South Florida Water Management District
Well Drilling Program Assessment – Y2001
Technical Memorandum WS-13

Prepared by:
John Lukasiewicz, P.G.
Hydrogeology Section Supervisor, WRM
and
Nancy Little, WRO

March 2002

South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Fl 33306
(561) 686-8800
www.sfwmd.gov

EXECUTIVE SUMMARY

This document was developed at the request of Mr. Joe Taylor (then Deputy Executive Director, Water Resources Operations Business Group). The request was conveyed in a staff meeting in September 2000 to the authors when they were asked to assess the drilling program to determine whether or not it is a "District core competency." This document provides a summary of the primary considerations reviewed to comply with that request. In addition, it includes staff's assessment of the District's drilling program and efficiency, examines short and long term drilling plans and projections, and provides specific recommendations and alternatives for the future operation of the District's drilling program.

The District's well drilling program began in 1976 and its performance is reviewed periodically. The last review was completed in 1996. Records of the program's performance between FY97 and FY98 were not maintained primarily due to changes in the organization during that time. Therefore, this report considers work performed only from FY99 and FY00. Past reviews noted that the emphasis of the District drilling business was on data collected during the drilling operation; while the emphasis of a private contractor, who must show a profit, was typically on speed (maximum footage drilled per day). However, over the past five to seven years, District hydrogeologists have had much success using contracted services to collect data while drilling both shallow and deep wells.

Up until October 2001, the drilling program was managed in the Electronic Support and Data Acquisition (ESDA) Department, under the Water Resource Operations (WRO) Resource Group, Technical Services Division. In October 2001, the drilling program was transferred to the Hydrogeology Section in the Water Supply Department, under the Water Resources Management (WRM) Resource Group. Three full-time drilling associates are in the program. Capital equipment consists of seven vehicles, including two drill rigs, and various types of support equipment. In addition to drilling and constructing new wells, another important function the District's drilling program serves is in maintaining, repairing, and plugging existing District monitor wells. The District maintains over 500 monitor wells, many of which are artesian (naturally flowing wells).

Two major in-house drilling projects were accomplished in the two-year period between FY99 and FY00. During that period, multiple shallow 2" diameter wells and one deep 12" diameter Floridan aquifer well were constructed. In-house costs to construct the shallow 2" diameter wells averaged $54 per cased foot, whereas contractor costs were estimated at $30 per cased foot. In-house costs were approximately 80% higher than contract services for the two shallow well projects. Deeper well construction costs for in-house drilling versus contractor were $234 and $163 per foot, respectively, approximately 44% higher to do the work in-house.

Other factors considered in evaluating whether this drilling program is a District "core competency" were broken out into pro's and con's as follows:

PRO's - Reasons TO Continue In-House Drilling Operations:

- Avoid financial loss on capital equipment;
- Increased flexibility provided to the District's Project Managers;

- District gains flexibility, positive image in emergency situations, (i.e. drought management monitoring);
- Reduction in project manager's time spent on contracting out services;
- Backlog of available/pending drilling projects exists;
- Opportunities to enhance specialized "niche" drilling services exist; and
- Three District Associates are already qualified and trained to drill.

CONS- Reasons NOT TO Continue In-House Drilling Operations:

- District procurement delays;
- District budget process impedes ability to optimize program's efficiency;
- Drill crew limited to a 40-hour work-week;
- Program efficiency limited because of its small size and scale;
- Types of drilling methods and capabilities are limited;
- Current organizational structure inadequate. If a dedicated field supervisor cannot be added to this operation, it should be discontinued;
- Politics biases judgement and ultimately drilling operations performance; and
- The future of District drilling has shifted toward deeper ASR wells, outside the capabilities of the current equipment and drill crew.

Based on our evaluation, we have concluded that the drilling business is not a District "core competency." The authors recommend that the District ramp down and ultimately discontinue its drilling program if it cannot improve its efficiency and cost effectiveness. Complete records of the program should be kept in the future to make this assessment possible. A reassessment of the program should be made prior to the FY04 budget process and used as a stop/go decision tool by management.

Program termination can be done abruptly (sell or auction all drilling equipment and immediately re-direct staff to other work areas) or in phases. The authors recommend phasing the program out over time as this would cause the least disruption. Steps would include the following:

1. Sell the Schramm rig;
2. Complete the backlog of drilling projects that can feasibly be done with the mobile rig;
3. Continue to use the District drill crew to maintain the District's extensive monitor well network and install new ones in select areas;
4. Shift the activities of the drilling staff to ongoing hydrologic/hydrogeologic support activities in ESDA;
5. Drilling staff to outsource well rehabilitation projects or re-train.

TABLE OF CONTENTS

List of Tables:

Appendices:

BACKGROUND

Purpose and Scope

This document was developed at the request of Mr. Joe Taylor (then Deputy Executive Director, Water Resources Operations Resource Group). The request was conveyed in a staff meeting on September 2000 to the authors when they were asked to assess the drilling program to determine whether or not it is a "District core competency." A core competency is something only the District can do well (better than the private sector). This document provides a summary of the primary considerations reviewed to comply with that request. In addition, this document includes staff's assessment of the District's drilling program and efficiency, examines short and long term future drilling work projections, and provides specific recommendations and alternatives for the future operation of the drilling program.

Previous Drilling Program Performance Reports

The performance of the District's well drilling program is reviewed periodically. The program was last reviewed in 1996. Previous reviews and business case documents were written in 1991 and 1993. These included an extensive report written by the Budget Division. The final analysis of each of these reports has typically been to continue the program and follow-up with periodic review. Cost analyses from previous reviews were based on several criteria including the type of drilling work performed for the time period of the review, the actual workload for District drilling rigs and crews, and the method of evaluating cost. In some instances the costs were shown to be more favorable using District staff and equipment. In other cases, contracted work efforts were shown to be more cost effective.

Historically, it appears that the decision of whether or not to continue the District's well drilling program using in-house resources has been difficult to evaluate. A statement from the Budget Division's *Well Drilling Final Report – Cost Analysis/Evaluation of the District's Well Drilling Program (October 1992),* best describes this dilemma. "Besides costs, other factors should be considered before reaching a conclusion…the intangible benefits associated with maintaining an in-house program, any unusual circumstances which may have affected the program's cost effectiveness, and the projected level of future drilling activity."

Previous analyses of the District's drilling services versus drilling by private contractors have reflected differences in costs based on the depth, diameter, and drilling method used. It was concluded that since well drilling for the purpose of scientific monitoring is not an exact science, unknown costs could occur in time and materials. There is potential for lost fluid circulation in highly porous zones, which in turn can cause hole collapse around the drill rod. This can permanently seal the rod in the hole. Lost drill rod is a costly risk. Since much of the drilling activities take place in areas where little or no geologic information exists, that risk is relatively high. To offset this, private contractors must include a risk factor in their costs to increase the probability of making a profit on the job. This risk factor takes into account unforeseen situations that may occur during the drilling operation. Past reports noted that the emphasis of the District drilling business was on data collection during the drilling operation while the emphasis of a private contractor, who must show a profit, was typically on speed (maximum footage drilled per day). However, over the past five to seven years, very successful data collection and overall results have been realized using contracted drilling services for both shallow and deep wells.

Organization, History, and Function of Drilling Program

The District initiated the well drilling program in 1976. Before October 2001, it was managed in the Electronic Support and Data Acquisition Department (ESDA), under the Water Resource Operations Resource Group, Technical Support Division. In October 2001, it was transferred to the Water Supply Department under the Water Resources Management Resource Group. Three regular, full time drilling associates staff the drilling crew. These staff members include one Specialist Drilling Associate, one Senior Drilling Associate, and one Staff Drilling Associate.

