ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

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DYE TEST
AND
WATER QUALITY SAMPLING
FINAL REPORT

SULPHUR SPRINGS POOL
JANUARY - OCTOBER 1989

PREPARED FOR:

Hillsborough River Basin Board
Southwest Florida Water Management District
2379 Broad Street
Brooksville, Florida 33512-9712

PREPARED ON BEHALF OF:

Sulphur Springs Action League
320 W. Waters Avenue
Tampa, Florida 33604

BY:

Environmental Engineering Consultants, Inc.
5119 North Florida Avenue
Tampa, Florida 33603

May 8, 1990

Sulphur Springs Action League

"The Springs - let's make it sparkle"

320 W. Waters Ave., Tampa, FL 33604
Phone: (813) 935-3115

May 10, 1990

Mr. Greg Jones, Project Manager
Southwest Florida Water Management District
7600 N. Highway 301
Tampa, Florida 33617

Re: Sulphur Springs Pool
Dye Test and Water Quality Sampling
Final Report

Dear Mr. Jones:

In accordance with the Agreement between the SWFWMD and the SSAL dated September, 1988 we are forwarding for your review ten (10) copies of the final report.

We appreciate the cooperation of the Hillsborough River Basin Board in supporting our efforts to open up the Sulphur Springs Pool. This study provides detailed information heretofore unavailable about the sinkhole/spring system in North Tampa. We suggest a direction to utilize the pool safely in the short term while the long term solution to upgrading problem stormwater facilities is undertaken.

Thank you for your assistance and advice in the direction this study took.

Sincerely,

SULPHUR SPRINGS ACTION LEAGUE

Robert E. Wallace III, P.E.
Hillsborough River & Pool Committee

REW/lrp

DYE TEST AND WATER QUALITY SAMPLING
FINAL REPORT
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DYE TEST AND WATER QUALITY SAMPLING FINAL REPORT
SULPHUR SPRINGS POOL

I. BACKGROUND:

The Sulphur Springs Action League (SSAL) under a grant from the Hillsborough River Basin Board has performed fluorescent dye tests and water quality testing of the Sulphur Springs Pool and upstream sinkholes to understand more of the hydrogeology of the system as a means of isolating the bacterial contamination that has closed the pool. This work was an extension of the effort contemplated in City Council Resolution 88-647 regarding the Sulphur Springs Pool revitalization.

As an extension of the cooperative effort Hillsborough County Environmental Protection Commission has performed analytical water quality testing of samples taken by the Sulphur Springs Action League. Through the cooperation of Mr. Tom Cardinale, Lab Manager, the frequency and scope of the original water quality testing has been extended significantly. Mr. Greg Jones, Project Manager for Southwest Florida Water Management District, was able to procure the loan of a fluorometer from the U. S. Geological Survey which allowed more frequent dye testing to be performed. Mr. Mike Burwell of the City of Tampa provided keys for access to the Sulphur Springs Pool, Jasmine and Orchid Sink areas to be used by Sulphur Springs Action League and also provided advice and use of their fluorometer for dye test readings.

We are also grateful to Mr. Leon Berry of 8208 N. 13th Street who has shared rainfall data taken at his residence since January, 1988. At the end of this report we acknowledge all the government and volunteer personnel who assisted in this effort.

This report will summarize the testing performed to date and will give indications of what has been discovered and what conclusions can be drawn at this time.

SUMMARY OF TESTS

Dye Test	Alaska to Sulphur Springs	1/14-15/89
Dye Test	Jasmine to Sulphur Springs	1/20-21/89
Dye Test	Alaska to Sulphur Springs	2/11/89
Dye Test	Jasmine to Sulphur Springs	5/19,20,21/89
Water Quality Test	Curiosity, Jasmine, Alaska,Sulphur	6/5,6,7/89
Dye & Water Quality Test	Curiosity, Jasmine, Alaska,Sulphur	7/18,19,20/89
Dye & Water Quality Test	Curiosity, Jasmine, Alaska, Sulphur	9/22,23,24/89
Water Quality Test	Jasmine, Alaska, Sulphur	10/16,17,18/89

See Sulphur Springs System Diagram Page 5
and Appendix A for Map

II. HISTORY OF PREVIOUS TESTS:

In 1958 Dye tests were conducted by the City of Tampa Water Department and later published by the USGS. The velocities of 320 - 380 ft/hr were established from the Curiosity/Blue Sink area to Sulphur Springs (28 to 40 hrs). Lower velocities of 210 ft/hr were established for flows from Curiosity/Blue Sink to

RESOLUTION NO. 88- 647

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF TAMPA, FLORIDA; EXPRESSING ENCOURAGEMENT AND SUPPORT FOR THE REVITALIZATION AND REOPENING OF THE SULPHUR SPRINGS POOL AND RIVERFRONT PARK; PROVIDING AN EFFECTIVE DATE.

WHEREAS, the Sulphur Springs Pool is a natural landmark and a cultural and historic resource of the City of Tampa, which formerly brought great recreational enjoyment to the citizens of the area for more than a century; and

WHEREAS, the Pool and adjacent Riverfront Park have been closed since June, 1986 on advice of the Hillsborough County Health Department due to unacceptable bacteria levels; and

WHEREAS, Sulphur Springs is known to be hydrogeologically connected to several upstream natural springs and sinkholes which have been affected by urban stormwater runoff and other activities of man; and

WHEREAS, concerned citizens of the City of Tampa, including the Sulphur Springs Action league, consider the pool's reopening to be a key element to the revitalization of the area and a deserving goal which will benefit all citizens of the City of Tampa.

NOW, THEREFORE,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF TAMPA, FLORIDA:

Section 1. That the City Council of the City of Tampa does hereby express its encouragement and support for the revitalization and reopening of the Sulphur Springs Pool and Riverfront Park.

Section 2. That the City Clerk of the City of Tampa send copies of this Resolution to the Southwest Florida Water Management District, the Hillsborough County Environmental Protection Commission and the Florida Department of Environmental Regulation.

Section 3. That all proper officers of the City of Tampa do all things necessary and proper in order to carry out and make effective the provisions of this Resolution.

Section 4. That this Resolution shall take effect immediately upon its adoption.

PASSED AND ADOPTED BY THE CITY COUNCIL OF THE CITY OF TAMPA, FLORIDA, ON APR 14 1988.

Jim Vern
CHAIRMAN, CITY COUNCIL

ATTEST:

Frances Henriquez
CITY CLERK

PREPARED AND APPROVED BY:

David M. Carr
DAVID M. CARR
CITY COUNCIL ATTORNEY

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Poinsettia (Jasmine) (25 hrs). The dye was visible at Sulphur Springs for 23 hours after arrival. See Appendix J.

In 1987 Mr. Mike Burwell of the City of Tampa Department of Public Works Stormwater Management Division tried to recreate the 1958 test. No connection could be dye traced from Curiosity to Sulphur and plugging of the sink was surmised. A positive connection between Orchid Sink and Sulphur Springs with a velocity of 320 ft/hr and a 20 hour time of arrival was established. The dye took about 26 hours to flush out of the Sulphur Springs Pool. See Appendix L.

The City also commissioned a microbial study of the Curiosity, Jasmine, Orchid, Alaska Sinks and Sulphur Springs in 1987. See Appendix M. It concluded that Jasmine and Orchid could be contaminating Sulphur Springs with bacteria but that Curiosity and Alaska were not.

II. DYE TEST ALASKA I:

On January 14, 1989 divers equipped with special dry suits for hazard protection descended to the base of Alaska Sink and introduced 1 gallon of concentrated green dye. The Sulphur Springs Pool, the river and the Gazebo wells were then observed for the presence of dye.

Previous tests by the City of Tampa in 1958 and 1987 yielded underground velocities of 315 and 320 ft/hr for the system. Therefore to traverse the 1,800 feet the time was estimated to be about 5.67 hours or 5 hours 40 minutes.

No visible dye was observed at the pool in the time estimated and at first there was disappointment that the Alaska Sink may not be directly connected. There was a sighting of green water in the river near the Harbor Club but it was not completely positive. See map in Appendix A.

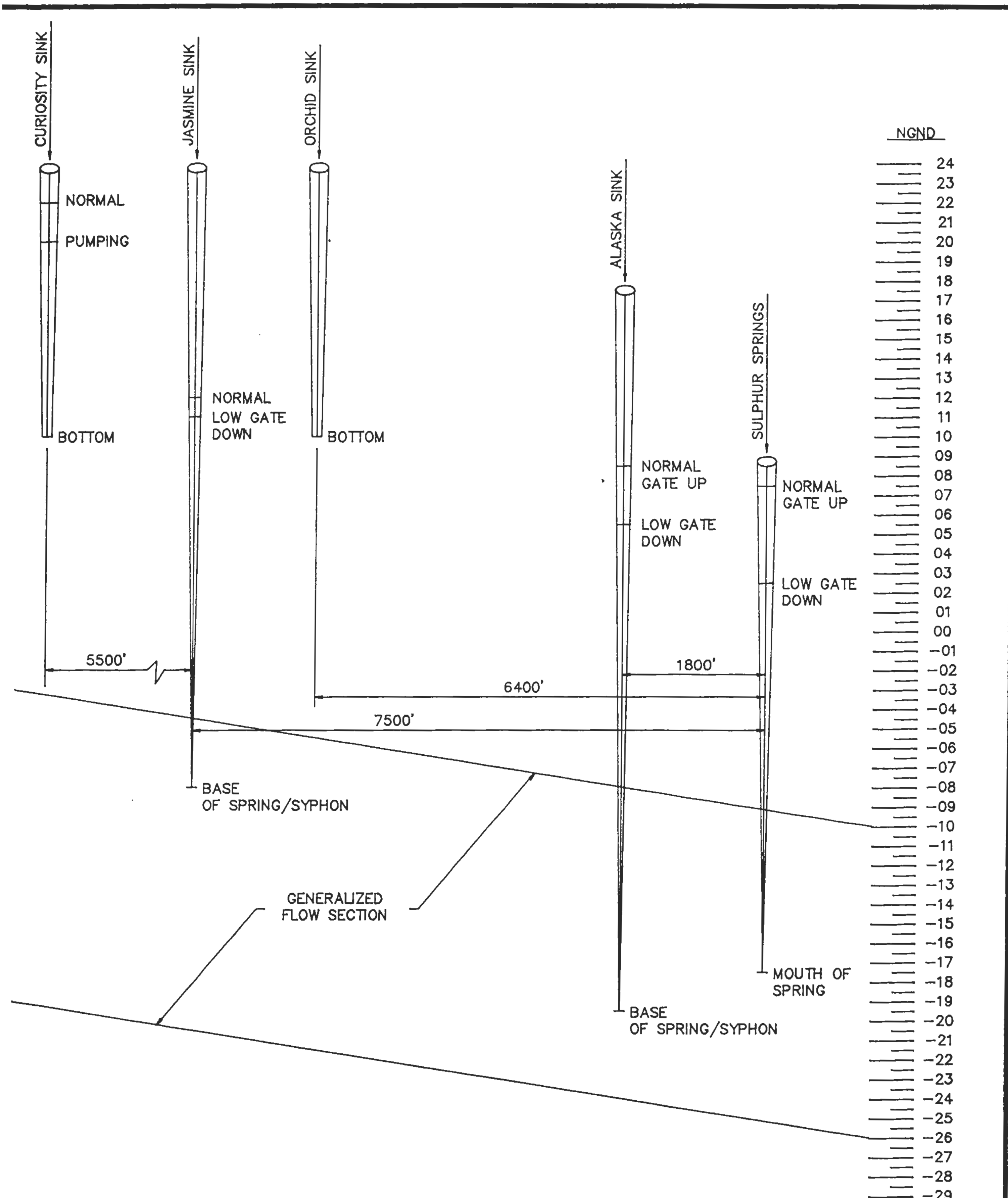
Dye was introduced at 9:59 AM. Sightings were made thereafter and recorded. Samples were taken and bottles kept cool and free of sunlight. A blank was taken at Sulphur Springs Pool for background fluorescence samples.

The following Table summarizes field observations.

