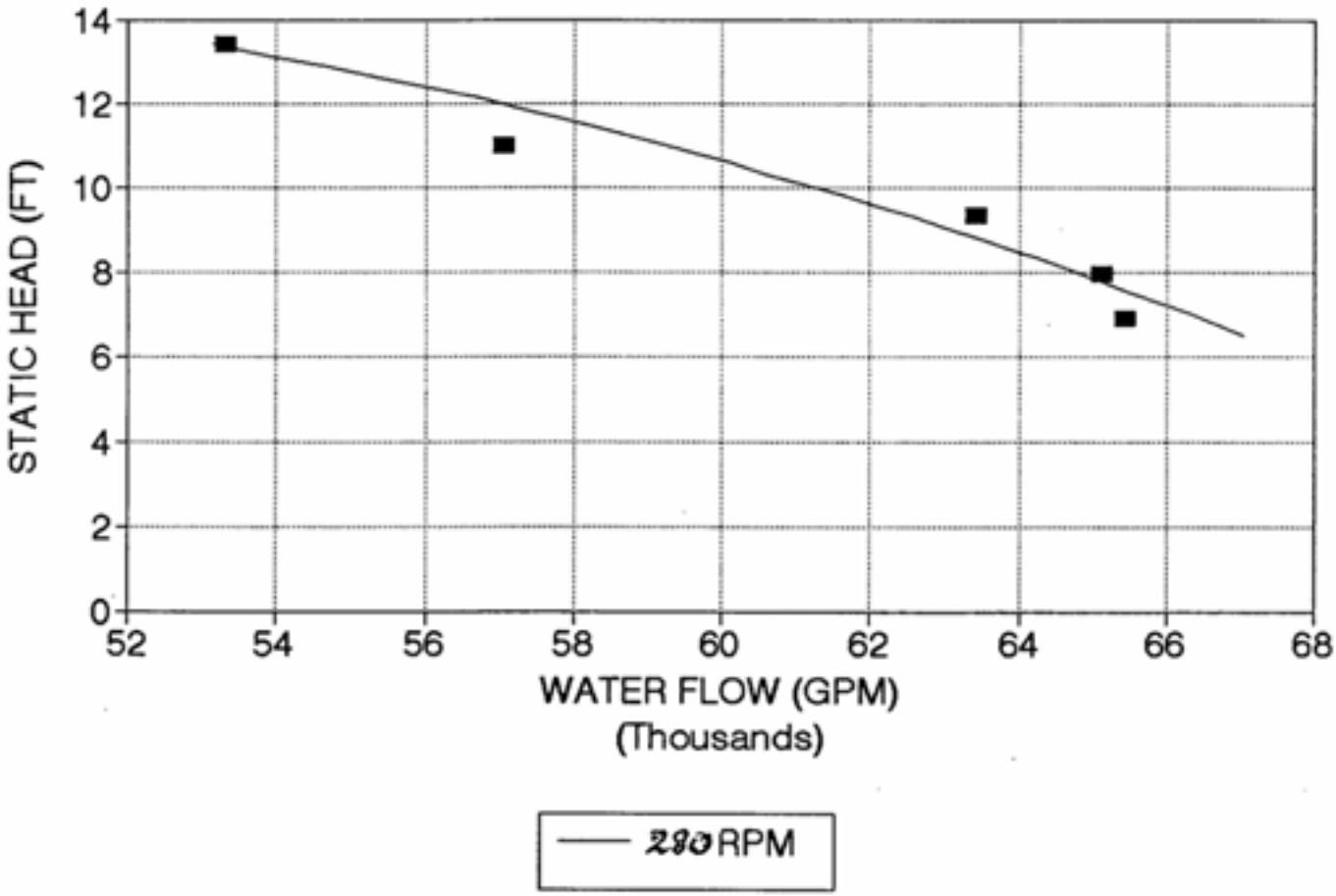
Exhibit 19

M & W PUMP CORPORATION
33 N. W. 2nd STREET
DEERFIELD BEACH
FLORIDA 33441
U. S. A.
ESTABLISHED 1926

SITE SPECIFIC FIELD TEST PERMORMANCE CURVE

STATION No.3 PUMP No.1

S/N 2754 24-APR-96



ASSUMING THAT NO ALTERATIONS ARE MADE TO THE SYSTEM, IN MY PROFESSIONAL JUDGMENT AND CALIBRATION METHODOLOGY, INSTRUMENTATION, PROCEDURE, DATA COLLECTION AND INTERPRETATION, AND FINAL FLOW EQUATION WILL BE SUFFICIENT TO CALCULATE THE DISCHARGE QUANTITY AS DESCRIBED IN CHAPTER 40E-63 FLORIDA ADMINISTRATIVE CODE (F. A. C.).