The primary function of this drilling crew has been to drill water wells constructed primarily for data acquisition. The lithologic, geophysical, hydraulic, and water quality data collected from these wells are used in the development of three dimensional ground water flow models that directly contributes to the District's strategic water supply planning and water quality initiatives. Data collected during construction, and then subsequently during long term monitoring of these wells, provides information used for determining the occurrence and distribution of ground water resources, availability of these resources, and ground water/surface water interactions.

In addition to drilling and constructing new wells, another important function the District's drilling program includes maintaining and repairing existing monitor wells. There are over 500 existing District wells to maintain. The drill crew also responds to emergency calls where valved, naturally flowing wells have been hit by maintenance crews and requires quick repair. This monitoring supports development and implementation of the District's Lower East Coast (LEC), Lower West Coast (LWC), Upper East Coast (UEC), and Kissimmee Basin Water Supply Plans, the Florida Department of Environmental Protection (FDEP)/District Ambient Groundwater Quality Program, and the United States Geological Survey (USGS)/District cooperative agreement contract network of monitor wells.

CURRENT DRILLING PROGRAM EQUIPMENT AND CAPABILITIES

Inventory

The following equipment is part of the drilling program:

- V1842 Schramm T-685W Rotadrill (sold in Summer of 2001),
- V1200 Mobile Drill B-80
- V1333 Transport Truck (rig tender)
- V1389 Transport Truck (rig tender)
- V1841 Utility Truck, 4x4 (service truck)
- V2079 Backhoe/V1946 Trailer
- V1054 Utility Truck (outfitted with draw works for camera/video logging)

Additional support equipment includes various sizes of drill rods and bits, two compressors, various pumps, and miscellaneous tools-of-the-trade such as: drilling elevators, well casing, drilling mud, de-sander, etc.

The two drill rigs (Schramm-T-685W Rotadrill and Mobile Drill B-80) have different capabilities. **Table 1 and 2** lists the current capabilities of the equipment in terms of drilling techniques, casing diameters, and total depths attainable.

Mobile Rig

The Mobile Drill B-80 (V-1200) is equipped to drill shallow (10 to 200' below land surface {bls}), dual tube (a coring method) holes. It can also be switched to mud rotary drilling as needed to drill deeper holes (up to 500' bls), and to install small casing diameter (2 to 4 inches) PVC wells. It can also be used to drill hollow-stem auger holes (12" diameter) up to 30' bls.

Table 1: Mobile Drill Rig Capabilities.

Drilling Technique	Casing Diameter Install Capabilities	Depth Capabilities (feet bls)
Dual tube	Drill 6" diameter hole to set 2" diameter casing (flush joint steel, or PVC/FRP)	Up to 200' w/existing drill pipe – capability 400' w/purchase of additional drilling pipe.
Mud rotary	Drill 6" diameter hole to set 2" diameter casing	Up to 500' unless hit rock, or lose circulation (could typically hit rock, or lose circulation from 200' – 500' bls)
	Drill 6" diameter hole to set 4" diameter casing	Up to 500' unless hit rock, or lose circulation
	Drill 12" diameter hole to set 8" diameter casing	If no surface casing is needed, up to 200' unless lose circulation
Auger	Drill 12" diameter hole to set 2" diameter casing	30'
	Drill 12" diameter hole to set 4" diameter casing	30'

Schramm Rig

The Schramm T-685W Rotadrill Rig has the capability of drilling deeper (up to 2100' achieved), 8" diameter pilot holes using reverse air. The top-head is not outfitted to perform dual tube drilling and would need to be changed for this capability. The Schramm rig is limited by the diameter casing it can set primarily because it has a maximum winch (lift) capacity of 6,200 pounds. Therefore, the use of larger diameter, heavier steel casings is limited. Additionally, for larger diameter holes, 12" – 16", there are rig limitations related to the discharge configuration of the top-head drive which is less than desirable. The drilling crew has encountered problems with materials becoming plugged during drilling resulting in lengthy drilling times in certain conditions and depths.

Table 2: Schramm Drill Rig Capabilities.

Drilling Technique	Casing Diameter	Depth and Comments
Mud rotary	Drill 6" diameter hole to set 2" diameter casing	Up to 500' unless hit rock, or lose circulation (could typically hit rock or lose circulation from 200' – 500')
	Drill 6" diameter hole to set 4" diameter casing	Up to 500' unless hit rock, or lose circulation (casing limit for 4" steel is approx. 550')
	Drill 12" diameter hole to set 8" diameter casing	Up to 500', limited to lost circulation (casing limit for 8" steel is approx. 210')
	Drill 16" diameter hole to set 12" diameter casing	Up to 500', limited to lost circulation (casing limit for 12" steel is approx. 125')
Reverse air	Drill 6" diameter hole to set 2" diameter casing	Depth of 2100' achieved – drill rod available to 2300' (casing limit for 2" steel is approx. 1650')
	Drill 8" diameter hole to set 4" diameter casing (would set 12" surface casing first)	2100' – 2300' (casing limit for 4" steel is approx. 550')
	Drill 12" diameter hole to set 8" diameter casing	Casing limit for 8" PVC is approx. 1170'
	Drill 16" diameter hole to set 12" diameter casing* (would set 18" surface casing first)	Casing limit for 12" PVC is approx. 623' Casing limit for 12" steel is approx. 125' (would need stabilizer and bit – not in inventory)

**Note: To set 18" surface casing, a 24" hole needs to be drilled. A large diameter stabilizer is needed for this, which cannot easily fit in the drill floor (table) opening. To make it fit requires much effort and time.*

BUSINESS CASE COST ANALYSIS

An attempt was made to obtain records related to drilling activities over the past five years. However, records were not maintained between FY97-FY98 primarily as a result of several District organizational changes over that period, whereby multiple changes in the supervisory responsibilities of the program took place. The monthly and quarterly drilling program reports recorded up to and including FY96 were used in the previously referenced drilling program report (1996). Therefore, a complete report of program accountability over the past five years was not possible. It is strongly recommended that detailed records of the program's performance be required in the future.

Table 3 lists drilling projects completed in FY99 and FY00 along with estimated cost comparisons between in-house and contracted services. The in-house cost estimates and assumptions are listed in **Appendices A and B**. Contractor costs were estimated using similar work tasks taken from the District's General Services Drilling Contracts C-10900, C-10991, C-10992, C-10993, also managed in ESDA. Two in-house drilling projects were accomplished in the two-year period between FY99 and FY00. The first involved constructing multiple, shallow 2" diameter wells. The second involved constructing a deep (2,100' bls), larger diameter (12" PVC) well at the C-31 site near St. Cloud, Osceola County. In-house costs per casing foot to construct the shallow 2" wells were $62 and $47 for the Lake Toho and LWC projects, respectively. This compared to estimated contract costs of $30 per cased foot. In-house costs were between 56% to 106% higher for the two shallow well projects, respectively. A summary of those cost estimates are provided in **Appendices A-1 through A-3**. The drill rig used for these shallow wells was V-1200 (the Mobile rig).

Costs to drill the deeper well at St. Cloud with the Schramm rig were also higher than contract services. Due to the limitations of this rig, the assignment took much longer than originally anticipated. In fact, the well was never actually completed as will be discussed later in the report. Remaining work to complete the job is currently being outsourced to a local contractor. Costs for in-house drilling on the St. Cloud site versus contract costs were $234 and $163 per foot, or 44% higher in-house costs. In-house cost estimates are summarized in **Appendix B-1**. Further discussion on this Schramm rig is included later in this report.