Alaska Dye Test Saturday, January 14, 1989

Fluorescence Readings	Time	Comments
-	9:59 am	Dye introduced by divers in Alaska
0	11:45 am	No color SS sample #1 hand grab
0	12:45 pm	No color SS sample #2 hand grab
-	12:45 pm	Green dye noted in River at Harbor Club by Dexter, Darwin & Jeff
110	1:15 pm	Hillsborough River at Harbor Club Sample #3
0	1:55 pm	No color SS sample #4 hand grab
0	2:55 pm	No color SS sample #5 temperature 24°C hand grab
100	3:59 pm	No color SS sample #6
50	5:00 pm	No color SS sample #7
		On Sunday, January 15, 1989, Mr. Joe Stewart took four more grab samples
840	8:05 am	No color SS
1020	9:05 am	No color SS
1140	10:00 am	No color SS
170	11:00 am	No color SS

During the test the gauge height was 7.63 and 7.64 which continuously held flows from 40.4 to 40.6 cfs (26.17 mgd). See USGS Data from SS Pool in Appendix I. Water level at Alaska was about 8.6 ft and at the SS Pool 7.63. About a 1.0 ft gradient existed.



NAME: 88027A4.DWG
T UPDATED: 05/03/90
T PLOTTED: 05/03/90

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC. CONSULTING ENGINEERS AND ENVIRONMENTAL SCIENTISTS 5119 NORTH FLORIDA AVENUE – P.O. BOX 7854 – TAMPA, FLORIDA 33673	SULPHUR SPRINGS SYSTEM SULPHUR SPRINGS HILLSBOROUGH COUNTY, FLORIDA	DATE: JUNE 1988 JOB NUMBER: 88027	SCALE: N.T.S. SHEET: A4
DESIGNED: R.E.W. / DRAWN: R.L.B. / CHECKED: R.E.W.			

It was not until the following month when samples were taken to the City of Tampa lab that fluorometer readings confirmed that non-visible amounts of dye were indeed present. The time of arrival was 6 hours and could have been less because samples were only taken on the hour.

In addition, the river sample taken at the time of the green water sighting confirmed dye being present only 3.25 hours after placement. Other samples collected at the pool the following day indicate that as much as 25 hours after introduction that dye was still arriving at the pool.

In that dye was not plainly visible but only present in non-visible concentrations at the pool it would indicate that under normal conditions only a slight flow connection from Alaska exists. Dye seeps slowly since small amounts of water flow into the sink displacing waters contained within it.

The time of arrival was very close to that predicted 6.0 vs 5.67 hrs and indicates Alaska is in the flow line of Curiosity and Orchid. The 1958 dye test of Curiosity yielded non-visible concentrations of dye in Alaska (10th Street) some 25.67 hours after introduction. The quickness with which water reached the river 3.25 hours traveling a distance of some 1,750 feet yields a velocity of 538 ft/hr. The river water level being about 5 to 7 feet lower than the Sulphur Springs Pool would have a greater hydraulic gradient and would corroborate USGS literature which cites greater velocities as flows near the Hillsborough River. See Appendix K.

The divers that introduced the dye could not physically feel water moving into or out of the base of the sink. The sink had a great deal of debris in it and the actual location of inflow/outflow in the spring/syphon is unknown. This dye test yielded valuable confirmations as a beginning toward developing more data on travel time and pathways. In addition, the interconnection of Alaska to Sulphur had never been proved before.

IV. <u>DYE TEST JASMINE I:</u>

Failing to get City of Tampa legal permission for divers to access the Jasmine Sink by the test date of January 20, 1989, the dye had to be introduced via boat. The dye was lowered to the syphon base in a container via a rope. See Appendix E for Map. This method accounted for a lag time of dye to exit the sink of up to 1 hour.

Mr. Mike Burwell of the City of Tampa, who conducted the dye test at Orchid in 1987, gave advice on procedures. See Appendix B for Correspondence.

Water samples were taken at 12 locations over varying time periods up to 48 hours. A total of 155 water samples were taken and analyzed for fluorescence by the City of Tampa Hooker's Point lab. The locations were Jasmine Sink, Jasmine Wells 1, 2, 3, Pless Well, Church Well, Orchid Sink Well 1 and 2, Alaska Sink, Harbor House (Tourist Club) Well, Gazebo Well and Sulphur Springs.

The Sampling/Location Matrix was as follows:

1 - Jasmine Sink
2 - Well #1
3 - Well #2
4 - Well #3
5 - Pless Well #4
6 - Church Well #5
7 - Orchid Well #1
8 - Orchid Well #2
9 - Alaska
10 - Harbor House (Tourist Club) Well
11 - Gazebo Well
12 - Sulphur Springs

0 = Gallon
X = 500 ml

	1	2	3	4	5	6	7	8	9	10	11	12	
1/20/89													Samples
10 am Initial	0	0	0	0	0	0	0	0	0	0	0	0	
11 am 1 hr.	X	X	X	X	X	X	X	X					
12 pm 2 hr.	X	X	X	X	X	X	X	X					Gal Of Ea.
2 pm 4 hr.	X	X	X	X	X	X	X	X	X	X	X	X	JB & RP
4 pm 6 hr.	X	X	X	X	X	X	X	X					
6 pm 8 hr.	X	X	X	X	X	X	X	X					
Sunset													
8 pm 10 hr.	X	X	X	X	X	X	X	X					RW
12 pm 14 hr.	X								X	X	X	X	
1/21/89													
4 am 18 hr.	X								X	X	X	X	
Sunrise													RW & FR
8 am 22 hr.	X	X	X	X	X	X	X	X	X	X	X	X	
10 am 24 hr.	X								X	X	X	X	
12 am 26 hr.	X								X	X	X	X	FR
2 pm 28 hr.	X	X	X	X	X	X	X	X	X	X	X	X	
4 pm 30 hr.	X								X	X	X	X	RW & DC
6 pm 32 hr.	X	X	X	X	X	X	X	X	X	X	X	X	
Sunset													DC
10 pm 36 hr.	X								X	X	X	X	
1/22/90												*	DC
2 am 40 hr.	X								X	X	X	X	
6 am 44 hr.	X								X	X	-	X	
													RW
Sunrise													
10 am 48 hr.	X	X	X	X	X	X	X	X	X	X	X	X	

* Isco Automatic Samplers in Use @ Sulphur Springs.

The following Table summarizes field observations. Jasmine Dye Test Friday January 20, Saturday, January 21 and Sunday, January 22, 1989.

Time/Date	Location	Remark
1/20/89		
10:00 am	Jasmine (Poinsettia or Trinity)	Dye set via John Burkart Boat & Sealed bowl on String.
11:10 am	"	Initial Sampling Run complete by JB & Rafael Perez.
11:30 am	"	Dye evenly dispersed in Sinkhole.
2:00 pm	"	Dye does not appear to be exiting the sink.
4:30 pm	"	Dye appears to have centralize in the sink per RP.
6:00± pm	"	Rainfall starts, Rob Wallace.
9:00 pm	"	Water level at Jasmine 12.0±ft No visible dye but there is poor visibility after dark in center of spring.
9:30 pm	"	Orchid water level 1.5 ft below spillway on east side of
10:30± pm	"	sink. Rainfall stops.
1/21/89		
12:45 am	"	Jasmine water level 11.75 ±
1:00 am	"	Orchid water level 2.5 ft. ± below spillway on east side.
2:30 am	"	Jasmine Rain starts.
3:30 am	"	Jasmine Rain stops.
4:30 am	"	Jasmine Water Level 12.0 ± Raining again.
6:00 pm	"	Jasmine Water Level 13.5 Rain Steady - Dan Chesser.
10:00 pm	"	Jasmine Water Level 1.5-2.0 (11.5 - 12.0) ft. - Not raining.
1/22/89		Jasmine Water Level
2:00 am	"	Up about 1 foot (12.5 - 13.0) since last reading. Raining Again. DC
6:00 am	"	Missed Gazebo Well Sample - RW
10:00 am	"	Clear sky for final round of samples RW.
10:30 am	"	Orchid Water Level 4.0 ± ft above spillway (est. el. 22.0) RW
11:00 am	"	Jasmine Water Level 12.25 RW

Note:
All samples taken to EEC for storage and transfer to City of Tampa Lab.

Well Data: See Appendix E for Location Maps.

Pless Well 0-17 ft sand, 2 ft clay, 8 ft limerock, 27 ft deep - 2" steel casing - hand driven used for yard sprinkler system. Good flow.

Jasmine Well 1 - Total Depth for casing 33.1 ft. Static WL 16.6
2 - Total Depth for casing 31.6 ft. Static WL 16.9
Orchid Well 1 - Total Depth for casing 42.6 ft. Static WL 19.8
2 - Total Depth for casing 36.5 ft. Static WL 22.5

Dye placed in the water at Jasmine took over 24 hours to dissipate based on fluorometer readings. A shallow upstream well (Jasmine 1) placed by the City of Tampa showed no evidence of dye.

The following table shows the wells in the vicinity of Jasmine flourometer readings: (For Locations See Map Appendix E.)

Hour	Jasmine 1 Upstream	Jasmine 2 Downstream South	Jasmine 3 EEC Wellpoint SW of Sink	Jasmine 4 Pless Well South of Sink	Jasmine 5 Church Well SW	Orchid Sink Well 1	Orchid Sink Well 2
Initial	0	0	0	0	0	0	0
1	0	0	50	0	10	0	0
2	0	10	220	0	10	0	0
4	-	0	0	0	0	0	0
6	0	0	300	100	0	0	0
8	-	0	110	0	50	0	0
10	0	20	160	50	110	0	0
22	-	55	130	60	90	0	50
28	0	185	0	0	110	0	100
32	0	0	0	0	0	80	180
48	-	0	110	-	0	0	140

- = No test.

The following table shows the results of flourometer readings at these locations:

Hour	Alaska Sink	Harbor House (Tourist Club) Well	Gazebo Well	Sulphur Springs
Initial	0	50	0	0
3	0	-	0	0
8	0	-	0	0
14	0	-	0	0
18	0	-	0	0
22	0	50	0	2
24	0	60	0	12
26	0	80	0	18
28	0	120	0	15
30	0	150	0	10
32	0	150	0	8
36	0	-	0	4
40	0	150	0	3
44	0	220	-	4
48	0	320	0	2

- = Not tested.

Other downstream shallow wells in the vicinity showed dye within 1 to 6 hours of placement. A church located next door having a well of unknown depth showed the presence of dye in 8 hours.

Shallow monitoring wells around Orchid Sink showed dye at 22 and 32 hours. Alaska Sink and Gazebo wells never showed any trace of dye. The Harbor Club (Tourist Club) Well showed dye at 24 hour time arrival with the concentration still rising at 48 hours.

Sulphur Springs Pool showed a time of arrival of 22 hours with a peak at 26 hours. Dye was still dissipating at 48 hours and the conclusion of the test. At no time was the dye visible during the sampling.

Based upon a distance of 7,500 feet between Jasmine and Sulphur Springs, the travel time nets a velocity of 341 ft/hr. The head differential was from 12 - 13.5 at Jasmine to 7.66 - 7.67 at Sulphur Springs. Flow was 41.0 - 41.2 cfs. (26.56 mgd). About at 4.5 - 6.0 ft. gradient existed during the test.

The direct connection of Jasmine Sink and Sulphur Springs had been surmised before, but never proved. This was the first test to do so. It also correlated well with the City of Tampa's test in 1987 from Orchid to Sulphur wherein a 20 hour time of arrival was established.

V. DYE TEST ALASKA II:

On February 11, 1989 divers again descended into Alaska Sink and released 2 gallons of concentrated green dye at the base ofthe sink about 28 feet below water surface. The time of release was conveyed via underwater line from the divers to surface microphones and then signal sent over short-wave radio to Sulphur Springs Pool.

As soon as the release of dye was signaled the flood gates at Sulphur Springs Pool were opened to lower the water level in the pool slightly over 5.1 feet in 2 hours. The level at Alaska started receding immediately and had lowered 0.5 feet in 5 minutes and a maximum of 3.3 feet in 3 hours.

Listed below are the relative water elevations recorded as the water levels at both locations fell:

	Sulphur Springs Pool	Alaska Sink
February 11, 1989	9:28 A.M. 7.64 ft.	9:27 A.M. 8.63 ft.
	9:30 A.M. 6.50 ft.	9:33 A.M. 8.15 ft.
	9:33 A.M. 5.80 ft.	9:37 A.M. 7.24 ft.
	9:35 A.M. 4.75 ft.	9:42 A.M. 6.31 ft.
	9:40 A.M. 3.03 ft.	9:47 A.M. 5.93 ft.
	9:43 A.M. 2.90 ft.	9:52 A.M. 5.83 ft.
	9:47 A.M. 2.75 ft.	9:57 A.M. 5.67 ft.
	9:53 A.M. 2.66 ft.	10:07 A.M. 5.60 ft.
	10:30 A.M. 2.51 ft.	10:17 A.M. 5.50 ft.
	11:30 A.M. 2.48 ft.	10:27 A.M. 5.49 ft.