M & W PUMP CORPORATION
CERTIFICATION
20-MAY-96

Exhibit 19

ACME IMPROVEMENT DISTRICT
STATION # 4
UNIT # 1

SERIAL # FARMERS 1886
DATE 24 APR 96

PIPE INSIDE DIA 54 INCHES
ENGINE SPEED FOR CURVE 1199 RPM

DESIGN POINT
255 RPM
60000 GPM
8.5 FT

STATIC HEAD (INCHES)	TEST PUMP SPEED (RPM)	TEST ENG SPEED (RPM)
65	308	1448
64	288	1354
62	261	1227
60	238	1119
59	221	1039

MANOMETER READINGS (INCHES)	20.0	17.5	11.0	10.0	9.2
	19.5	17.8	11.0	9.0	9.1
	18.1	15.1	12.8	9.0	8.0
	17.5	15.0	12.0	8.9	8.0
	16.8	14.0	12.0	8.1	7.1
	16.5	13.1	9.9	8.0	7.0
	16.1	12.0	9.8	7.0	6.0
	14.8	13.6	9.0	7.1	5.9
	15.1	14.5	9.0	7.5	4.1
	12.8	11.7	9.8	6.1	3.6
AVG VEL (FT/SEC)	9.45	8.78	7.54	6.56	5.98
AIR GAP IN TOP OF PIPE (INCHES)	0.0	0.0	0.0	0.0	0.0
FRACTION OF TOTAL PIPE AREA	1.00	1.00	1.00	1.00	1.00
TEST FLOW RATE (GPM)	67486	62678	53821	46863	42694
TEST HEAD (FT)	6.8	6.5	6.0	5.7	5.5

SPEED TO BE USED FOR CURVE 255 RPM

POINTS TO PLOT ON CURVE
DEVELOPED FROM AFFINITY LAWS

SPEED (RPM)	HEAD (FT)	FLOW (GPM)	ST HEAD (FT)	FLOW (GPM)
308	6.8	67486	3.7	55873
288	6.5	62678	4.2	55496
261	6.0	53821	4.9	52584
238	5.7	46863	5.7	50210
221	5.5	42694	6.5	49262