All in-house cost estimates consider the front-end costs of capital equipment amortized over 10 years. The basis for the 10 years came from the District's Fleet Replacement Plan (2001) and is the life-span given for District's drill rigs. Front-end costs include the annual lease (to purchase) payments on V-1842, materials and supplies, and an overhead factor as shown in **Appendix B-1**. Estimated contract costs calculated for equivalent work tasks are given in **Appendix B-2**. As previously discussed, the cost comparisons provided in **Table 3** demonstrate that in-house costs were not competitive with contract services for all classes of wells during this time period (FY99, FY00).

The Schramm rig is not designed for installing long, heavy strings of steel casing. Rather, PVC casing must be used. This is a major limitation as we found out at the C-31 site. Here, the bottom 30 feet of the 12" diameter PVC casing was shattered after installation while air-developing the well. The damaged casing was not repairable with District equipment. Repairs and well completion were subsequently outsourced to a drilling contractor. That work is still

pending as of this writing. Costs will probably exceed $100,000 to outsource completion of the well. Steel casing is a necessity in deep well construction as was clearly demonstrated here.

Based on our drill crew's experience with the Schramm rig over the last two years, a more optimistic cost projection was done for a pending project in the Kissimmee Basin and is presented in **Appendix C-2** along with the assumptions used. The project consists of drilling shallow, intermediate, and Floridan wells. Although more competitive than the C-31 site, the District cost to do business with the Schramm rig here still exceeds a predicted contract cost by 32% (see **Appendix C-1, and Appendix C-2**). Twenty-two percent of that cost; however, is due to the payment of the drill rig lease, a portion of which must be factored into each project. The Schramm rig is on a 7-year, self-financed lease with a total cost of $560,000.

Table 3: FY99 and FY00 Drill Projects, Cost Comparisons Between In-House Versus Contracted.

Project	# of Wells	Casing Diameter	Total Feet Drilled	Rig	District Total Cost (labor & equip.)	Contractor Cost Total	District vs. Contractor Costs ($ per foot)
FY99 - Lake Toho Drawdown – monitor wells from 17-130'	5	2"	329'	V1200	$20,482 *(Append. A-1)*	$9,979	$62/30
FY99 – Lower West Coast Water Shortage – monitor wells from 18-298'	11	2"	1,432'	V1200	$66,925 *(Append A-2)*	$42,960	$47/30
C-31 Lower Floridan Aquifer 2100' test well FY99 – drill to 380' to set casing FY00 – drill open hole to 2,100'	1	18" to 104' 12" to 380' 6" to 2100'	2,100'	V1842	$492,550 *(Appendix B-1 and B-2)*	$342,360* *(Appendix B-3)*	$234/163
FY99/00 Lower West Coast Water Shortage – CREW Land	4	2"	168'	V1200	$6,150 *(Appendix A-4)*	$5,040	$37/30

* *Cost to outsource completion of well*

In addition to constructing the wells listed in **Table 3**, the drill crew also repaired and plugged existing District monitor wells in FY99 and FY00. These activities are listed in **Table 4**. Costs for these miscellaneous repair projects were estimated to amount to $33,700.

Table 4: FY99 and FY00 Miscellaneous Well Repair and Well Abandonment Projects

Fiscal Year	Project	Cost per Well	# of Wells	Total $
FY99	Well Repair- Misc	$2,000	3	$6,000
FY00	Well Repair – Ambient GW Network, *(Appendix A-5)*	$742	14	$10,393
FY00	Well Repair – SFWMD & USGS General Groundwater Network	$1,000	3	$3,000
FY00	Kissimmee River Restoration – Wells plugged, *(Appendix A-6)*	$2,043	7	$14,300
	Grand Total:			**$33,693**

The annual operating budget for the District's drilling program is summarized in **Table 5**. These annual totals include funds budgeted under all object codes in each annual budget from FY99 through FY01. The drilling program was funded at a level of approximately $400,000 each of the last two fiscal years (FY00 and FY01) and just over $500,000 in FY99. Although budgeted, the actual amounts spent each year were probably somewhat less than these amounts since each year some funds remain unspent. However, overhead costs such as staff time in Fleet for vehicle maintenance, upper management time, etc. are not captured here.

Table 5: Annual Budgets – In-House Drilling Program

Object Code	Description	FY99	FY00	FY01
5101	Regular Salaries & Wages	$140,561	$103,703	$107,851
5210 - 5249	Fringe Benefits	$48,086	$36,478	$37,937
5319	Other Contractual Services	$45,000	$45,500	$45,500
5415	Parts/Supply/Expns - Other	$94,184	$111,540	$96,540
5417	Photographic Supplies	$0	$0	$100
5419	Office Supplies	$0	$0	$800
5422	Lumber & Wood Products	$1,000	$0	$0
5423	Metal Products	$486	$0	$0
5426	Uniforms & Safety Shoes	$1,000	$1,230	$1,230
5503	Equipment Rental	$0	$0	$15,125
5508	Capital Lease Annual Payments	$84,861	$84,861	$84,861
5553	Training	$100	$0	$0
5554	Travel	$5,463	$21,800	$16,350
5559	Professional Licenses	$125	$150	$300
5599	Freight	$0	$1,250	$1,250
5650	Automotive Equipment	$71,000	$0	$0
5654	Furniture and Equipment	$16,952	$0	$0
	Totals	***$508,818***	***$406,512***	***$407,844***

IN-HOUSE DRILLING OPERATIONS – PRO'S AND CON'S

PRO's - Reasons TO Continue In-House Drilling Operations

1. *Avoid financial loss on capital equipment.* The newer "Schramm" drill rig was procured in FY98 using a self-financed, lease/purchase funding arrangement. Under the terms of the arrangement, lease payments will end in FY05. The Schramm drill rig purchase price was approximately $560,000. As of FY01, a balance of $327,000 was owed to complete the purchase. Scheduled payments began in FY98 and will continue through FY05. Lease payments have been budgeted for fiscal year (FY01) through the "D" program in Water Supply. However, the "D" program managers are concerned about the cost-effectiveness of the operations and are reconsidering funding the entire program in future years. The Schramm rig sold at auction for $200,000 on September 2001.

   Other related support equipment include the older Mobile rig, as well as the other associated support vehicles and equipment. The current market value for the equipment has not been assessed.

2. *Avoid political ramifications of sustaining the loss described above.* This topic addresses questions of "Why are we in this situation today?" and "Why did District buy this rig (Schramm) if operating it is not cost effective?" An explanation is offered under CON's, number 1.

3. *Increased flexibility provided to the District's Project Managers.* Using District drilling capabilities, the project manager of a drilling assignment has increased flexibility and is not "locked into" a predefined scope of work. The project scope can be modified without costly and time-consuming contract amendments that might occur if such changes were required of the drilling contractor. However, there is a drawback to this because the project manager at times can easily procrastinate and not scope out the project until the final hour.

4. *District gains flexibility, positive image in emergency situations, (i.e. drought management monitoring).* When the District declares water shortage restrictions in areas impacted by drought conditions, there have been instances when installation of new wells are needed quickly to replace agricultural and water supply wells. Wells needing replacement are typically completed (screened) above the declining water levels. In such instances, contract-drilling companies typically handle the demand for new wells. However, District drilling operations can be deployed to an area to assist, which creates a positive public perception that the District is out there when needed to deal effectively with water supply crises.

5. *Reduction in project manager's time spent contracting.* Contract management requires a considerable amount of effort and is an onerous, time consuming task at the District. The time demands are primarily on the project manager who can least afford to focus on the details of assembling a drilling contract scope of work as well as managing the contract through the procurement system. Use of the District drilling operation eliminates most of that burden for the project manager.