(Continued)

	Sulphur Springs Pool		Alaska Sink	
February 11, 1989	3:46 P.M.	2.54 ft.	11:27 A.M.	5.35 ft.
	5:23 P.M.	2.5± ft.	12:27 A.M.	5.33 ft.
	5.36 P.M.	7.0± ft.		

The gate at Sulphur Springs was closed at 5:23 P.M. and was back to normal water level at 5:37 P.M. at which point the test was terminated. The flow at the beginning of the test was 40.6 cfs or 26.2 mgd. When the gates are lowered the flow increases due to the dewatering of the aquifer storage and an increased hydraulic head is established. The amount of flow increase is not known because the flow vs staff gauge at lower elevations of the slidegate has not been calibrated. The USGS staff gauge readings for the test dates are in Appendix I.

Fluorometer and bacteria readings were taken at the pool after the dye was introduced in Alaska. Four points downstream were observed; Hillsborough River at the Harbor House, Harbor House Well, Sulphur Springs Pool and the Gazebo Well.

At Alaska the dye dissipated rapidly due to the drawdown action. An attempt was made to introduce neutral buoyancy spheres into the base of the sink hoping they would find their way to Sulphur Springs. However, the balls though at the correct specific gravity, displayed no movement as the velocities were almost imperceptible to the divers. The divers indicated the dye did appear to move away from them.

The following table reflects fluorometer readings taken and analyzed at the City of Tampa Laboratory:

Time	Alaska	Hills. River	Harbor House	Sulphur Springs	Read Later on 9/5/89 with USGS Flourometer	Gazebo
T=0	0	0.40	0	0	4%	0
T=1	0.61	0.35	0.45	0	-	-
1.5	-	0.35	-	0.40	5%	-
2.0	0.40	0.40	0.60	0.35	5%	-
3.0	-	0.40	-	0.35	5%	-
3.5	-	-	-	0.62	5%	-
4.0	-	-	0.20	3.42	5%	0.25
4.5	-	-	-	8.45	9%	-
5.0	0.35	0.35	-	8.80	12%	-
5.5	-	-	-	6.00	10%	-
6.0	-	-	-	4.40	7%	-
6.5	-	-	-	2.82	7%	-
7.0	0.35	0.35	-	1.58	7%	-

The Harbor House well had dye appear within 1 hour. The Hillsborough River yielded no visible or analytical test to show presence. Presumably, lowering the head made the pool the preferable route for the dye due to the visible quantities apparent at the pool. Traces of dye appeared at the pool in 1.5 hours. Field notes record a slight color at 2.5 hours. The dye was visible at the 3.5 - 4.0 hours ranges and reached a deep green color at 4.5 - 5.5 hours. When the gate was closed at the end of the test green color was still evident in the pool basin. The water level rose rapidly and was back over the spillway in 14 minutes. However, it took the system over a day to achieve the 7.64 elevation at which the test started. This is due to replenishing the lost storage capacity when the gates lowered.

Further, readings of water levels were taken in North Tampa to help locate interconnected points. Water levels at stormwater retention basins and sinks at 109th Avenue and N. Blvd. (SRB), Curiosity Sink, Seneca SRB, 99th Avenue and Club SRB, Jasmine Sink, Alaska Sink and Sulphur Springs were observed.

2/11/89		109th & N. Blvd.	Curiosity	Seneca	99th & Club	Jasmine
		W.L./Time	W.L./Time	W.L./Time	W.L./Time	W.L./Time
T=0	9:28 AM	23.6/7:00	22.3/7:05	22.25/7:08	17.8/7:15	12/0/9:30
T=1	10:28 AM	23.7/10:33	22.4/10:40	22.15/10:46	17.7/11:03	11.4/11:07
T=2	11:28 AM	23.7/11:57	22.5/12:04	22.15/12:14	17.7/12:43	11.25/12:23
T=5	2:28 AM	23.7/3:23	22.7/3:16	22.15/3:18	17.7/3:05	11.0/3:11
T=7	4:28 AM	23.7/5:13	22.6/5:12	22.15/5:07	17.7/4:49	10.9/4:54

From the above readings it is apparent that 109th, Seneca and 99th Stormwater Retention Basins are not influenced within a 7 hour period. Jasmine Sink however, was visibly drawndown within 1.5 hours and continued to recede as long as the gate was open at Sulphur Springs. Since Jasmine is over 7,500 feet north of Sulphur Springs the water storage lost is in a 1 ft. (Jasmine) to 5 ft. (Sulphur) drawdown over the system. Since the flow has not been calculated below 6.3 ft. at Sulphur Springs the water flow is unknown for this drawdown.

Bacteria samples were also taken at Sulphur Springs on a one-half hour basis from 9:00 AM to 3:30 PM. This was done to see if inducing a head and changing flow characteristics would have any effect on bacteria levels. However, the test was conducted on a Saturday and when the samples were delivered to the Hillsborough County Health Department the following Monday, they were beyond the 30 hour hold time and would not be run. Sample sheet in Appendix C.

This experiment was to vary the head conditions to gain more data on travel times and aquifer velocities. This test drew upon a January 9, 1988 drawdown test which established an Alaska-Sulphur connection. See Appendix C. The Harbor Club and Gazebo wells confirmed dye presence but the River did not show visible or analytical dye presence. Visible dye appeared at Sulphur Springs in a 3.5 hour time of arrival and peaked at 5.0 hours.

Unlike the Alaska I test, green dye was plainly evident at Sulphur Springs Pool. Apparently the suction provided by lowering the flood gates drew more dye out of Alaska Sink into the flow stream to Sulphur Springs. With two varying travel times at two different sets of head conditions more can be learned about the aquifer system. The dramatic change in elevation at Alaska plus the dye trace interconnection prove without a doubt the relation of this sink to Sulphur Springs. The drop in elevation at Jasmine further extends the interconnection of Sulphur Springs to upstream sinks.

VI. <u>DYE TEST JASMINE II:</u>

Another dye test was conducted at Jasmine Sink with a diver placing dye at the base of the sink directly into the syphon. This sink has a spring at the base of the north side and a syphon on the south side. On Friday, May 19, 1989 at 5:00 PM the diver released 1 gallon of concentrated dye which immediately flowed into the main flow system on its way to Sulphur Springs. Some dye remained in the sink but due to this method of placement there was no lag time in the sink itself as opposed to Jasmine I.

It was initially planned to change the head condition by lowering the gate at the pool in the same manner as Alaska II. However, there were delays encountered in getting City approval to conduct the test (See Appendix D for correspondence). The City Stormwater Department finally consented to the test on May 5, 1989, but by this time the Water Department had started pumping and the pool was on-line for drinking water usage. In this mode the pump (19.8 million gallons/day) adjacent to the pool lowers the level of the pool about a foot by its suction action. When the pool is being pumped water quality is of concern to the Water Department and they would not allow the gates to be opened at Sulphur Springs. Opening the gate for sustained periods has been known to increase chlorides in the pool.

Since the intent of the test was to obtain another flow reading and time of travel at a different set of head conditions (Jasmine I, 12.0$\pm$ to Sulphur Springs 7.5$\pm$ = 4.5 ft) this test was undertaken with the City Water Department having been pumping the pool for over a week. Thus the system was stabilized and no rainfall had occurred for the previous 10 days. The head conditions at the time of the test were Jasmine 10.0$\pm$ and Sulphur Springs 6.3$\pm$. The hydraulic head was thus 3.7 feet for this test where it had been 4.5 feet in the prior test which was also affected by rainfall.

Using a simple hydraulic formula, which will be discussed later, an estimate was made of the Jasmine to Sulphur Springs travel time and velocity based on the head conditions of May 19, 1989. The estimated time of arrival was 24.25 hours assuming no rainfall. Jasmine I had established a 22 hour time of arrival including a 1.0$\pm$ hour lag time in the sink itself. The previous test yielded a 341 ft/hr velocity so with the lower driving head the velocity was predicted to be about 310 ft/hr.

After dye placement water samples were taken hourly from 6 wells around the sink, in the Jasmine Sink and in the 2 Orchid wells for 5 hours. Starting at 2 PM on Saturday, May 20th water samples were taken every 2 hours until 10 PM. An ISCO automatic sampler was set to run every half hour for 24 samples from 10:30 AM to 10:00 PM on Saturday. A total of 85 samples were taken and preserved for fluorescence analysis.

Mr. Greg Jones had obtained the loan of a fluorometer from the USGS in Tampa. The hope was that the Sulphur Springs dye testing effort could be enhanced if a fluorometer was readily available. Unfortunately, the piece of equipment was old and difficulty was obtained first in getting it to run and then in having reliability. Eventually, it was coerced into producing data which would yield relative fluorescence readings but concentration testing was not possible.

Field Notes and Observations

Friday, May 19, 1989	
5:00 PM	Dexter Huc set dye in Jasmine Sink, RW
6:00 PM	Jasmine, Jasmine 1, 2, 3, Pless, Church, 924, Orchid 1, 2, RW
7:00 PM	Initial samples taken Alaska, Harbor House and Sulphur, Jasmine, 1, 2, & 3, Pless, Church, 924, Orchid 1 & 2 RW.
8:00 PM	Jasmine, 1, 2, & 3, Pless, Church, 924, Orchid 1 & 2 RW.
9:00 PM	Jasmine, 1, 2, & 3, Pless, Church, 924, Orchid 1 & 2 RW.
10:00 PM	Jasmine, 1, 2, & 3, Pless, Church, 924, Orchid 1 & 2 RW. Jasmine, Alaska, Sulphur, RW
Saturday, May 20, 1989	
2:00 PM	Jasmine WL raised and lowered 0.25 ft. Water stain evident reason unknown? Rain? No green dye is evident at Sulphur. Dye is gone from sink FR.
7:30 PM	Need to get City Water Department pump flowrate. Flow over spillway about 3.4 cfs or 2.2 mgd. Southern half of pool has unusual green tint more so than north half. Took grab sample 26.5 hrs., RW
7:40 PM	Opened plug at Harbor House Well - about 1.0 gpm, RW
9:30 PM	Definite visual confirmation of green dye! 28.5 hr.$\pm$, RW
11:10 PM	Dye still visible, RW & DC
11:30 PM	Jasmine WL 10.0 Curiosity WL 20.3, RW
Sunday, May 21, 1989	
4:00 AM	Pool still has green color, DC

Due to problems getting the USGS fluorometer to function for the test, an attempt was made to estimate the correct time of arrival by comparisons to the 1987 Orchid test. During that test dye introduced at Orchid Sink was visible at Sulphur Springs for about 9.0 hours. The dye peaked in concentration about 6.0 hours after time of arrival. The peak took place 3.0 hours after a visible concentration was reached. See Appendix L.

Using this previous City test as a guide the following comparison was made.

	Time of Arrival	Visibility Start	Peak	Visibility End
Orchid 87	T + 20.0	23.0	26.0	32.0
Jasmine II 89	T + 23.5	26.5	29.5	35.0

<---------9 hrs.---------->

<---3.0---->

<-------6 hrs.---------->

Therefore, from this curve fitting comparison to the Orchid test of 1987 and in the absence of fluorometer analysis it is estimated the time of arrival was about 23.5 hours. A 24.25 time of arrival had been predicted so this was excellent correlation of data of the Jasmine to Sulphur Springs connection. Since a rise in water level at Jasmine occurred after the dye had been set it is possible a small rainfall event took place in the neighborhood that went undetected. Regardless, a slight rise in water level would have increased the driving hydraulic head and could have reduced travel time slightly. Precision of 1-2 hours in predictability over 7,500 feet at this point was deemed acceptable results.

The dye arrived at Sulphur Springs based on visual estimates at 26.5 hours. The dye was plainly visible up to 35 hours after placement. The City Water Department had been pumping the pool for at least a week so the whole North Tampa system up to Curiosity Sink had stabilized. This test though not performed at expected head conditions yielded more data on the system.

Much more confidence as to travel time predictability has been gained through these dye tests.