EQUATION COEFFICIENTS

A = 2 C = 8
B = 15500 N = 255

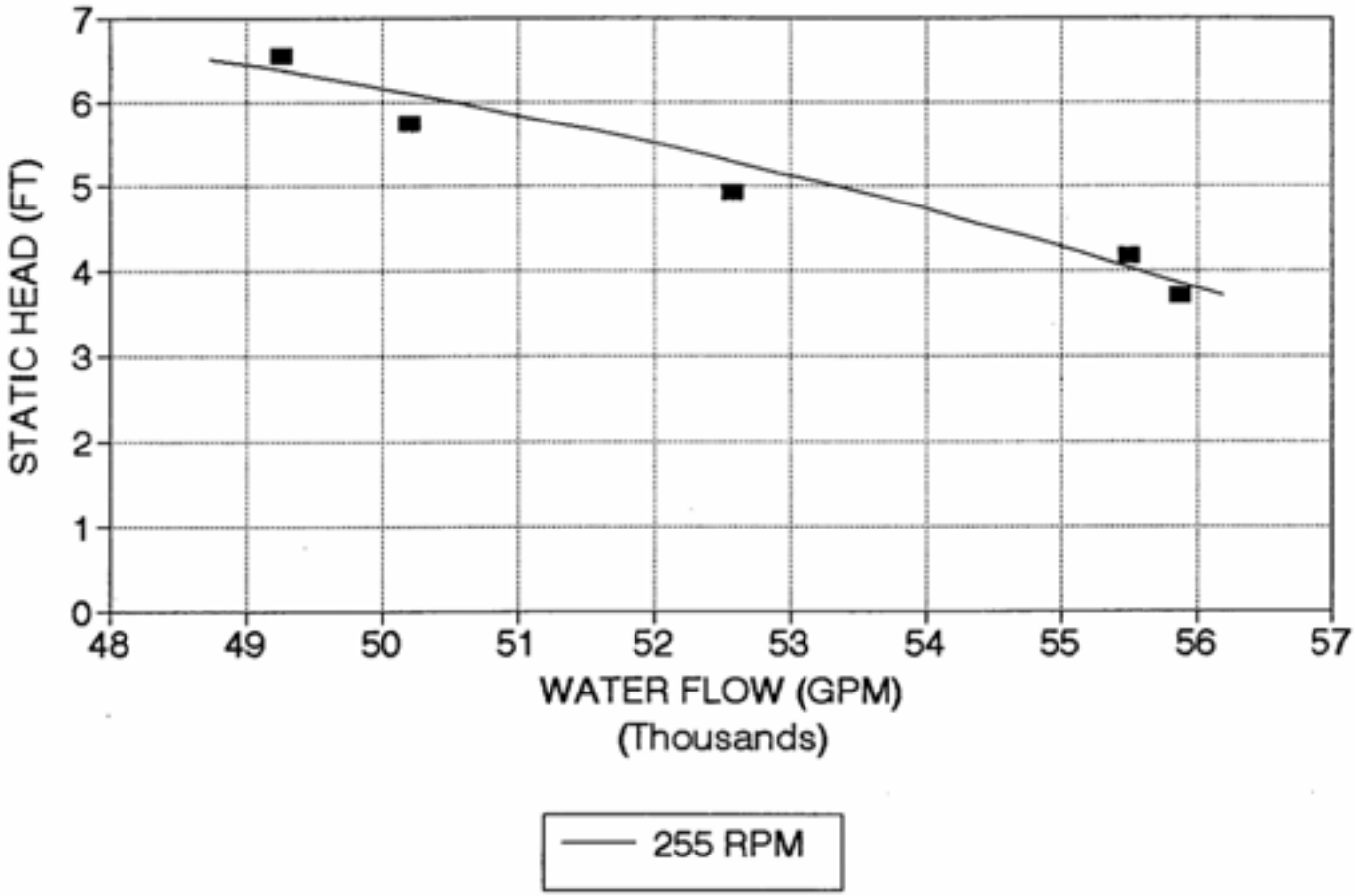
Exhibit 19

M & W PUMP CORPORATION
33 N. W. 2nd STREET
DEERFIELD BEACH
FLORIDA 33441
U. S. A.
ESTABLISHED 1926

SITE SPECIFIC FIELD TEST PERMORMANCE CURVE

STATION No.4 PUMP No.1

S/N 1886 24-APR-96



ASSUMING THAT NO ALTERATIONS ARE MADE TO THE SYSTEM, IN MY PROFESSIONAL JUDGMENT AND CALIBRATION METHODOLOGY, INSTRUMENTATION, PROCEDURE, DATA COLLECTION AND INTERPRETATION, AND FINAL FLOW EQUATION WILL BE SUFFICIENT TO CALCULATE THE DISCHARGE QUANTITY AS DESCRIBED IN CHAPTER 40E-63 FLORIDA ADMINISTRATIVE CODE (F. A. C.).

M & W PUMP CORPORATION
CERTIFICATION
20-MAY-96

Exhibit 19

ACME IMPROVEMENT DISTRICT
STATION # 4
UNIT # 2

SERIAL # 4816
DATE 24 APR 96

PIPE INSIDE DIA 54 INCHES
ENGINE SPEED FOR CURVE 1600 RPM

DESIGN POINT
320 RPM
60000 GPM
6.5 FT

STATIC HEAD (INCHES)	TEST PUMP SPEED (RPM)	TEST ENG SPEED (RPM)
58	355	1775
60	327	1635
65	299	1495
68	280	1400
71.5	265	1325

MANOMETER READINGS (INCHES)	12.0	9.9	8.1	6.1	3.3
	12.6	10.3	7.1	6.1	3.0
	12.8	10.2	9.0	7.0	2.1
	13.8	9.3	6.1	6.1	1.8
	11.0	9.8	6.9	5.9	1.8
	11.6	8.5	7.8	5.8	2.0
	9.8	8.0	7.1	4.8	3.0
	10.0	7.3	6.3	5.3	5.1
	11.8	9.0	7.8	6.3	5.0
	12.0	9.0	8.0	5.3	4.5
AVG VEL (FT/SEC)	7.93	6.99	6.30	5.61	4.04
AIR GAP IN TOP OF PIPE (INCHES)	0.0	0.0	0.0	0.0	0.0
FRACTION OF TOTAL PIPE AREA	1.00	1.00	1.00	1.00	1.00
TEST FLOW RATE (GPM)	56590	49900	44973	40015	28845
TEST HEAD (FT)	5.8	5.8	6.0	6.2	6.2