6. *Opportunities to enhance specialized "niche" drilling and well repair services exist.* The District has the opportunity to expand specialized drilling ("niche drilling") where the private drilling sector falls short of meeting District project demands. Such a niche and opportunity exists with "dual tube" specialty drilling services. This is a method currently limited to one contractor in South Florida- Hydrologic Associates, Inc. of Miami. It should be noted, however, that to capitalize on this specialty niche, the District would need to either: 1) re-design the Schramm drill rig or 2) upgrade its older drill rig for the job (current limitation of 200' for dual tube drilling). An estimate to enable either of these rigs to perform these services to the level desired has not been developed, but can be provided upon request. In addition to drilling niches, an opportunity exists to transition the drilling program into a well maintenance and operation program. This is very much needed at the District.

7. *Historical backlog of available/pending drilling and well repair needs at the District.* There's plenty of work to keep the District drilling and well maintenance programs busy for the foreseeable future, especially if we capitalize on the niche (split-spoon or dual-tube) drilling opportunity available. Historically, District drilling operations have always had a backlog of wells to drill, construct, and repair. Future drilling projections are listed in **Appendix D**.

8. *Three associates qualified and trained to drill and repair wells.* These three associates make up the District's "drill crew." Continuation of the District's drilling and maintenance operations would not require them to be re-trained to do other things, thereby, capitalizing on their existing expertise and skills. No District time, money, or energy would be required to proceed with full cross training.

CON's - Reasons NOT TO Continue In-House Drilling Operations

1. *Management Changes.* Although the Schramm drill rig was finally procured (a 3 year process) and delivered to the District in 1998, the justification and ultimate decision to purchase this rig was made as far back as 1995. Much has changed at the District since that time. Two District reorganizations (WRE in 1997 and entire District in 1999) completely changed the management under which the drilling operations reside. Two essential components of operations management suffered as a result: 1) support, supervision and management of the drill crew was reduced; and 2) contract management and oversight during procurement and delivery of the Schramm drill rig suffered. These are discussed in more detail below.

   <u>No Dedicated Field Supervisor</u>
   Between 1976 and 1995, the District's drilling operations were supervised by a full-time dedicated field supervisor (one focused entirely on sustaining drilling operations) combined with six additional field technicians and a litany of field vehicles all housed in one place. At that time, the field supervisor and the drill crew reported exclusively to the Hydrogeology Division Director. Within this structure, ownership of the drilling operation's performance, efficiency and ultimate products (wells) were housed in one shop under one line of management. Since 1995, there has been no dedicated field supervisor and with the 1997 reorganization, the drilling program was moved away from its Hydrogeologist customers under a different line of

management. That was reversed again in October 2001, when the drilling program was transferred back to the Hydrogeology Section within the Water Supply Department.

Contract Management of Schramm Rig Procurement in 1997/98

The Schramm rig is not the type envisioned by the originators of the procurement effort back in 1995. In other words, the District received a different product (rig) than originally envisioned. The new rig could not drill and construct the types of wells originally intended. After the rig was ordered, key staff who originally wrote the specifications were no longer in the organization (organizational structure changes, person leaving the District, and person transferring to another Division). After the rig was finally delivered to the District and during the window provided in the contract to "fully accept delivery and inspect the rig", no acceptance testing was done to confirm the ability of the rig to successfully perform the type of work specified in the work order. There was an evident communication breakdown between supervisory/ management staff, drilling crew, scientific staff (Hydrogeologists – end customers), supplier, and manufacturer. Consequently, once the 30-day inspection window expired, the District was left with a rig incapable of doing the work at hand.

2. *Current organizational structure inadequate.* If a dedicated field supervisor cannot be added to this operation, it should be discontinued. There is tangible loss of efficiency in the program when a dedicated field supervisor is not available to provide support and oversight. The required field supervisor would be responsible for the following areas:

a) Procurement of supplies and equipment. The drill crew may be on assignment at a job site and away from their headquarters for weeks at a time, often deployed in remote locations. Unanticipated conditions can be encountered and equipment can breakdown necessitating an immediate need for delivered parts and supplies. A field supervisor is needed to facilitate and expedite procurement and delivery of these supplies to the job site in order to minimize down time. Down time is one of the primary inefficiencies of the program.

b) Maintenance of fleet. As previously stated, the success or failure of the program is directly effected by equipment availability and down time. Focused supervision is required to ensure that equipment and vehicle servicing is regularly scheduled and properly timed to ensure the optimum efficiency of the operations. If one critical vehicle is down for a week, and the other is down the next week, then the drilling program is down for two weeks. This has happened on numerous occasions in the recent past.

c) Communications. A significant amount of communication needs to occur between the drill crew and District headquarters, particularly with the Hydrogeologists or other project managers at the District. Due to intensive workloads, meetings, and project schedules, the project managers and staff may not always be able to communicate with the drill crew directly. Information must be relayed through a reliable supervisory link. Solutions to field situations must be addressed and decisions made

quickly which often requires input and attention from all three levels of expertise (driller, field supervisor, and hydrogeologist).

d) Budget projections. Specialty equipment, as well as specialty technical services, is often required on a project-by-project basis. A field supervisor is needed to track these needs, plan, and budget for them annually.

e) Performance reporting and optimization. How many wells were constructed last month? How can we improve efficiency next month and what went wrong? What can we do differently to improve? These are all performance evaluation and optimization questions which must be done (and are done in the private sector) to keep the operations viable through time. A dedicated field supervisor would have the time to continuously keep records and evaluate these issues on a regular basis.

f) Field supervision of the drill crew. The drill crew is often deployed in remote areas that are sometimes a 3-4 hour drive from District headquarters. The crew may be deployed there from Monday to Thursday or Friday each week. Without a dedicated supervisor, adequate oversight and field supervision of the drilling operations is not possible.

3. *District politics biases judgement and ultimately drilling operations performance.* Drilling rigs are large, expensive, highly visible pieces of equipment. On several occasions through the history of the District's drilling program, private citizens, members of our Governing Board, or Executive Office, have scrutinized the operations based on personal observations about the location of the rig or what's seen happening (or not happening) at the site. When this occurs, management from all rungs of the ladder are summoned to meetings, or required to explain and justify the situation. In many cases there is a reasonable explanation, however, "politics is perception." District staff struggle with balancing perceptions, trying to manage resources wisely, and work within the limits of budgets, equipment, and human resources. Sometimes operational decisions must be in response to politics, and not necessarily agreed upon as the best course of action by all parties. It is recognized that these situations and outcomes are usually unavoidable.

   The District has also been viewed by the drilling industry as a source of unfair competition. This is not good politics and has created negative perceptions about the District. Periodically, private industry challenges our role in the drilling business, citing unfair competition.

4. *District Procurement delays.* The nature of the drilling business dictates the need for speedy, efficient procurement of supplies and materials when needed. For example, during the course of drilling a well, information about the character of the subsurface reveals itself during bit penetration. Well design decisions are made at the drill site directly after the borehole is drilled. These well design decisions include the need for well casing, well screen and other materials which must be procured and delivered to site before further work can proceed. In this case, those materials need to be on site the very next business day. Another example, is one where a specialized piece of equipment for the rig breaks down and needs replacement (like an elevator) before

operations can continue. Here, progress is completely halted until that piece arrives on site.

In most cases, the District's procurement process is not consistently sensitive to the urgency sometimes required for purchases. It can take weeks to get delivery of vital equipment and supplies, even with a dedicated field supervisor. The length of delay is directly related to the dollar amount needed for the purchase. The costlier the item, the more complex the process, and the longer it takes to procure. The best way to manage this inherent handicap is to plan as far in advance as possible. However, since equipment breakdowns cannot be predicted, they cannot be planned.