VII. <u>TRAVEL TIME CALCULATIONS</u>:

In an effort to better understand the aquifer system and to predict the flowrates of water from upstream sinkholes to Sulphur Springs, a crude modeling attempt was made. Simplifying assumptions included that the flow conduit from Curiosity to Jasmine to Orchid to Alaska to Sulphur was fairly well developed.

This had been evidenced by the historic dye test and the substantial flow reporting to ground surface at the Springs.

Therefore, since the system seemed to act as an underground conduit with several "windows" to the aquifer Manning's equation was tested for general applicability.

Manning's equation is an empirically derived relationship between the following components:

$$V = \frac{1.486}{n} R^{2/3} \quad S^{1/2}$$

Where V = velocity ft/time unit
n = coefficient of roughness
R = hydraulic radius = $\frac{\text{wetted perimeter}}{\text{diameter}}$
S = slope ft/ft

Velocities have been established quite easily and seem to be fairly constant over a 30 year span. The slope or hydraulic gradient is known based on survey datum existing throughout North Tampa at the aquifer "windows". The coefficient of roughness and hydraulic radius are unknown due to the subterranean nature of the conduit. Yet the two knowns can be calculated in to the equation in order to solve for a factor of n and R which will be constant for the system.

Hence for the Jasmine I test the following was calculated.

Velocity: 7,500 ft divided by 22 hrs. = 341 ft/hr

Slope: Jasmine 12.0 - SS 7.45 = 4.55 ft

4.55 ft divided by 7,500 = 0.06067%

Reconfiguring the equation to solve for the unknown we find:

$$\frac{R^{2\backslash 3}}{n} \text{ Constant} = \frac{V}{1.486(S)^{1\backslash 2}}$$

$$= \frac{341}{(1.486)(0.06067\%)^{1\backslash 2}} = 9316$$

Therefore, the unknown coefficient of roughness and hydraulic radius of the aquifer flow system have a constant value in the Jasmine to Sulphur Springs run of $R^{2\backslash 3}/n = 9316$.

Taking this value and manipulating the S value or hydraulic gradient we can now see varying values of velocity. In fact this was what was used to <u>predict</u> the travel time for Jasmine II.

S = (Jasmine 10.0-Sulphur 6.25 ft) divided by 7,500 = 0.0005

$$V = 1.486\ (R^{2\backslash 3}/n)\ S^{1\backslash 2}$$

$$= 1.486\ (9316)(0.0005)^{1\backslash 2}$$

$$= 309.5 \text{ ft/hr.}$$

Taking the predicted velocity and calculating the travel time is as follows:

Distance = Velocity x Time

$$\text{Time} = \frac{\text{Distance}}{\text{Velocity}}$$

Time = 7,500 ft divided by 309.5 ft/hr = 24.23 hrs

say

24.25 hrs.

This is how the previously predicted time of arrival for Jasmine II was calculated.

The same calculations were performed upon the Alaska to Sulphur Springs dye test. The Alaska I test was initiated with a hydraulic gradient of Alaska 8.63± to Sulphur Springs 7.64 or a delta of 1.0 ft. This distance is 1,800 feet, therefore the slope is 0.000556. The velocity was 1,800 feet divided by 6 hours or 300 ft/hr.

Using this information and solving for the unknown aquifer constant n and R we find.

$$\left(\frac{R^{2\backslash 3}}{n}\right) \text{ constant} = \frac{V}{1.486(S)^{1\backslash 2}}$$

$$= \frac{300}{1.486\ (0.000556)^{1\backslash 2}} = 8{,}562$$

During the Alaska II test with the Sulphur Springs gates open after 1 hour the hydraulic gradient was 2.98 ft (Alaska 5.49 - Sulphur 2.51). Using this revised gradient of S = 2.98/1800 = 0.0016556.

Solving for the velocity at this artificially induced head:

$$V = 1.486\ (R^{2\backslash 3}/n)\ S^{1\backslash 2}$$

$$= 1.486\ (8562)(0.0016556)^{1\backslash 2}$$

$$= 517.7 \text{ ft/hr.}$$

Time of arrival therefore is:

$$\text{Time} = \frac{\text{Distance}}{\text{Velocity}} = \frac{1{,}800 \text{ ft}}{517.7 \text{ ft/hr}} = 3.48 \text{ hours}$$

When this calculated time of arrival is compared to the observed data the correlation is nothing short of excellent! The mystery of the system is revealing itself.

VIII. WATER QUALITY SAMPLING:

A "Water Quality Sampling Plan for Alaska and Sulphur Springs" was prepared for SWFWMD to be reviewed and approved as a basis for executing the study. See Appendix U. As originally conceived the work would center on the relationship between Alaska and Sulphur Springs. Water Quality testing was to take place after travel times could be established. Water flowing under

Alaska would have certain water quality characteristics and these could be compared to Sulphur Springs to see 1) how water quality reacts as the flow progresses from north to south and 2) how water quality might change from dry season to wet season.

The study originally budgeted 4 tests at 2 locations for a total of 8 water quality composite samples. The samples were to be taken by trained volunteer labor with a contract laboratory being paid for the analytical work. However, Mr. Tom Cardinale, Lab Manager of the Hillsborough County Environmental Protection Commission offered their laboratory services and thus the study was able to extend to 4 tests for 4 locations and more parameter added. The funds budgeted for water quality analytical was diverted to buy more concentrated flourescent dye.

The list of parameter selected was chosen based on general water characteristics, aquifer characteristics and urban runoff characteristics.

<u>General Water Quality</u>

pH

Color
Turbidity
Temperature

<u>Aquifer Characteristics</u>

Calcium Ca
Sodium Na
Magnesium Mg
Alkalinity
Sulfates SO_4
Chloride Cl

<u>Urban Runoff Characteristics</u>
Total Coliform
Fecal Coliform
Fecal Streptococcus
Nitrate & Nitrite $NO_3 + NO_2$
Residual Solids
Oil & Grease
Lead Pb
Chromium Cr

The intent was to extend the water quality testing to each aquifer "window" currently known in the Sulphur Spring system. See Figure 1 and Map in Appendix A. Curiosity Sink though judged not to be connected by the City in 1987 does have a spring which boils water in the rear of the 11513 Ravine Drive. Jasmine Sink and Alaska Sink both have historically been shown to be connected to Curiosity as well as Sulphur Springs. Therefore, these four points constitute the four best known accessible points to take water quality measurements of the aquifer as it moves south through North Tampa.

The strategy applied was to sample Curiosity at the beginning of the test. Wait about 24 hours (the USGS published 25.4 hrs) to sample Jasmine (also known as Poinsettia or Trinity Springs) and then wait about 16 hours to sample Alaska and then another 6 hours to Sulphur Springs. Water samples with the exception of Curiosity were to be 2 hours composites to account for variation in flow and lack of precision.

If all water was taken from the same underground stream at various points then hopefully any increase in constituents from north to south might point to inputs to the system and may point the way to finding a source of contamination. Similarly, tests were to be varied as to rainfall. The first test was a dry weather test and the other beginning, middle and end of the wet season. In this manner the water quality of the system could be studied and conclusions drawn from the data.

IX. WATER QUALITY TEST #1 DRY WEATHER:

The first water quality test was to be performed in May to establish the dry weather water quality of Alaska and Sulphur Springs. Since the Hillsborough County Environmental Protection Commission had volunteered laboratory services the scope of the sampling was extended. Two other upstream aquifer windows were added; Curiosity and Jasmine. Due to the delays in getting permission to perform the Jasmine II dye test, the water quality testing was not performed until the first week in June. The sampling was scheduled when weather reports indicated rain may be on its way. Between the Alaska II dye test and this test preparations were being made to facilitate sampling for water quality.

A diver was used to place a 1/4" suction line in the underwater mouth of Sulphur Springs. This line was weighted and wedged in a crevice such that the force of the flow would not dislodge it. The other end was tied off at a ladder on the northside of Sulphur Springs.

It was intended that divers would set all of the suction as close as possible to the aquifer windows for the best possible water quality data representing the underground stream flow. Alaska and Jasmine were put in place by divers, weighted and tied off at the surface. Time ran out when weather reports predicted rain and the Curiosity Sink suction line had to be set by hand from the surface with a weighted rock.

The samples were taken with a peristaltic pump that was hooked up to first purge the line downward to flush any solids free and then pumped for 15 minutes to clear the line for analytical sampling. Field measurements of pH and temperature were taken. Notes were made on the water level, clarity of sample, duration of sample, location of suction line and other pertinent information. Since this was the dry weather sample with no stormwater, grab samples were the only thing needed. It took about 12-15 minutes to fill all sample jars.

Access to Curiosity Sink was provided by Mr. Ron Jeddon of 11513 N. Ravine Drive. He located the point of the spring boil that is visible in the pond in his backyard. See Location Map Appendix E. This was where the suction line was lowered the day of the sampling. The water clarity at the surface was turbid and murky with temperature of 27^{o}C. The water from the suction line placed 18 feet deep was crystal clear; no turbidity and temperature of 25^{o}C.

At Jasmine the City provided keys for access and since no diving was to be performed for sampling it was not necessary to notify the City or have the police dive team on standby as was the case for previous dives at Jasmine or Sulphur. The suction line was located at the spring side of the sink (north side) in about 15 feet of water.

At Alaska the suction line was set on the northwest corner of the sink in about 28 feet of water. This corner was chosen by the divers as that most likely to be near the freshwater flow into the sink.

Curiosity, Jasmine, Alaska and Sulphur were four points known to have been connected and all somewhat in line as the water flows south through North Tampa to its outfall at the pool. It was hoped by observing the water quality in the dry season and then over the duration of a rainy season that conclusions about water quality could be obtained. Varying water quality over distance might point to where the degrading inputs are taking place. The first sample at Curiosity was taken at time (T=0) then the Jasmine sample would be taken about T=24 (USGS published 25.4 hrs) with Alaska at T=40 (6 hrs up stream of Sulphur) and Sulphur at T=46 (22 hours from Jasmine). Therefore, water quality can be monitored as the underground stream flows through North Tampa.

WATER QUALITY TEST #1 DRY WEATHER

SUMMARY TABLE

General W.Q.	Curiosity	Jasmine	Alaska	Sulphur
Date/Time	6/5/89 9:48 AM	6/6/89 7:45 AM	6/7/89 8:45 AM	6/7/89 7:39 AM
pH	7.34	7.20	7.25	7.26
Color Pt/Co	5	5	2	6
Turbidity NTU	1	4	2	1
Temperature ^{o}C	25.0	25.0	24.0	24.0
Aquifer Characteristics (mg/l unless noted):				
Calcium Ca	67.5	102	109.5	118
Sodium Na	9.0	110	19.0	192
Magnesium Mg	3.0	14	5.5	22.5
Alkalinity	149	180	230	160
Sulfates SO_4	16	84	49	140
Chlorides Cl	16	224	32	385
Fluorides F	-	-	-	-
Potassium K	1.0	-	0.5	-
Urban Runoff Characteristics				
Total Coliform Tc #/100 ml	8	64	232	1400
Fecal Coliform Fc #/100 ml	<4	<4	124	1000
Fecal Streptococcus FC #/100 ml	36	132	100	500
Nitrate & Nitrite NO_2, NO_3	0.42	0.20	1.91	0.52
Residual Solids	216	697	393	1040
Oil & Grease O&G	<0.1	1.4	1.4	2.4
Lead Pb ug/l	<20	<20	<20	<20
Chromium Cr ug/l	<40	<40	<40	<40
Comments:	WL 19.75	WL 9.7	WL 8.1(est)	WL 6.5
	12 minutes Sample Suction Line 18 ft deep	15 minutes Sample Suction line 15 ft deep Spring N/side	15 minutes Sample Suction 28 ft deep N/E corn.	15 minutes Sample Suction 28 ft deep center spring

moved up due to rain

The first sample was taken at Curiosity on June 5, 1989, 9:48 AM. Jasmine was sampled on June 6, 1989 at 7:45 AM but on that afternoon a rainfall event occurred. The rainfall event occurred about 1 - 3 PM on June 6, 1989. It was later found that 1.1 inches of rainfall fell in North Tampa.

Field notes on 6/7/89 recorded that Orchid Sink had the appearance that about 5.0$\pm$ (WL 16.0$\pm$) feet of water has been present but that it was dry on that date. The water level at Alaska rose and fell about about 1.5 feet (WL 8.1 - 9.6$\pm$) at the same time. No evidence of a surge was recorded at the Sulphur Springs Pool. Since the rainfall event occurred on the afternoon of June 6, 1989 it was decided to sample Sulphur Springs first and then sample Alaska. So early in the morning Sulphur was sampled followed by Alaska. Sample sequence was about the following: Curiosity T=0, Jasmine T=22, Alaska T=47, Sulphur Spring T=46.