SPEED TO BE USED FOR CURVE 320 RPM

POINTS TO PLOT ON CURVE
DEVELOPED FROM AFFINITY LAWS

SPEED (RPM)	HEAD (FT)	FLOW (GPM)	ST HEAD (FT)	FLOW (GPM)
355	5.8	56590	3.9	51010
327	5.8	49900	4.8	48832
299	6.0	44973	6.2	48132
280	6.2	40015	7.4	45731
265	6.2	28845	8.7	34832

EQUATION COEFFICIENTS

A = 1.7 C = 9
B = 15000 N = 320

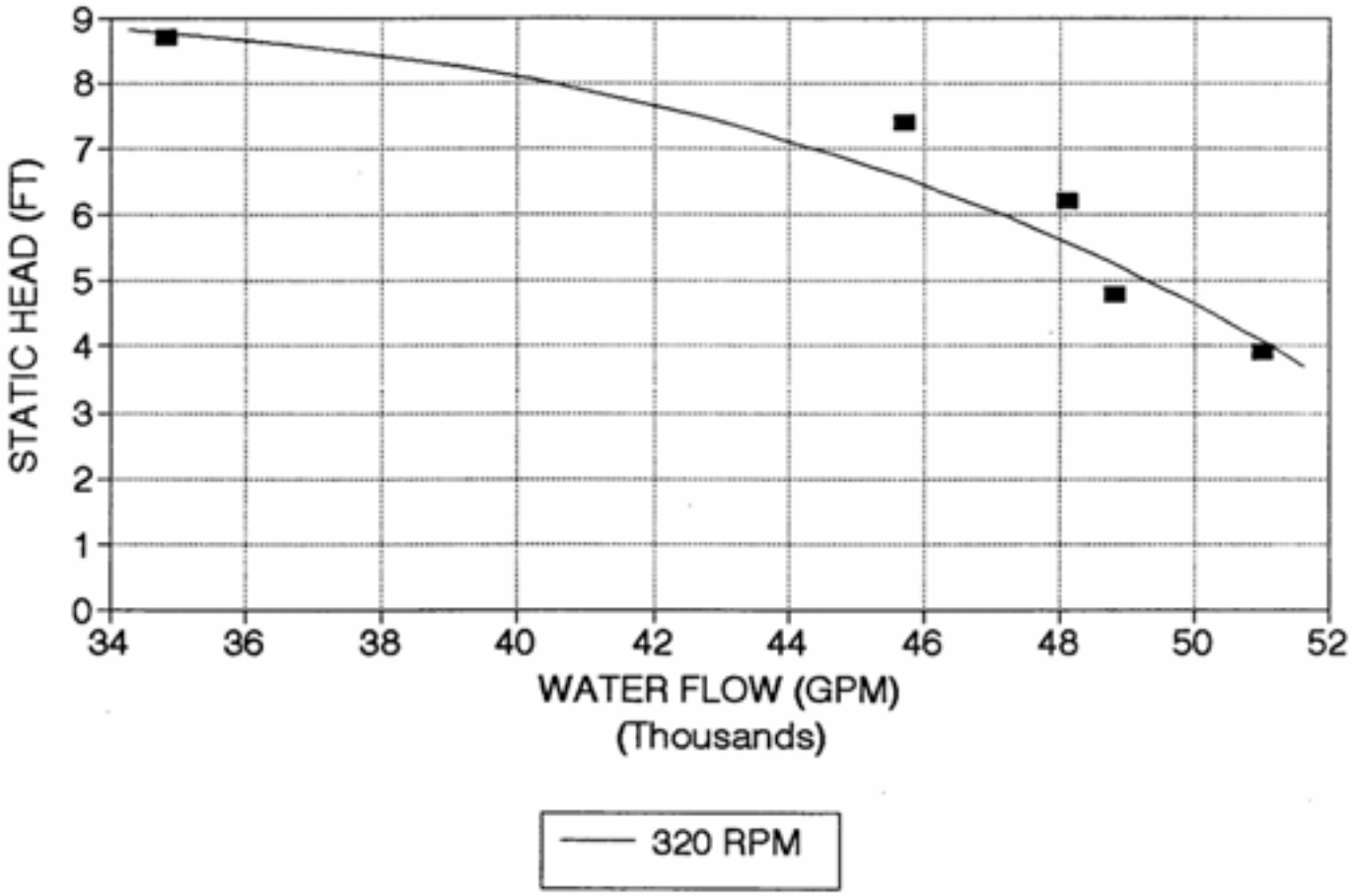
Exhibit 19

M & W PUMP CORPORATION
33 N. W. 2nd STREET
DEERFIELD BEACH
FLORIDA 33441
U. S. A.
ESTABLISHED 1926

SITE SPECIFIC FIELD TEST PERMORMANCE CURVE

STATION No.4 PUMP No.2

4816 24-APR-96



ASSUMING THAT NO ALTERATIONS ARE MADE TO THE SYSTEM, IN MY PROFESSIONAL JUDGMENT AND CALIBRATION METHODOLOGY, INSTRUMENTATION, PROCEDURE, DATA COLLECTION AND INTERPRETATION, AND FINAL FLOW EQUATION WILL BE SUFFICIENT TO CALCULATE THE DISCHARGE QUANTITY AS DESCRIBED IN CHAPTER 40E-63 FLORIDA ADMINISTRATIVE CODE (F. A. C.).

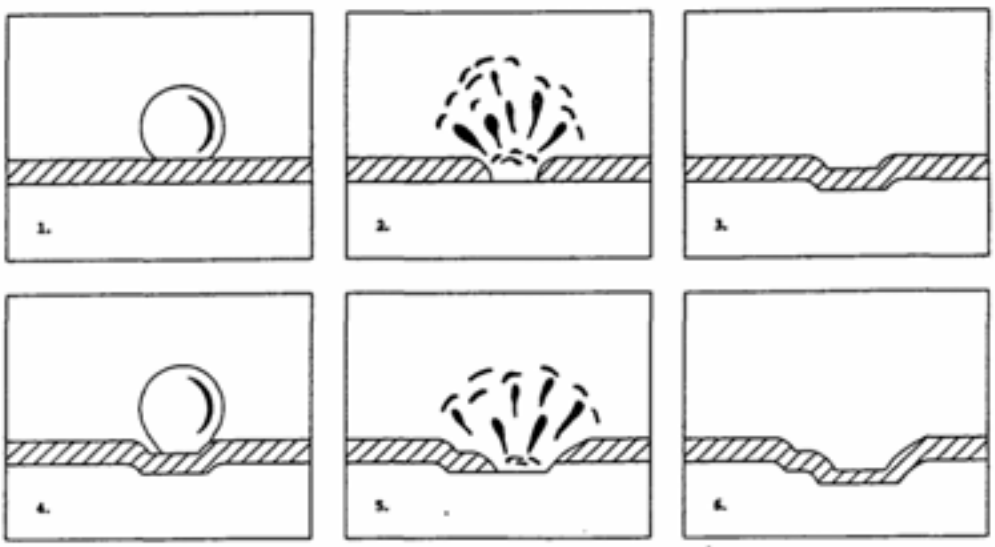
M & W PUMP CORPORATION
CERTIFICATION
James D. [illegible]
20-MAY-96

Cavitation Damage

Cavitation damage is a special form of erosion corrosion which is cause by the formation and collapse of vapor bubbles in a liquid near a metal surface. Cavitation damage occurs in hydraulic turbines, ship propellers, and other surfaces where high-velocity liquid flow and pressure changes are encountered. Before considering cavitation damage, let us examine the phenomenon of cavitation. If the pressure on a liquid such as water is reduced sufficiently, it boils at room temperature. Consider a cylinder full of water which is fitted with a tight piston in contact with the water. If the piston is raised away from the water, pressure is reduced and the water vaporizes, forming bubbles. If the piston is now pushed toward the water, pressure is increased and the bubbles condense or collapse. Repeating this process at high speed such as in the case of an operating water pump, bubbles of water vapor form and collapse rapidly. Calculations have shown that rapidly collapsing vapor bubbles produce shock waves with pressure as high as 60,000 lb/in². Forces this high can produce plastic deformation in many metals. Evidence of this is indicated by the presence of slip lines in pump parts and other equipment subjected to cavitation.

The appearance of cavitation damage is somewhat similar to pitting, except that the pitted areas are closely spaced and the surface is usually considerably roughened. Cavitation damage has been attributed to both corrosion and mechanical effects. In the former case, it is assumed that the collapsing vapor bubbles destroy protective surface films which results in increased corrosion.

This mechanism is shown schematically. The steps are as follows: (1) a cavitation bubble forms on the protective film. (2) The bubble collapses and destroys the film. (3) The newly exposed metal surface corrodes and the film is reformed. (4) A new cavitation bubble forms at the same spot. (5) The bubble collapses and destroys the film. (6) The exposed area corrodes and the film reforms. The repetition of this process results in deep holes.



Schematic representation of steps in cavitation.