5. *District budget process.* Drilling operations are costly. Not only are rigs expensive to buy, operate, and maintain, but the inventory and maintenance of proper support equipment is also costly. Many essential pieces of support equipment simply do not get funded through the budget process. In the current program, there seems to always be one piece of equipment lacking, one that cannot be used to full capacity, or that is incompatible. Historically, items have been cut, compromised, or deferred in the budget process.

   Current examples of deficiencies in the drilling program include the need for:
   - A 1.5 ton utility truck – (only a 1 ton is available), cement mixer, and welding equipment.
   - Additional staff is needed, since we have two rigs, but only one crew. Currently, due to the size of the crew, only one rig may be utilized at a time. This significantly limits the full utilization of both rigs – one rig will always be parked and not in use. The backhoe is transported to whatever job site is in progress.
   - Hiring two additional well drilling personnel to run the second rig was not approved,
   - Repairs on the older rig V-1200 (only deck replacement – completed in FY00) was not approved,
   - Purchase of a new air compressor was not approved.
   - Purchase of a second backhoe and cement mixer was not approved.

   District must find a way to gain consistent approval for these and future equipment needs and resources in the budget process for the operation to be efficient.

6. *Drill crew limited to 40-hour workweek by District policy.* Drill crews in private industry typically work whatever it takes (>80 hours at times) to get the job done. In some cases, private industry may rotate crews on a site to complete a job. The District has a single drill crew of three who are limited to a 40-hour workweek. Drilling operations are handicapped by these restrictions, especially when it can take up to six hours in round trip travel time to the drill site. It is especially difficult (if not impossible) to travel, drill and be efficient during holiday weeks.

7. *Limitations based on Program's small size and scale.* In the well drilling industry, efficiencies increase with the size of the operation (efficiencies of scale). Industry drilling operations typically consist of several drilling rigs and crews working for the same central command. With multiple crews, rigs and associated support equipment, resources can be shared, swapped and joined to optimize the efficiency of the entire operation. The District's operation consists of one drill crew and one set of support equipment. The operation is only as strong as its weakest link. When one link breaks, operations can be shut down. Links include, but are not limited to:

    - Drill crew of three (3)
    - Support Vehicles (5)
    - Drilling Rigs (2)
    - Equipment and Materials
    - Backhoe
    - Compressor
    - De-sander

8. *Types and methods of drilling limited.* With existing equipment, the District is limited in the types of drilling and testing it can do. The District currently specializes in drilling mud-rotary holes and constructing PVC cased wells <500' deep. Reverse-air drilling is possible, but not efficient. Most limiting is not the depth, but the diameter and types of casing we can install.

    - Due to both rigs design limitations, they cannot install PVC well casings greater than 18" diameter.
    - Its current lifting (weight) capability prohibits installing more than 308 feet of 18" PVC. In addition, there are no welding capabilities available in the operation. This limits well construction to the use of only PVC casing.
    - Steel casing, a preferred material for deeper wells is not an option, unless a welder is on site. This adds additional cost to a project. Steel casing cannot be installed very deep because of the weight limitation of the Schramm rig of 6200-pound winch capacity.
    - The Schramm rig is not capable of dual tube drilling and cannot retrieve a core sample (would require a design change at an additional cost). Hydraulic testing using inflatable down hole packers is also not an option. The weight and size of the packer assembly exceeds the load capacity of the drill rig's mast.
    - In addition, the District drill crew does not have the equipment or training to perform this type of test. All these services are required by many District projects and they are currently outsourced.

CONCLUSIONS & RECOMMENDATIONS

The purpose of this report was to determine whether or not the District's drilling program is a District "core competency." Also to document the current (Y2001) status of the District's in-house drilling program and to provide recommendations on the future direction of that program. Core competency is defined as something only the District can do well, better than the private sector.

The District is at a new stage in defining its key roles, especially as they relate to the major responsibilities for flood protection, water supply planning, water quality protection and enhancement, and the Comprehensive Everglades Restoration Plan (CERP). In 2001, staff were asked to define "core competency " areas. The question then becomes "Is the continuation of an in-house drilling program a core competency?" The conclusion documented in this report is that the drilling business is not a District core competency. This conclusion is based on several factors that have been discussed in more detail in the body of the report and are listed below.

- *It's not cost effective.* Drilling services of the type that our staff can perform have been successfully contracted out to private companies. It costs less to contract this work out then to do it ourselves. In addition, contractors typically do the job faster.
- *The future of District drilling has shifted toward larger, deeper Floridan wells.* There are projects slated for the Kissimmee Basin Planning Area, Lower West Coast Planning Area, and Upper East Coast Planning Area that can realistically keep a drilling crew working full time over the next several years. However, the major drilling workload in CERP (not listed here) are associated with Aquifer Storage and Recovery (ASR). The District drilling program is not capable of performing this deep drilling and cannot construct the types of ASR wells needed.
- *Dedicated field supervisor would be required to continue program.* This is a must. Without it, the drilling program cannot function adequately. This is discussed in detail in **CON's** under *Management Changes.*
- *Politics and bureaucratic processes doom the program.* This is discussed in detail in the section called *In-House Drilling Operation - Pro's and Con's* where eight bureaucratic examples are listed under **CON's**.

The authors recommend that the District ramp down and ultimately discontinue its drilling program if it cannot improve its efficiency and cost effectiveness. This can be done abruptly (sell or auction all drilling equipment and immediately re-direct staff to other work areas), or in phases. The authors recommend phasing out over time as this would cause the least disruption. This could be accomplished in the following steps.

1. Sell the Schramm rig and it's associated equipment. The Schramm rig is the most costly and least effective item in the operation. As of the close of FY01, the pay out on the Schramm was $327,000 through FY05. The Schramm rig sold on auction for $200,000 in September 2001 following the direction provided in this report. The associated rig equipment should also be sold. This leaves an outstanding balance of $127,000 sale price as of the close of FY01.

2. Complete the backlog of drilling projects that can feasibly be done with existing equipment. There are projects for the crew to work on in the near future, most of which are listed in **Appendix D**. One involves drilling in the Kissimmee Basin for Wetland Criteria Development. This project is being accomplished as a combined effort utilizing in-house staff and contractors. The in-house drilling will consist of shallow to medium depth wells, and can be done using the District's Mobile rig. The Mobile rig is older and is paid off. It was recently refurbished and will only require replacement of the air compressor ($40,000). Once the Mobile rig has exhausted its useful life, FY03, it should not be replaced.

3. Continue to use the District drill crew to maintain the District's extensive monitor well network. As noted, the District monitors and maintains an extensive network of monitor wells (~500) that are part of District cooperative agreement with the USGS and FDEP. The District's drill crew maintains the integrity of these wells by rehabilitating them and repairing them as needed. Much of this work does not require the use of either rig. When a rig is required, the Mobile rig can be used.

4. Shift the activities of the drilling staff to more hydrologic/hydrogeologic support activities. When the drill crew is not drilling they have been crossing over to provide support to other ESDA hydrogeologic activities. This is done randomly, not necessarily in the most efficient manner. Should the decision be made to "get out of the business," this crew's cross training activities could intensify. A specific schedule of training would be set up and followed.

5. Train drilling staff to outsource. The customers for most drilling products are in the Water Resource Management (WRM) Resource Group. The professional staff of Hydrogeologists in this group spend a considerable amount of time managing and overseeing contract drilling activities. Since drill crew members are licensed water well contractors, they can readily be trained to oversee drilling activities and deliverables under the direction of these Hydrogeologists.