The Water Quality #1 results are shown in Summary Table on the next page and on Hillsborough County Environmental Protection Commission Laboratory sheets in Appendix E. The water appeared to show some increase in contamination levels as it moves south.

The general water quality parameters showed little variance for pH, color, turbidity and temperature. The aquifer characteristics showed uniform increase in all concentrations with the exception of Alaska for Sodium, Magnesium and Chloride.

Urban Runoff Characteristics all increased from north to south with some exceptions. In no case was Lead or Chromium present above detectable concentration. Fecal Strep, Residual

Solids and oil and grease all increased from Curiosity to Jasmine, diminished to Alaska and then rose again to Sulphur.

It appears as though the Curiosity site was a valid location for aquifer sampling since every parameter had the lowest value with the exception of pH and temperature. Due to the cleanup activities at Alaska Sink it is not known if the connection to the aquifer has been aided or impeded. A later section will detail the cleaning sequence for this site.

Some of the Alaska concentration for Fecal Strep, Nitrate/Nitrite, Residual Solids and Oil and Grease appear not to fit the sequence. The bacteria increase appears to be stormwater related.

Other water quality data obtained from the City of Tampa Water Department indicates that during the period of pool pumping from May 16 to June 6, (See Appendix O). Total coliform bacteria levels ranged from 200 to non-detectable (Bathing Standard <1000).

It was somewhat fortuitous that the City Water Department was pumping the pool during the three previous weeks because if the source of bacteria were septic tanks or leaking sanitary sewer lines it would seem that this sustained drawdown of the system would pull them into the pool. No bacteria spikes occurred until after the rainfall of June 6, 1989. The flowrate of the City Pump is 19.8 mgd and the flow over the weir was estimated to be 2.2 for a total flow of 22.0 mgd.

Therefore, the first water quality sample taken at Sulphur Springs which exhibited total coliform at 1400 was probably rainfall influenced and not a true dry weather sample due to the premature arrival of a rainfall event.

A calculation of the time of arrival based upon the observed head at Orchid and the depressed water level at Sulphur Springs would be calculated as follows:

$$S = \frac{(16.0 \text{ Orchid} - 6.5 \text{ Sulphur})}{6400} = 0.001484$$

$(R^{2\backslash 3}/n)$ Constant = Same as for Jasmine to Sulphur

$$V = \frac{(1.486)}{1.486} \; \frac{R^{2\backslash 3}/n}{(9316)} \; \frac{(S)^{1\backslash 2}}{(0.001484)^{1\backslash 2}} = 533 \text{ ft/hr}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Velocity}} = \frac{6400 \text{ ft}}{533 \text{ ft/hr}} = 12.0 \text{ hours}$$

Using one half of the head at (13.5 ft) Orchid to allow for falling head conditions the time of arrival could have been 14+ hour.

Since rain fell on the afternoon of June 6, 1989 between 1 - 3 PM nominally 2 PM) then time of arrival could have been as little as 12.0 - 14.0 hours. The bacteria spike could have started at 2:00 - 4:00 AM on June 7, 1989 thus a value of 1400 total coliform at 7:39 AM would be a reasonable result after the input of stormwater to the system at Orchid and/or Jasmine.

Though not entirely as desired the first water quality test yields further valuable information about the system.

X. <u>WATER QUALITY TEST #2 BEGINNING WET WEATHER</u>:

Discussion evolved with EPC lab of trying to couple the next round of sampling with a rainfall event in hopes of more readily quantifying the effect of stormwater inputs on the system. Four samples were to be taken at Curiosity, Jasmine, Alaska and Sulphur as before. However, an additional 12 bacteria samples were to be taken at the pool hourly to see if the arrival of stormwater from Jasmine could be predicted and observed.

On July 19, 1989 following a rainfall event at about 5:00 - 7:00 PM 1 gallon of dye was pumped via peristaltic pump and suction line into Jasmine.

The previously set suction line near the spring side of the Jasmine sink was used. There would be up to a 1 - 2 hour lag time in the sink for this dye to move to the syphon side and exit to the aquifer. A water quality grab sample was taken from Jasmine at 9:05 to 9:10 PM prior to pumping the dye in at 9:15 PM.

Since this sample was taken out of sequence from the four point program, Curiosity was sampled as a grab the next morning at about 10:45 AM.

The water level at Jasmine was about 12.0± ft. and Orchid had at least 2.0 ± feet of water in it (13.2± ft.). The Sulphur Springs pool level was normal (7.6± ft.) as no pumping was taking place. Calculations were made based on the head differences and a 22.0 hour time of arrival from Jasmine to Sulphur Springs was estimated. A one hour lag time was used to predict hour of arrival at Sulphur Springs (7/18 9:15 PM + 1 hr. + 22 hrs. = 8:15 PM 7/19). A 2 hour water quality composite was centered at 8:00 PM in Sulphur Springs from 7:00 to 9:00 PM. The Alaska composite was 2 hours to be centered on 3:00 PM. It was actually taken from 2:45 to 4:30 PM. Composite samples were taken with 5 aliquots

WATER QUALITY TEST #2 BEGINNING WET WEATHER

SUMMARY TABLE

General W.Q.	Curiosity	Jasmine	Alaska	Sulphur
Date/Time	7/19/89 10:48 AM	7/18/89 9:05PM	7/19/89 2:45 PM 4:30 PM	7/19/89 7:00PM 4:00PM
pH	7.42	6.92	7.31	7.25
Color Pt/Co	5	36	2	11
Turbidity NTU	1	13	2	1
Temperature ^{o}C	25.5	25.0	26.5	26.25
Aquifer Caracteristics (mg/l unless noted):				
Calcium Ca	63	113	109	127
Sodium Na	8.0	103	19.0	280
Magnesium Mg	3.0	11	6	32
Alkalinity	148	258	232	158
Sulfates, SO_4	12	1	51	185
Chlorides Cl	15	210	32	529
Urban Runoff Characteristics				
Total Coliform Tc #/100 ml	50	<10	400	2000
Fecal Coliform Fc #/100 ml	30	<10	168	1000
Fecal Streptococcus FC #/100 ml	760	10	---	---
Nitrate & Nitrite NO_2, NO_3	0.11	0.06	1.97	0.22
Residual Solids	238	686	364	1311
Oil & Grease O&G	<1.0	1.0	<1.0	<1
Lead Pb ug/l	<20	<20	<20	<20
Chromium Cr ug/l	<20	<20	<20	<20
Comments:	WL 23.1	WL 12.0±	WL 8.6±	WL 7.6±
	Clear water 10 minute sampling time	After rainfall event grab 1 gal dye pumped in 9:15 P.M.	1 hr. 45 min. composite	Normal 2 hr composite

slightly less than a quart each to produce 1 gallon of composite. A clean gallon water jug was used to contain the sample and kept on ice.

Since EPC supplied 12 extra bacteria sample bottles for this test it was determined they would be collected hourly at Sulphur Springs for 12 hours. The start time was set at a 22 hour time of arrival from 5:00 PM 7/18 or at 3:00 PM 7/19/89. In this way the effect of a stormwater input at Sulphur Springs could be assessed. It was anticipated that the dye would be visible at Sulphur Springs so fluorescence samples were taken hourly with the bacteria samples. The USGS recorded the flowrate at Sulphur Springs for the tests was later found to be between 37 cfs (23.9 MGD) and 38 cfs (24.5 MGD). The hourly bacteria and fluorescence results are as follows:

July 20, 21, 1989

Time	Total Coliform		Flouresence	Sampler
3:00 PM	250		4%	TD
4:00 PM	180		4%	TD
5:00 PM	360		4%	TD
6:00 PM	700		5%	TD
7:00 PM	850		5%	TD & JB
8:00 PM	1000		4%	TD & JB
9:00 PM	7000		4%	TD & JB
10:00 PM	11000	Orchid Spike	5%	FR
11:00 PM	9000		5%	FR
12:00 AM	11000	Jasmine Spike	5%	FR
1:00 AM	9000		5%	RW
2:00 AM	5000		5%	RW

This shows an initial increase in bacteria concentration at about 5:00 PM. From the 1987 dye test of Orchid there was a 6.0 hour lag time from time of arrival to peak concentration. The 10:00 PM spike to 11,000 counts/100 ml is Orchid Sink reporting in. Two hours later there appears an equivalent spike to 11,000 from Jasmine Sink. From previous dye test results we know that Orchid and Jasmine vary in travel times by 2 hours. Therefore, these peaks are the arrival of stormwater from the two upstream sinks.

In 1987 Mr. Mike Burwell of the City of Tampa Stormwater Department investigated and found a 26 hour peak concentration with a 20 hour time of arrival from Orchid under rainfall conditions. To produce a 10:00 PM spike on 7/19/89 there would have been stormwater input to Orchid Sink at 8:00 PM on 7/18/89. Rainfall had been recorded on 7/18/89 at about 5:00 - 7:00 PM in North Tampa. The 2 - 3 hour discrepancy is probably accounted for by inaccuracies as to the time water actually surged into the sink. However, at this stage in the investigation this level of precision is quite satisfactory.

Dye introduced at Jasmine failed to arrive at Sulphur in visible concentrations. The fluorescence readings at the pool did not vary. This may be due to inaccuracies in the sensitivity of the fluorometer loaned by the USGS. This was the first use made of the instrument as previous dye testing was done at City of Tampa laboratory. However, samples leftover from the Alaska II dye test were tested and readings in the 6 - 12% range were visible during that test with 4% being considered background at the pool. Since dye was injected 2 - 4 hours after rainfall it's arrival was probably 2 - 4 hours after the 12:00 AM spike and no sampling was being conducted at that time.

An analysis of the Water Quality is made now with the notes that Jasmine was sampled after a rainfall event and the Curiosity sample was not taken in the upstream time sequence as before. SeeSummary Table. The pH seems to decrease and the temperature increases which might be expected with a stormwater input. Color increased and Turbidity stayed about the same overall.

The aquifer characteristics all increased and moreover increased in very similar characteristics to the previous dry weather sample. The Alaska data was almost identical to the previous sample which may indicate the sink does not have much interchange with the aquifer and is fairly isolated. The only change was in bacteria from the previous sample and this test was after rainfall.

In the urban runoff characteristics all parameters increased from north to south with the exception of lead, chromium and oil and grease which were essentially non-detectable. The water level at Curiosity was up about 3.5 feet due to stormwater inflows yet the only major change in water quality was an increase in bacteria and a decrease in nitrogen compounds.

At Jasmine it was curious that after a rainfall event there was less bacteria at the spring side than in the previous test. One would think that mixing would occur. However, the hydraulic pressure at the spring side where the suction line was set must have provided an envelope of aquifer water. Since there was no bacteria influx it must be speculated that little source of contamination exists upstream at the beginning of the rainy season. The nitrogen decreased by half from Curiosity to Jasmine while the residual solids almost tripled. This was an identical circumstance on the previous test. The bacteria level of the Sulphur Springs pool at the time of sampling has been discussed. The aquifer characteristics of Sulphur all increased except alkalinity which stayed essentially the same. Nitrogen decreased from the previous sample while residual solids increased both of which can be explained through increased aquifer flow. Color increased slightly over the previous test.

One of the most significant pieces of information generated thus far is the rapidity with which bacteria levels can change at the pool. Within a 2 hour period levels went from 850 to 7000 over an 800% increase. Since the bathing standard is 1000 (counts/100 ml) that means the pool went from swimmable to unswimable in 2 hours.

The other startling piece of information is the dual bacteria spikes at Sulphur Springs occuring 2 hours apart and arriving very close to the predicted travel times from the upstream Orchid and Jasmine sinkholes.

XI. <u>WATER QUALITY TEST #3 MID WET WEATHER</u>:

On September 19, 20, 21 water quality samples were taken in the approximate travel time at Curiosity, Jasmine, Alaska and Sulphur. EPC had requested baseline samples from each point so 4 grab samples were taken for initial conditions then 3 more sequential composite samples downstream for a total of 7 samples from the system. On Friday, September 22nd a heavy rainstorm hit North Tampa and on the following day bacteria testing wasinitiated at Sulphur Springs in an effort to see the arrival sequence.

Red flourecent dye was placed in Orchid on the southside on September 22, 1989 at about 2:55 PM. The water level when the dye was placed was about 8 - 9 feet deep or elevations 19.2 - 20.2 ± feet. Jasmine was previously pumped with 1 gallon of green flourecent dye via peristaltic pump at 2:35 PM on September 22, 1989. This effort was followed by water level observations and bacteria and flourecense samples at Sulphur Springs. Samples were taken every two hours. Based on the previous test there was about a 29 hour time to peak so sampling was initiated at 24.0 hours to obtain the arrival and peak sequence. Dye was not anticipated in visible concentrations.

The results of the testing are as follows:

SULPHUR SPRINGS WATER QUALITY #3
Bacteria and Flourescence Reading

Date Time	Flourescence Percent	Total Coliform #100/ml	Fecal Coliform #100/ml	Fecal Spreptococcus#100/ml	Sampler	Comments
9/23 - Saturday						
4:00 P.M.	44	4500	2500	1300	RW	Rain starting.Jasmine 13-14,Orchid 15-17,Sulphur 7.7
6:00 P.M.	29	3000	2000	1900	RW	Raining
8:00 P.M.	24	2900	2900	1300	DC	Lt. rain
10:00 P.M.	19	3000	2400	900	DC	Steady Lt. Rain
9/23 - Saturday						
12:00 P.M.	18	2700	2700	900	DC	No rain

SULPHUR SPRINGS WATER QUALITY #3
Bacteria and Fluorescence Reading

Date Time	Flourescence Percent	Total Coliform #100/ml	Fecal Coliform #100/ml	Fecal Spreptococcus#100/ml	Sampler	Comments
9/24 - Sunday						
2:00 A.M.	14	2300	1600	1200		No rain possible green
4:00 A.M.	13	1500	1500	900	FR	No rain fuel smell possible green
6:00 A.M.	10	1400	1400	900	FR	Fuel smell no rain
8:00 A.M.	8	1500	500	300	FR	Fuel smell over cast
10:00 A.M.	6	1500	1000	200	FR	Fuel smell
12:00 P.M.	5	1000	900	900	FR	Fuel smell
2:00 P.M.	5	1300	1300	800	RW	Slight hydrocarbon odor WL 7.7
4:00 P.M.	3	----	----	----	RW	No rain, no odor
6:00 P.M.	3	----	----	----	RW	Drizzle starting slight odor

Water Level Readings:

Curiosity: 9/24/89 2:25 P.M., W.L. 22.3 Evidence it had been up to 23.5 recently. Stormwater pump operating.

Jasmine: 9/23/89 4:00 P.M., W.L. 13.7
9/24/89 2:15 P.M., W.L. 13.7

Orchid: 9/22/89 2:55 P.M., W.L. 19.2 - 20.2
9/23/89 4:00 P.M., W.L. 15.6±
9/24/89 2:10 P.M., W.L. 13.6±

For the entire 22 hour period after sampling began the pool was unswimmable. The rainfall event was recorded by Mr. Berry as 1.2 inches on September 22 and 0.48 in. on September 23, 1989. Greater rainfall and more saturated conditions elevating the hydraulic head as well as high water levels in the Jasmine and orchid sinks contributed to the shorter travel times. The USGS recorded flow at Sulphur at 46 cfs or 29.7 mgd. The peak bacteria and flouresence concentration arrived earlier than predicted. Further calculations made on the 19.7$\pm$ ft. water level at Orchid when the storm ceased show that the velocity could be as high as 599 ft/hr with a 10.7 hr time of arrival if the hydraulic head was sustained. The travel time was misjudged due to relying on the previous test. Yet the heavier rainfall conditions definitely accelerated the travel times. Of note is the florescence readings which went to background after about 49 hours after placement. We learned the USGS flourometer did not have the capability to differentiate the red and green dyes. The bacteria levels were not quite back to swimmable at the point the samples were ended.

The water quality testing was started on September 19, 1989 with four samples being taken at Curiosity, Jasmine, Alaska and Sulphur Springs. All samples were taken with the peristaltic pump purging the line downward first then pumping for 10 - 15 minutes to purge the line and then fill sample bottles. All initial samples were grab type taking only as along as the peristaltic pump needed to fill sample the bottles.

WATER QUALITY TEST #3 MIDDLE WET WEATHER
SUMMARY TABLE

General Water Quality	Curiosity 9/19/89 9:50 AM	Jasmine Baseline 9/19/89 10:30 AM	Jasmine 9/20/89 10:30 AM 12:00 PM	Alaska Baseline 9/19/89 12:15 PM	Alaska 9/21/90 10:30 AM 12:00 PM	Sulphur Baseline 9/19/89 11:30 PM	Sulphur 9/21/89 1:00 PM 2:30 PM
pH	7.29	7.25	7.40	7.16	7.38	7.33	7.38
Color Pt/Co	----	4	18	4	7	7	8
Turbidity NTU	5	6	48	5	5	2	2
Temp. ^{o}C	23^{o}	22^{o}	23^{o}	22^{o}	24^{o}	22^{o}	24^{o}
<u>Aquifer Characteristics mg/l unless noted</u>:							
Calcuium Ca	61	77	87	98	110	125	121
Sodium Na	9	68	65	19	19	260	260
Magnesium	3.2	9.4	8.5	5.8	5.9	33	32
Alkalinity	152	167	190	234	233	154	155
Sulfates SO_4	14	55	---	50	51	170	169
Chlorides Cl	15	143	132	33	31	572	506
<u>Urban Runoff Characteristics</u>:							
Total Coliform TC #100 ml	110	1900	TNTC	260	6000	190	9000
Fecal Coliform FC/#100 ml	110	360	TNTC	240	6000	80	5000
Fecals Strep, FS #100/ml	30	230	49,000	180	----	<10	----
Nitrate & Nitrate NO_2, NO_3	0.64	0.45	0.06	2.33	2.23	0.91	0.86
Residual Solids	211	503	485	397	381	1406	1308
Oil & Grease O & G	1	<1	1.4	<1	1	<1	1
Lead, Pb ug/l	<20	<20	<20	<20	<20	<20	<20
Chromium Cr, ug/l	<20	<20	<20	<20	<20	<20	<20
<u>Comments</u>:		<u>W.L.</u> Unable to read 10 min. grab slightly turbid	<u>W.L.</u> Almost above marker, 1.5 hr. comp., 7-15 min. aliquot turbid		<u>W.L.</u> 1.5 hr. comp. 7-15 min. aliquot clear		Normal-7.5± 1.5 hr. comp. 7-15 min. aliquot clear

Back in July the suction line at Jasmine had been relocated by divers due to the line being silted in when checked after Water Quality Test #2. During this sampling the line became clogged and had to be reset from the surface with a new line and weight being tossed into the approximate location of the spring base. As well the line at Alaska had been vandalized and had to be reset from the surface with a new line and weight. In July, the divers reset the Sulphur Springs suction line after it had been vandalized but for Water Quality Test #3 it was still intact. After the initial four samples then Jasmine, Alaska and Sulphur were sampled the following days in approximately the sequential travel time. However, delays in personnel availability delayed the Alaska and Sulphur test longer than was desired. Sample sequence Curiosity T = 0, Jasmine T = 25, Alaska T = 49, Sulphur T = 51.

From observing the data reported in the summary table for Water Quality Test #3 the following comments are offered. For general water quality parameters the pH increased along with temperature. Since this was the mid rainy season sample, the change in pH from the previous sampling could be due to flushing of the system. Turbidity and color decreased.

All the aquifer characteristics showed an increase with the exception of alkalinity which stayed approximately the same.

The urban runoff characteristics all showed an increase. Bacteria was quite high at the pool for the composite sample. Nitrogen and Residual solids increased.

The Jasmine sample appeared to be affected by the relocation of the sampling line. The sample was noted as turbid and had bacteria too numerous to count (TNTC) thus this is more likely a stormwater sample than an aquifer sample at this time.

The Alaska sample appears to be almost identical to previous samples with the exception of color, turbidity and bacteria.

The turbidity at Sulphur for the baseline sample was 2 as it was for the sequential composite. However, in the baseline test the pool was swimmable and in the composite it was not. Therefore, turbidity and bacteria do not have correlation at Sulphur Springs.

XII. <u>WATER QUALITY TEST #4 END WET WEATHER</u>:

The fourth and last water quality test was taken in the same format as the third with a baseline sample being taken at Jasmine, Alaska and Sulphur. Curiosity could not be accessed due to a scheduling error. The same points were then sampled with the sequential times as follows: Jasmine T=22.5, Alaska T=45, Sulphur T=49.

There was no rainfall event so no dye was induced or bacteria readings taken at the pool. The Jasmine results show high bacteria at the baseline which diminished significantly from 39,000 to 5000 the next day. See Summary Table #4. At the time of the sampling there was no evidence of previous rainfall though Mr. Berry recorded 0.26 inches on October 14, 1989. It is speculated that a short duration localized rainfall may have hit near Jasmine on the 15th or 16th.

Alaska continues to show evidence of consistent water quality with only color, turbidity and bacteria varying to any degree. At Sulphur Springs it is of note that a high (16,000) bacteria reading was recorded on a 2 hour composite.

Water Quality Test #3 and #4 both had baseline test followed by sequential test which both had large changes from 1000 or less to 9000 or more. The other water quality parameter changes were as follows. Those parameters which decreased were calcium, magnesium, sulfates, chlorides nitrogen and residual solids. Those items increasing along with bacteria were pH, color turbidity and oil and grease. Correlation of these compounds may yield a non-bacterial indicator or group of indicators which may give a chemistry test that could indicate when non-swimmable conditions are coming.

Further analysis of each location over time will be undertaken in the next section to see what other conclusions may be drawn from the data.

To date this effort comprises the most comprehensive series of tests yet undertaken to both understand the travel time relationships between the sinks and springs and to understand the water quality changes induced by stormwater into the North Tampa Sulphur Springs system.

WATER QUALITY TEST #4 END WET WEATHER SUMMARY TABLE

General Water Quality	Curiosity	Jasmine Baseline 10/16/89 2:45 P.M.	Jasmine 10/17/89 12:20 PM 2:20 PM	Alaska Baseline 10/16/89 3:45 PM	Alaska 10/18/89 10:45 PM 12:45 AM	Sulphur Baseline 10/16/89 5:15 AM	Sulphur 10/18/89 1:45 PM 3:45 PM
pH	(Access	7.02	7.22	7.10	7.15	7.16	7.33
Color Pt/Co	not available)	6	4	3	2	13	15
Turbidity NTU		6	13	5	4	1	4
Temp. ^{o}C		24^{o}	25^{o}	24^{o}	24^{o}	25^{o}	25^{o}
<u>Aquifer Characteristics mg/l unless noted</u>:							
Calcuium Ca		99	99	110	114	130	123
Sodium Na	(No	85	87	19	19	280	270
Magnesium	Sample	11	10	6	6	33	32
Alkalinity	Taken)	179	176	230	230	155	155
Sulfates SO_4		63	65	52	53	176	169
Chlorides, Cl		165	163	31	30	550	507
Flourides, F		0.16	0.14	0.24	0.27	0.21	0.24
<u>Urban Runoff Characteristics</u>:							
Total Coliform TC #100 ml		39000	5000	400	2000	1040	16000
Fecal Coliform FC/#100 ml		1430	460	300	80	110	4000
Fecal Strep, FS #100/ml		70	150	260	1390	<10	450
Nitrate & Nitrate NO_2, NO_3		0.28	0.33	2.25	1.51	0.78	0.38
Residual Solids		563	586	385	391	1350	1322
Oil & Grease 1 O & G		1	2	<1	1	<1	1
Lead, Pb ug/l		<20	<20	<20	<20	<20	<20
Chromium Cr, ug/l		<20	<20	<20	<20	<20	<20
<u>Comments</u>:	Owners wife would not permit access due to scheduling error	Water clear 15 min. grab	2 Hr. composite	Water clear 15 min. grab	Water clear 2 hr. composite	Water clear 15 min. grab	Some sediment 2 hour composite

XIII. WATER QUALITY ANALYSIS BY LOCATION

Curiosity Sink:

The data from this location indicate that the spring is aquifer water. For the duration of the tests we were never able to get a diver to check out the relationship of the suction line and the spring mouth. An envelope of clear water exists under the more turbid, murky surface water of the low area.