REFERENCES

SFWMD, "Well Drilling Final Report – Cost Analysis/Evaluation of the District's Well Drilling Program." Budget Division, October 1992.

SFWMD, Fleet Replacement Plan, 2001.

Appendix A-1 - In-house Cost Estimate for Lake Toho Drilling - District Drill Crew

Personal Services Costs

Employee	Hourly Salary Costs	Actual Hours	Total Salary Costs	Fringe Rate *	Total Fringe Costs	Total Costs
Spec. Drill. Assoc.	$20.62	149	$3,072.38	54%	$1,659.09	
Sr. Drilling Assoc.	$15.34	149	$2,285.66	54%	$1,234.26	
Staff Drilling Assoc.	$12.47	131	$1,633.57	54%	$882.13	
Total Personal Services Costs:			$6,991.61		$3,775.47	$10,767.08

Travel / Per Diem Costs

Type/Description	Employee	Mileage Costs	Total Per Diem / Hotel	Days	Amount	
Total Per Diem	All	-	$632.00	-	$632.00	
Total Travel / Per Diem Costs						$632.00

Supplies / Materials

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Drilling Supplies (estimate)	1	$3,000	1	$3,000.00	
Total Supplies / Materials:					$3,000.00

Capital Outlay

Total Capital Outlay	$0.00
TOTAL DIRECT COSTS:	$14,399.08

Plus: INDIRECT COSTS (as a % of Salaries)

FY 01 Department	Total Salary Costs	Salaries Indirect Rate *	
ESDA 5270	$6,991.61	87%	
TOTAL INDIRECT COSTS			$6,082.70
TOTAL PROJECT BUDGET:			**$20,481.78**

Appendix A -2 - In-House Cost Estimate for LWC Water Shortage Drilling

Personal Services Costs

Employee	Hourly Salary Costs	Actual Hours	Total Salary Costs	Fringe Rate *	Total Fringe Costs	Total Costs
Spec. Drill. Assoc.	$20.62	530	$10,928.60	54%	$5,901.44	
Sr. Drilling Assoc.	$15.34	478	$7,332.52	54%	$3,959.56	
Staff Drilling Assoc.	$12.47	465	$5,798.55	54%	$3,131.22	
Total Personal Services Costs			$24,059.67		$12,992.22	$37,051.89

Travel / Per Diem Costs

Type/Description	Employee	Mileage Costs	Total Per Diem / Hotel	Estimated Days	Amount	
Total Per Diem	All	-	$3,941.74		$3,941.74	
			Total Travel / Per Diem Costs			$3,941.74

Supplies / Materials

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Drilling Supplies (estimate)	1	$5,000	1	$5,000.00	
		Total Supplies / Materials:			$5,000.00

Capital Outlay

Total Capital Outlay	$0.00
TOTAL DIRECT COSTS:	$45,993.63

Plus: INDIRECT COSTS (as a % of Salaries)

FY 01 Department	Total Salary Costs	Salaries Indirect Rate *		
ESDA 5270	$24,059.67	87%	TOTAL INDIRECT COSTS	$20,931.91
			TOTAL PROJECT BUDGET	**$66,925.54**

Appendix A-3 - District In-House Cost vs. Contractor Cost - 2" Shallow Monitor Wells
(Based on FY99 & FY00 District projects and FY99 & FY00 General Services Contract projects)

Driller	Casing Depth	# of Wells	Total footage	Total Cost	Cost per foot	Avg. Cost / foot
Contractor	15'	7	105	$3,169	$30	
Contractor	15'	4	60	$1,729	$29	
Contractor	30'	10	300	$8,345	$28	$29
District	27 - 130'	5	329	$20,482	$62	
District	18 - 298'	11	1432	$66,926	$47	
District	30 - 40'	4	168	$6,150	$37	$49

Appendix A-4 - In-House Cost Estimate for Crew Land Drilling

Personal Services Costs

Employee	Hourly Salary Costs	Actual Hours	Total Salary Costs	Fringe Rate *	Total Fringe Costs	Total Costs
Spec. Drill. Assoc.	$20.62	45	$927.90	54%	$501.07	
Sr. Drilling Assoc.	$15.34	45	$690.30	54%	$372.76	
Staff Drilling Assoc.	$12.47	36	$448.92	54%	$242.42	
Total Personal Services Costs			$2,067.12		$1,116.24	$3,183.36

Travel / Per Diem Costs

Type/Description	Employee	Mileage Costs	Total Per Diem / Hotel	Days	Amount	
Total Per Diem	All	-	$668.50	-	$668.50	
			Total Travel / Per Diem Costs			$668.50

Supplies / Materials

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Drilling Supplies (estimate)	1	$500	1	$500.00	
		Total Supplies / Materials			$500.00

Capital Outlay

Total Capital Outlay	$0.00
TOTAL DIRECT COSTS	$4,351.86

Plus: INDIRECT COSTS (as a % of Salaries)

FY 01 Department	Total Salary Costs	Salaries Indirect Rate *	
ESDA 5270	$2,067.12	87%	TOTAL INDIRECT COSTS $1,798.39

TOTAL PROJECT BUDGET	**$6,150.26**

Appendix A-5 – Cost Estimate for Ambient Well Repair – District Drill Crew

Personal Services Costs

Employee	Hourly Salary Costs	Actual Hours	Total Salary Costs	Fringe Rate *	Total Fringe Costs	Total Costs
Spec. Drill. Assoc.	$20.62	96	$1,979.52	54%	$1,068.94	
Sr. Drilling Assoc.	$15.34	78	$1,196.52	54%	$646.12	
Staff Drilling Assoc.	$12.47	72	$897.84	54%	$484.83	
Total Personal Services Costs			$4,073.88		$2,199.90	$6,273.78

Travel / Per Diem Costs

Type/Description	Employee	Mileage Costs	Total Per Diem / Hotel	Days	Amount	
Total Per Diem	All	-	$375.50	-	$375.50	
			Total Travel / Per Diem Costs			$375.50

Supplies / Materials

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Drilling Supplies (estimate)	1	$200	1	$200.00	
		Total Supplies / Materials			$200.00

Capital Outlay

Total Capital Outlay	$0.00
TOTAL DIRECT COSTS	$6,849.28

Plus: INDIRECT COSTS (as a % of Salaries)

FY 01 Department	Total Salary Costs	Salaries Indirect Rate *		
ESDA 5270	$4,073.88	87%	TOTAL INDIRECT COSTS	$3,544.28
			TOTAL PROJECT BUDGET	**$10,393.55**

Appendix A-6 - Cost Estimate for Well Abandonment, KRR PoolC - District Drill Crew

Personal Services Costs

Employee	Hourly Salary Costs	Actual Hours	Total Salary Costs	Fringe Rate *	Total Fringe Costs	Total Costs
Spec. Drill. Assoc.	$20.62	112	$2,309.44	54%	$1,247.10	
Sr. Drilling Assoc.	$15.34	128	$1,963.52	54%	$1,060.30	
Staff Drilling Assoc.	$12.47	112	$1,396.64	54%	$754.19	
Total Personal Services Costs			$5,669.60		$3,061.58	$8,731.18

Travel / Per Diem Costs

Type/Description	Employee	Mileage Costs	Total Per Diem / Hotel	Estimated Days	Amount	
Total Per Diem	All	-	$435.50		$435.50	
			Total Travel / Per Diem Costs			$435.50

Supplies / Materials

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Drilling Supplies (estimate)	1	$200	1	$200.00	
		Total Supplies / Materials			$200.00

Capital Outlay

Total Capital Outlay	$0.00
TOTAL DIRECT COSTS	$9,366.68

Plus: INDIRECT COSTS (as a % of Salaries)