The dry season sample in June, 1989 was taken prior to rainfall and is a true background sample. As with other sequential tests, pH, temperature, bacteria and residual solids increase to the first wet weather sample in July. Calcium, sodium, sulfates, chlorides, nitrate/nitrite decrease. Color, turbidity, oil and grease, magnesium and alkalinity stay essentially the same. Lead and chromium are below detectable limits.

From the beginning to the mid wet-weather sample, pH, temperature, calcium and residual solids decrease. Parameters that increase are turbidity, sodium, magnesium, alkalinity, sulfates, bacteria, nitrate/nitrite and oil and grease. Unfortunately due to a scheduling error, we could not take the end of wet weather sample as we had hoped.

In the overall June to September period there are only substantial increases in turbidity, bacteria and nitrate/nitrite. Those that decrease are temperature and calcium.

The influx of stormwater into the low area raises the head on the spring which should reduce inflow. It would also enhance mixing due to storm inflow velocity. Increase in stormwater could account for

CURIOSITY SINK WATER QUALITY
SUMMARY TABLE

General Water Quality	6/5/89 9:48 A.M.	7/19/89 10:48 A.M.	9/19/89 9:50 A.M.	10/16/89
pH	7.34	7.42	7.29	
Color, Pt/Co	5	5	---	(Access not
Turbidity NTU	1	1	5	available)
Temp. C^{o}	25^{o}	25.5^{o}	23^{o}	
<u>Aquifer Characteritics mg/l unless noted</u>:				
Calcium, Ca	67.5	63	61	
Sodium, Na	9.0	8	9	
Magnesium Mg	3.0	3.0	3.2	
Alkalinity	149	148	152	(No Sample
Sulfates, SO_4	16	12	14	taken)
Chlorides, Cl	16	15	15	
Potassium, K	1.0	----	----	
<u>Urban Runoff Characteristics</u>:				
Total Coliform TC #100 ml	8	50	110	
Fecal Coliform FC #100 ml	<4	30	110	
Fecal Steptococus FS #100 ml	36	760	30	
Nitrate & Nitrate NO_2, NO_3	0.42	0.11	0.64	
Residual Solids	216	238	211	
Oil & Grease, O & G	<0.1	<1.0	1	
Lead, Pb ug/l	<20	<20	<20	
Chromium Cr, ug/l	<40	<20	<20	
	<u>W.L. 19.75</u>: 12 minute sample. Suction line 18' deep.	<u>W.L. 23.1</u>: Clear Water 10 minute Sample time. Grab	<u>W.L.</u>: Unable to read. 10 minute grab slightly turbid.	

Comments:

Owners wife would not permit access due to scheduling error.

the change in turbidity, bacteria, temperature and calcium.

Jasmine (Poinsettia, Trinity Springs) Sink:

The first two water quality tests from dry weather to wet weather show a decrease in pH, sodium, magnesium, sulfates, chloride, bacteria, nitrate/nitrite, residual solids and oil and grease. The parameters that increased were color, turbidity calcium and alkalinity. Simple dilution of the system by increased flow does not account for the changes. The increase of color and turbidity could be due to upstream inputs or mixture of stormwater flow in the sink.

The Water Quality Test #3 took samples from a repositioned suction line which apparently was more susceptible to stormwater. The bacteria counts were significantly higher and the aquifer characteristics were all much lower than previously thus leading to the conclusion of stormwater inflow contamination instead of aquifer flow. The composite sample of 9/20/89 shows color and turbidity as well as bacteria which is from stormwater mixing in the sink.

The envelope of aquifer water from the spring side around the suction line was apparently penetrated when the line was repositioned. Water Quality Test #4 shows the same pattern. Nitrogen, bacteria and residual solids do not seem to be proportioned. The bacteria and nitrogen levels increase but the residual solids decrease. Therefore, stormwater at this location has high bacteria and nitrogen but lower residual solids than aquifer flow. Yet, the sample of 9/20/89 had bacteria TNTC but

JASMINE SINK WATER QUALITY

General Water Quality	6/6/89 7:45 A.M.	7/18/89 9:05 P.M.	9/19/90 10:30 A.M.	9/20/89 10:30 P.M. 12:00 P.M.	10/16/89 2:45 P.M.	10/17/89 12:20 P.M 2:30 P.M.
pH	7.20	6.92	7.25	7.40	7.02	7.22
Color, Pt/Co	5	36	4	18	6	4
Turbidity NTU	4	13	6	48	6	13
Temp. C^o	25^o	25^o	22^o	23^o	24	25
<u>Aquifer Characteritics mg/l unless noted</u>:						
Calcium, Ca	102	113	77	87	99	99
Sodium, Na	110	103	68	65	85	87
Magnesium	14	11	9.4	8.5	11	10
Alkalinity	180	258	167	190	179	176
Sulfates, SO_4	84	1	55	-	43	65
Chlorides,Cl	224	210	143	132	165	163
Flourides	-	-	-	-	0.16	0.14
<u>Urban Runoff Characteristics</u>:						
Total Coliform TC #100 ml	64	<10	1900	TNTC	39000	5000
Fecal Coliform FC #100 ml	<4	<10	360	TNTC	1430	460
Fecal Steptocus FS #100 ml	10	10	230	49,000	70	150
Nitrate & Nitrate NO_2, NO_3	0.20	0.06	0.45	0.06	0.28	0.33
Residual Solids	697	686	503	485	563	586
Oil & Grease, O & G	1.4	1.0	<1	1.4	1	2
Lead, Pb ug/l	<20	<20	<20	<20	<20	<20
Chromium ug/l	<40	<20	<20	<20	<20	<20
	<u>W.L. 19.7</u>: 15 minute sample. Suction line 15' deep spring	<u>W.L. 12.0+</u>: After Rain-fall event grab.1 gal. dye pumped in 4:15 PM	<u>W.L.</u>: Almost above marker,1.5 hrs composite 7-15 minute aliquots turbid	<u>W.L.</u>: Water Clear 15 minute grab	<u>W.L.</u>: 2 hr. composite	

the lowest nitrogen level observed, so there is variability in the stormwater constituents perhaps in the make-up of antecedent conditions.

Alaska Sink:

Of all the locations tested Alaska seems to have the most stable water quality due to the low interchange of aquifer water into the sink.

The pH varied only about 0.1 from the first sample over the seven samples taken. Temperature and oil and grease rose and fell over the rainy season. Calcium, sodium, magnesium, alkalinity, and residual solids were essentially unchanged over the seven samples.

Sulfates seemed to increase slightly while chlorides declined slightly. Bacteria, nitrate/nitrite, color and turbidity showed the largest swings probably in response to rainfall inflows.

This sink though hydraulically connected does not under normal head conditions have much inflow and thus turnover of water volume. Only a small amount of runoff from residential backyards contribute stormwater here so its effect on Sulphur Springs bacteria is negligible. A bacterial mass balance could confirm this hypothesis.

ALASKA SINK WATER QUALITY

General Water Quality	6/7/89 8:45 A.M.	7/19/90 2:45 P.M. 4:30 P.M.	9/19/89 12:15 P.M.	9/21/89 10:30 A.M. 12:00 P.M.	10/16/89 3:45 P.M.	10/18/89 10:45 P.M 12:45 P.M
pH	7.25	7.31	7.16	7.38	7.10	7.15
Color, Pt/Co	2	2	4	7	3	2
Turbidity NTU	2	2	5	5	5	4
Temp. C^{o}	24^{o}	26.5^{o}	22^{o}	24^{o}	24	24
<u>Aquifer Characteritics mg/l unless noted</u>:						
Calcium, Ca	109	109	98	110	110	114
Sodium, Na	19.0	19	19	19	19	19
Magnesium	5.5	6	5.8	5.9	6	6
Alkalinity	230	232	234	233	230	230
Sulfates, SO_4	49	51	50	51	52	53
Chlorides,Cl	32	32	33	31	31	30
Flourides	-	-	-	-	0.24	0.27
<u>Urban Runoff Characteristics</u>:						
Total Coliform TC #100 ml	232	400	260	6000	400	2000
Fecal Coliform FC #100 ml	124	168	240	6000	300	80
Fecal Steptocus FS #100 ml	100	-	180	-	260	1390
Nitrate & Nitrate NO_2, NO_3	1.91	1.97	2.33	2.23	2.25	1.51
Residual Solids	393	364	397	381	385	391
Oil & Grease, O & G	1.4	<1.0	<1	<1	<1	1
Lead, Pb ug/l	<20	<20	<20	<20	<20	<20
Chromium ug/l	<40	<20	<20	<20	<20	<20
	<u>W.L. 8.1 (est.)</u>: 15 min. sample. Suction line 28 ft. N.E. corner moved up	<u>W.L. 8.6</u>+: 1 hr 45 min. composite.		<u>W.L.:</u> 1.5 hr. composite 7-15 min. aliquots clear	<u>W.L.</u>: Water Clear, 15 min. grab.	<u>W.L.</u>: Water Clear, 2 hr. composite

Sulphur Springs Pool:

From the beginning of the rainy season to the end the following parameters increased at this location:

Increased	Those that decreased:
Color	
Temperature	
Calcium	
Sodium	pH
Magnesium	Alkalinity
Sulfates	Oil and Grease
Chlorides	
Residual Solids	

Those that were erratic were bacteria, turbidity and nitrogen. Lead and chromium were never in limits that were detectable and should not be considered further in other testing.

The flowrates for these test dates show the flow increasing through the rainy season as more rainwater raises water tables and adds flow to sinkholes which increase the hydraulic gradient and flow out of the mouth of Sulphur Springs.

In the last two tests when baselines were sampled the change from acceptable bacterial levels to unacceptable levels was accompanied by an increase in pH, color, turbidity, temperature and oil and grease. There was a decrease in calcium, sodium, magnesium, sulfates, chlorides, nitrogen and residual solids. The aquifer characteristics all tend to decrease which could be a direct result of dilution from sinkhole inflows. The water quality group increases could also be attributed to stormwater inputs. However the reason that nitrogen and residual solids decrease does not fit the scenario is unknown. There appears to be naturally occuring nitrogen in the system which is diluted by storm inputs.

SULPHUR SPRINGS POOL
LOCATION SUMMARY TABLE

General Water Quality	W.Q. 1 6/7/89	W.Q. 2 7/19/89	W.Q. 3 Baseline 9/19/89	W. Q. 3 Post 9/21/89	W.Q. 4 Baseline 10/16/89	W.Q. 4 Post 10/18/89
pH	7.26	7.25	7.33	7.38	7.16	7.33
Color Pt/C	6	11	7	8	13	15
Turbidity NTU	1	1	2	2	1	4
Temp. ^{o}C	24.0^{o}	26.0^{o}	22^{o}	24^{o}	25^{o}	25^{o}
Aquifer Characteristics mg/l unless noted:						
Calcium, Ca	118	127	125	121	130	123
Sodium, Na	192	280	260	260	280	270
Magnesium, Mg	22.5	32	33	32	33	32
Alkalinity	160	158	154	155	155	155
Sulfates, SO_4	140	185	170	169	176	169
Chlorides Cl	385	529	572	506	550	507
Flurides, F	---	---	---	---	0.21	0.24
<u>Urban Runoff Characteristics</u>:						
Total Coliform TC #100 ml	1400	2000	190	9000	1040	16000
Fecal Coliform FC/#100 ml	1000	1000	80	5000	110	4000
Fecal Strep, FS #100/ml	500	----	<10	----	<10	450
Nitrate & Nitrate NO_2, NO_3	0.52	0.22	0.91	0.86	0.78	0.38
Residual Solids	1040	1311	1406	1308	1350	1322
Oil & Grease,	2.4	<1	<1	1	<1	1
Lead, Pb ug/l	<20	<20	<20	<20	<20	<20
Chromium Cr, ug/l	<20	<20	<20	<20	<20	<20
<u>Comments</u>:	<u>W.L. 6.15</u> Dry First Stormwater go to pool 6/6 1.1 6/7 0.05 Being pumped by the Water Department	<u>W.L. 7.6</u> Beg Wet Rainfall Event Preceded 7/18 0.30 7/19 1.0 7/20 0.39 2 Hr. Comp.	<u>W.L. 7.5</u> Rainfall 9/18 0.11 9/19 0.85 Grab	Mid Wet Rainfall 1.5 hr. Comp.	End Wet No Rain Rainfall- 10/14 0.25 Grab	End Wet Rainfall 10/18 0.19 2 Hr. Comp.