FY 01 Department	Total Salary Costs	Salaries Indirect Rate *		
ESDA 5270	$5,669.60	87%	**TOTAL INDIRECT COSTS**	$4,932.55
			TOTAL PROJECT BUDGET	**$14,299.24**

Appendix B-1 - Cost Estimate for C-31 Drilling - District Drill Crew

Personal Services Costs

Employee	Hourly Salary Costs	Actual Hours	Total Salary Costs	Fringe Rate *	Total Fringe Costs	Total Costs
Spec. Drill. Assoc.	$20.62	2336	$48,168.32	54%	$26,010.89	
Sr. Drilling Assoc.	$15.34	2237	$34,315.58	54%	$18,530.41	
Staff Drilling Assoc.	$12.47	2207	$27,521.29	54%	$14,861.50	
Total Personal Services Costs			$110,005.19		$59,402.80	$169,407.99

Type/Description	Unit / Employee	Mileage Costs	Total Per Diem / Hotel	Days	Amount	
Total Per Diem	All	-	$22,318.99	-	$22,318.99	
Schramm Service	All Expenses		$2,658.00	-	$2,658.00	
Schramm Engineer	All Expenses	-	$698.61	-	$698.61	
			Total Travel / Per Diem Costs			$25,675.60

Equipment / Supplies / Materials

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Drilling supplies	All	19143.98	1	$19,143.98	
Rig Equipment Expenses (FY99)	All	$9,256.01	1	$9,256.01	
Rig Equipment Expenses (FY00) (see Appendix B-1.2)	All	$11,075.31	1	$11,075.31	
		Total Supplies / Materials			$39,475.30

Capital Outlay

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Drill Rig (rate/year)	Each	$50,900.00	2	$101,800.00	
Frontloader / Backhoe (rate/year)	Each	$3,250.00	2	$6,500.00	
Centrifugal Mud Pump (rate/year) (see Appendix B-1.2)	Each	$496.80	1	$496.80	
		Total Capital Outlay			$108,796.80
		TOTAL DIRECT COSTS			$343,355.69

Plus: INDIRECT COSTS (as a % of Salaries)

FY 01 Department	Total Salary Costs	Salaries Indirect Rate *		
ESDA 5270	$110,005.19	87%	TOTAL INDIRECT COSTS	$95,704.52

TOTAL PROJECT BUDGET **$439,060.21**

Appendix B-2 - Drilling Rig and Associated Equipment Costs

Schramm T685W Rotadrill, Drillrig, truck mounted
Total Cost **$509,000.00**
Amortization Rate / Year (10 years conditional) **$50,900.00**

Equipment Purchases for the Schramm Rig

Date	Item	Units	Price / Unit	Total Price	Fiscal Year
1/8/1998	Drill Rod, 4 1/2" x 20" x 2 7/8" I.F. reg with flat ends, .337 wall	9	$509.00	$4,581.00	FY98
3/11/1998	Drill Rod, 4 1/2" x 20" x 2 7/8" I.F. reg with flat ends, .337 wall	1	$509.00	$509.00	FY98
5/5/1998	Stabilizer, 10" finished O.D.	1	$2,350.00	$2,350.00	FY98
5/5/1998	Stabilizer, 20" finished O.D.	1	$3,731.00	$3,731.00	FY98
5/5/1998	Drill Rod, 4 1/2" x 20'	100	$448.00	$44,800.00	FY98
5/5/1998	Stabilizer, 30" finished O.D.	1	$6,457.00	$6,457.00	FY98
5/5/1998	Holeopener, 21-1/2" O.D.	1	$5,163.00	$5,163.00	FY98
5/5/1998	Holeopener, 30" O.D.	1	$5,550.00	$5,550.00	FY98
9/1/1998	Material to convert 7-pipe lazy susan carousel from 4 1/2" x 20' x 3 1/2" reg to 5" x 20' x 3 1/2" IF, material includes 7-pipe sockets, 7 guide plates, 2 drill pipe guides, 1 upper pipe plate holder	1	$3,051.03	$3,051.03	FY98
9/1/1998	Top Head Sub (5" x 3 1/2" IF), 5" hydraulic holding fork, 5" guide slip halves and handles, 5" x 20' pipe handling sling	1	$4,312.11	$4,312.11	FY98
9/1/1998	Material to install line centering arm on T685W including mounting plate, hydraulic cylinder, hydraulic valve section, fittings, hoses, requires hydraulic system knowledge and modifications and welding skills	1	$3,742.60	$3,742.60	FY98
	Total Equipment Purchases FY98				**$84,246.74**
9/1/1998	Labor charges for Schramm factory authorized serviceman to travel to District shop and assist with installation utilizing the District's tools and shop facilities for an estimated period of 3 days to include all travel, lodging, meal, car rental, and rela	1	$2,658.00	$2,658.00	FY98
	Total Labor Charges FY98				**$2,658.00**
1/8/1999	Gearbox lifting box eyes kit	1	$1,380.00	$1,380.00	FY99
1/8/1999	Sub, 3 1/2" IF pin x 15" x 5" OD	1	$645.00	$645.00	FY99
1/8/1999	Sub Adapter, 3 1/2: IF to 12 Flange	1	$1,290.00	$1,290.00	FY99
2/3/1999	40ORG side inlet reverse air swivel, 4 1/2" API full hole pin top, 3/4" air inlet with 3 1/2" I.F. regular pin pon bottom	1	$4,998.39	$4,998.39	FY99
	Total Equipment Purchases FY99				**$8,313.39**
11/24/1999	Reverse air swivel & hole opener	-	$6,773.00	$6,773.00	FY00
11/24/1999	10" stabilizers	-	$4,700.00	$4,700.00	FY00
1/26/2000	Drill rod 4 1/2" x 20'	15	$448.00	$6,720.00	FY00
	Total Equipment Purchases FY00				**$18,193.00**
	Total Spent FY98, FY99, and FY00 on Drilling Accessories and Rig Modifications				**$113,411.13**

Appendix B-3 - Contract Services Cost Estimates for St. Cloud FAS Drilling Project

St. Cloud F.A.S. Monitor Well

20-14-6 inch Well Completion

Items	Qty	Units	Avg. Unit Price	Extended Total
Mob/Demob	1	lump sum	$120,000.00	$120,000.00
Drill 7 7/8" Reverse-air pilot-hole	2080	feet	$40.00	$83,200.00
Drill 26" Reamed Borehole	120	feet	$50.00	$6,000.00
Drill 20" Reamed Borehole	260	feet	$45.00	$11,700.00
Drill 14" Reamed Borehole	790	feet	$40.00	$31,600.00
Install 20" Dia. Steel Casing	120	feet	$55.00	$6,600.00
Install 14" Dia. Steel Casing	380	feet	$40.00	$15,200.00
Install 6" Dia. Steel Casing	1240	feet	$24.00	$29,760.00
Type 1 Cement	1500	94 lb. bag	$16.00	$24,000.00
Standby Time	20	hour	$100.00	$2,000.00
Extra Work	20	hour	$175.00	$3,500.00
Air Develop	30	hour	$150.00	$4,500.00
Clean Fill	60	yd	$30.00	$1,800.00
Wellhead	1	lump sum	$2,500.00	$2,500.00
Total				**$342,360.00**

The above is for a 6-inch diameter lower Floridan monitor well completed to 1,240 feet below land surface (bls) drilled to a total depth of 2,200 feet. This total does not include any type of testing or geophysical logging. This is not a direct comparison to the present well construction at the St. Cloud site. The District-owned rig has severe weight / load restrictions that necessitated the use of PVC well casing instead of the more appropriate and more resilient steel casing.

Appendix C-1 - Cost Analysis for Kissimmee Basin Drilling Project - Using Contractual Services

Personal Services Costs

Employee	Hourly Salary Costs	Estimated Hours	Total Salary Costs	Fringe Rate *	Total Fringe Costs	Total Costs
Sr. Hydrogeologist	$28.22	80	$2,257.60	54%	$1,219.10	
Contract Specialist	$22.65	40	$906.00	54%	$489.24	
	Total Personal Services Costs		$3,163.60		$1,708.34	$4,871.94

Travel / Per Diem Costs

Type/Description	Employee	Mileage Costs	Daily Per Diem / Hotel	Estimated Days	Amount	
Site Supervision	Sr. Hydrogeologist		$50.00	12	$600.00	
			Total Travel / Per Diem Costs			$600.00

Contractual Service

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Mob/Demob/Site Restoration	Completed Activity	$10,000.00	1	$10,000.00	
Floridan Monitor Well	Completed Well	$22,530.00	1	$22,530.00	
Intermediate Monitor Well	Completed Well	$7,700.00	2	$15,400.00	
Shallow Monitor Well	Completed Well	$1,925.00	3	$5,775.00	
			Total Contractual Service		$53,705.00
			TOTAL DIRECT COSTS		$59,176.94

Plus: INDIRECT COSTS (as a % of Salaries)

FY 01 Department	Total Salary Costs	Salaries Indirect Rate *	
Procurement 6600	$906.00	87%	$788.22
Water Supply Planning 4350	$2,257.60	96%	$2,167.30
		TOTAL INDIRECT COSTS	$2,167.30
		TOTAL PROJECT BUDGET	**$61,344.24**

Appendix C-2- Cost Analysis for Kissimmee Basin Drilling - Using District Drill Crew

Personal Services Costs 10/24/00

Employee	Hourly Salary Costs	Estimated Hours	Total Salary Costs	Fringe Rate *	Total Fringe Costs	Total Costs
Spec. Drill. Assoc.	$20.62	320	$6,598.40	54%	$3,563.14	
Sr. Drilling Assoc.	$15.34	320	$4,908.80	54%	$2,650.75	
Staff Drilling Assoc.	$12.47	320	$3,990.40	54%	$2,154.82	
Sr. Supv. Eng. Assoc.	$22.88	80	$1,830.40	54%	$988.42	
	Total Personal Services Costs		$17,328.00		$9,357.12	**$26,685.12**

Travel / Per Diem Costs

Type/Description	Employee	Mileage Costs	Daily Per Diem / Hotel	Estimated Days	Amount	
On Site Drilling	Spec. Drill. Assoc.		$50.00	32	$1,600.00	
On Site Drilling	Sr.Drilling Assoc.		$50.00	32	$1,600.00	
On Site Drilling	Staff Drilling Assoc.		$50.00	32	$1,600.00	
Weekly Supervision	Sr. Supv. Eng.Assoc.		$50.00	8	$400.00	
			Total Travel / Per Diem Costs			**$5,200.00**

Supplies / Materials

Type/Description	Unit	Price Each Unit	# of Units	Amount	
Floridan Monitor Well	Completed Well	$14,735.00	1	$14,735.00	
Intermediate Monitor Well	Completed Well	$2,165.00	2	$4,330.00	
Shallow Monitor Well	Completed Well	$699.50	3	$2,098.50	
		Total Supplies / Materials			**$21,163.50**

Capital Outlay

Type/Description	Cost Per Year	% Applied to Project	Amount	
Drill Rig Lease	$80,000.00	17%	$13,600.00	
	Total Capital Outlay			**$13,600.00**
	TOTAL DIRECT COSTS			**$66,648.62**

Plus: INDIRECT COSTS (as a % of Salaries)

FY 01 Department	Total Salary Costs	Salaries Indirect Rate *	Amount	
ESDA 5270	$17,328.00	87%	$15,075.36	
		TOTAL INDIRECT COSTS		**$15,075.36**
		TOTAL PROJECT BUDGET		**$81,723.98**

Appendix D -Backlog of Drilling Projections by Region for In-House Drilling Operations

1) **Kissimmee Basin Planning Area**
   a) Project – Kissimmee Basin Drilling for Wetland Criteria Development – Project Manager – Chris Sweazy
      i) Potential Drill Site Locations
         - Disney Wilderness Preserve
         - Tibet – Butler Preserve
         - Orla – Vista County Park
         - Bear Creek County Park
         - Lake Cane – Marsha County Park
         - Moss Park
         - Florida Mitigation Bank
         - Disney Conservation Area
         - Disney World Property
         - KUA Conservation Area
         - Convention Center Mitigation Site
         - Marriott Conservation Area
         - Marion Creek SOR Property
         - Osceola County Mitigation Bank
         - SWFMD Cooperative Site (unnamed)
         - 2 Unnamed Sites

   b) Lake Istokpoga Wells, Highlands County – (FY02-03)
      i) Project Scope of Work - This project consists of three clusters of wells, surrounding the lake, as specific sites yet to be determined. Cluster "I" contains three wells and surface water stage recorder, and will be situated on the ridge side of the lake. The deep well will be approximately 200' below land surface (bls.). The intermediate well will be 60' bls. and the shallow well 30' bls. The two other clusters will consists of three wells, one 100' bls., one 60' bls., and one 30' bls. Split spoon samples will be obtained from the deepest wells at each site. Sieve analysis of the samples will be done to determine the hydraulic conductivity of the various subsurface layers. Additionally, slug tests will be done on each well. This will provide the needed lithologic information at three sites while the daily water levels in the wells, and surface water will allow the determination of vertical hydraulic gradients around the lake. It is likely that the depth of the screen interval of the shallower wells may be adjusted after the lithology of the deep well at each site is seen and reviewed.
      ii) Estimated Drilling Costs – To estimate drilling costs, bids of the drilling companies participating in the current General Services drilling contracts were reviewed. The Lake Istokpoga costs were calculated based on the rates of the two low bidders plus a bit extra. The cost to drill and complete the seven wells according to the plan described above should be $28,000 - $42,000. The cost for the complete sieve analysis is estimated to be $10,000 - $12,000. District staff could complete slug tests.

c) Glades – Highlands County (Possible Long-range Future Work

A ground water reconnaissance project was initiated by the District in this county several years ago and remains incomplete. To complete this effort we would require approximately five (5) drill sites, which would take approximately three (3) months per site. There will be seven (7) wells per site. This is a total of thirty-five (35) wells.

2) Lower West Coast Planning Area

a) Water Shortage Prone Areas – Need New Wells, At the Sears Rd. area, Devil's Garden in Hendry County, two (2) to three (3), approximately 140 feet, 4 inch diameter wells are needed. This area tends to have critical drawdowns in times of water shortage. The drilling project would take approximately one (1) month to complete.

b) Water Shortage Prone Area – Need Replacement Wells, Project Manager – Milt Switanek – Three (3) replacement monitor wells are needed in Collier and Lee Counties. The wells need to be replaced because they were destroyed over the past few years.

- C-458 (Lower Tamiami aquifer 80')
- C-741 (Lower Tamiami aquifer 80')
- L-1089 (Tamiami aquifer, 225')

3) Upper East Coast Planning Area

Monitor Well Replacements, Project Manager – Milt Switanek. All existing Surficial Aquifer System (SAS) wells are 2-inch diameter wells. If it is determined that these wells cannot be outfitted with a pressure transducer, then there is a need for approximately fifteen (15) SAS wells, each 60' deep, and 4" in diameter (PVC casing). The wells would be distributed throughout St. Lucie and Martin Counties.