XIV. RAINFALL VS. BACTERIA CORRELATION:

A great deal of effort in water quality/bacteria sampling has been performed at the pool over the years for a number of reasons. The Hillsborough County Health Department (HCHD) monitored the pool as a bathing place for human health protection. The City of Tampa Water Department monitored the pool as a source of drinking water. Hillsborough County Environmental Protection Commission (EPC) has monitored it in the past and presently to regulate water quality of the aquifer and surface water. Recently, the Southwest Florida Water Management District (SWFWMD) has taken quarterly water quality tests for water quality information.

When the pool was closed in June, 1986 by the HCHD it was suspected that the source of contamination was stormwater reporting into the upstream sinks. The City Stormwater Department performed dye tests (See Appendix L) to see if the upstream sinks could be a source of bacteria at the pool.

In January, 1988 Mr. Tom Cardinale of Hillsborough County Environmental Protection Commission prepared a summary of the previous 20 years of bacterial data on the pool and rainfall (See Appendix N). He was led to the conclusion that in an extraordinarily high number of cases rainfall preceded unswimmable bacteria levels at the pool. In fact, on the average 0.37 inches of rain falling on a given day would produce greater than 1000 ct/100 ml (unswimmable conditions) at the pool. And rainfall greater than 0.5 inches in the prior 24 to 48 hours would produce swimmable conditions. Virtually every bacteria spike at the pool could be correlated with rainfall events in the previous 3 days. See line Graph 4 Appendix N.

The Action League obtained water quality data from Mr. Jim Gianatasio of the Water Department for the years 1988 and 1989. As previously stated the Action League also obtained rainfall readings taken by Mr. Leon Berry at 8208 N. 13th Street for the year 1988 to present. See Appendix R. When these two pieces of information are compared there is an extremely high correlation.

For instance in Appendix O the City data and Sulphur Springs (Berry) rainfall are tabulated. Out of 324 total bacteria readings from January, 1988 through October, 1989 there were 89 (27.5%) of the samples that were unswimmable. Using a 3 - 4 day antecedent rainfall reading all but 7 of the unswimmable readings could be accounted for. This 7 out of 89 (7.9%) is probably a product of incompleteness of the rainfall data since Mr. Berry's rain gauge is about 1.25 miles from Orchid and Jasmine Sinks. Due to the localized nature of some rainfall events in our area it is quite possible that a heavy rain would fall north of Busch Blvd. and no reading be recorded at his residence (Bird and 13th Street).

The same logic holds true for all previous data wherein no rainfall was recorded at a particular locale yet a bacteria spike occurred at the pool. City of Tampa Rainfall Data from Seneca SRB Rain gauge from May 1986 to September, 1988 shows good correlation with the bacteria levels at the pool. Out of 504 bacteria readings 362 (72%) were swimmable. Using a 3 - 4 day antecedent rainfall reading 117 out of 142 (82%) bacteria spikes can be accounted for. Anomalies with the rain gauge readings could reduce this to 130 out of 142 or about 9%. This means the "mystery" spikes were only 8 - 9% over this period and as above are due to incompleteness of rainfall data. Further testing could completely put this issue to rest.

Mr. Cardinale was so impressed with the correlation that he was specific to rule out septic tanks and sanitary sewers as an alternate source of bacteria since these would produce constant bacteria readings but unswimmable bacteria spikes were intermittent with rainfall. EPC under Mr. Cardinale's direction has initiated daily sampling of the pool in order to get baseline data for proposed City of Tampa improvements at Orchid Sink. These daily readings when compared to Mr. Berry's rainfall readings (See Appendix R) show again a great correlation of rainfall to bacteria thus far in 1990. This coupled with dye trace and bacteria readings from these investigations make it clear that the source of bacterial contamination for the pool is stormwater related.

A 3 - 4 day antecedent condition is easily justified in the system due to the one day travel time from Jasmine/Orchid to Sulphur. Add to this the fact the stormwater can be seen standing in Orchid for well over a day and on one occasion for 3 consecutive days 9/22, 23, 24/89. In addition, the fact that rainfall could occur late one afternoon but would not be recorded until the next day which could easily add a 12 - 18 hour lag depending on time of daily rain gauge reading. For all these reasons a 3 - 4 day antecedent condition is reasonable in looking at rainfall/bacteria correlations.

Any "mystery" spikes can be isolated with very little further testing of Jasmine and Orchid sinks and the effect on the bacteria levels at the pool.

In a telephone conversation with Mr. Jim Gianatasio of the City of Tampa Water Department who has been in charge of water quality testing at the pool it was his observation that about 1 day after a rainfall event the pool bacteria levels elevate and that about 2 days after the rainfall event the bacteria have been flushed out of the system.

In terms of an acceptable indicator for bacteria and what it means to human health, the current prevailing standard is 1000 cts/100 ml of Total Coliform. This is the standard in force today per the DHRS Health Department. Some say that fecal coliform is a better indicator of a potential human health threat since these originate in the intestinal tract of warm blooded animals.

In a telephone conversation with Mr. Mike Leonard, USEPA Water Quality, Atlanta, GA (404) 347-2913, it was indicated that EPA views 1000 cts/100 ml of Total Coliform or 200 cts/100 ml of Fecal Coliform as a potential health threat in bathing waters. EPA has been considering using E. Coli as a standard but to date has not made regulatory changes. Thus far total coliform has been the prevailing standard. However, fecal coliform may be a more desirable standard for human health considerations and the new standard of E. Coli may warrant experimental testing at Sulphur Springs.

XI. ALASKA (TENTH STREET) SINK CLEAN-UP EFFORTS:

In 1987 the SSAL became aware of debris that was present in the Alaska Sink and performed a cleaning of the sink using scuba divers and a tow truck winch to hoist debris (See Appendix S for press clipping). As much cleaning as possible was done without jeopardizing the safety of the divers.

In 1988 the SSAL approached the Hillsborough River Basin Board for help to continue the clean-up effort at Alaska. The Basin Board subsequently approved funds for the outfitting of divers in protective gear and for crane and pump rental to further the clean-up (see Appendix U for agreement).

In August 1988, FDER gave approval for work in the sinkhole without permit. On December 31, 1988 divers entered Alaska to survey the sink for the impending clean-up using a crane with a clam-shell bucket.

On January 14, and February 11 and 12, 1989, dye tests were performed as mentioned earlier with the assistance of specially equipped divers and microphones to coordinate dye release.

On March 6 and 7, 1989, the crane was on-site to remove debris and silt to a roll-off dumpster provided by Waste Management. On March 9, 1989 after allowing time for the water to clear up from the disturbance, the divers again entered the sink to assess the effects of the clean out.

In this dive, the area of inflow from the aquifer was located in the Northwest corner of the base of the sink. This was the location from which subsequent water quality testing was performed at a depth of 28 ft. below water surface.

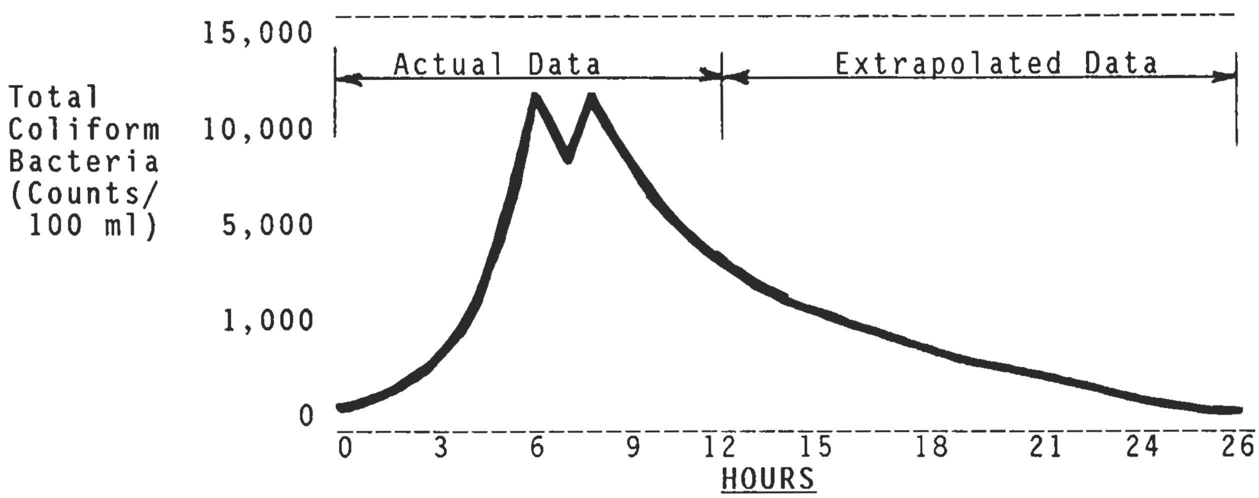
Starting on April 8, 1898 a diaphragm pump was used to remove solids and trash from the sink for a period of several days. About 25 cubic yards of material was removed.

On September 17, 1989 the divers again explored the sink to assess the status of cleanliness and aquifer flow into the sink. In February 3, 10 and 17, 1990 divers removed more trash that had been dumped in by illegal dumpers. March 21 through 23 had the clam-shell bucket crane back on-site for further removal. On March 31, 1990 divers again explored the sink for status.

XVI. BACTERIAL MASS BALANCE CONSIDERATIONS:

In the Jasmine II test the data produced the changing bacteria levels at the Sulphur Springs pool and two peaks were seen. An attempt was made to quantify the total coliform load that passed out of Sulphur Springs pool during the event. During the test there was noted to be 2 feet of standing water in Orchid Sink. If the bacterial output at Sulphur Springs approximated the dye trace curve established by the City of Tampa Stormwater Department test in 1987, then the duration was 26 hours with a peak at six (6) hours. So taking the Jasmine II test bacteria data and extrapolating it to fit the Orchid dye test curve we would have the following curve:

JASMINE II
Sulphur Springs Pool Total Coliform Counts



The flowrate at the pool was about 40 cfs for the duration of the test. 100 ml can be converted to cubic feet (cf) by multipying by 283.5.

Sulphur Springs Output Data:

Integrating under the curve for a composite total value the curve is broken into four segments:

0-3 Hrs: Avg. 400 cts x 3 Hrs (3600)(40)(283.5) = 0.49×10^{11} cts

3-9 Hrs: Avg.7,500 cts x 6 Hrs (3600)(40)(283.5) = 18.37×10^{11} cts

9-18 Hrs: Avg. 3,000 cts x 9 Hrs (3600)(40)(283.5) = 11.02×10^{11} cts

18-26 Hrs: Avg. 600 cts x 8 Hrs (3600)(40)(283.5) = 1.96×10^{11} cts

Storm Event Total = 31.84×10^{11} cts

Orchid Bacteria Input:

At 2.0 ft. deep the sink has a surface area of about 4,675 sf. x 2.0 ft. = 9,350 cf. EPC had previously tested raw stormwater flows and reported values of 57,000 and 87,000 cts (See Appendix T) for Total Coliform in Orchid Sink:

9,350 cf. x 73,000 cts avg. x 283.5 = 1.93 x 10^{11} cts

Jasmine Bacteria Input:

The City of Tampa reports the drainage basin for Orchid to be 130 Acres and for Jasmine 63 acres.

Using this ratio and assuming the storm loads to be roughly equal, we can estimate the bacteria load for Jasmine.

$$\frac{63}{130} \times 1.93 \times 10^{11} \text{ cts-cf} = 0.94 \times 10^{11} \text{ cts}$$

Adding Orchid and Jasmine together yields 2.87 x 10^{11} cts.

Comparing this to the estimated load at Sulphur Springs we find we are only off by a factor of 10. This is a very simple calculation and based upon a one time observation of the water level at Orchid. More water would have flowed through Orchid than that which was seen standing. To come within one order of magnitude with such a simple analysis seems very encouraging.

To put this in perspective 9,350 cf + 63/130 more for Jasmine equals 4,531 cf for a total of 13,881 cf or 103,830 gals. To produce the bacteria mass that was seen at Sulphur Springs 10 x this amount of water or 1,038,300 gals of bacteria laden stormwater would have been required. This is a great deal of water, but it is not a great deal of stormwater.

This method of quantifying the bacteria load at Sulphur Springs has a great deal of merit and has been overlooked by investigators previously. It points out that a large amount of heavily bacteria laden water is required to contaminate the substantial flow exiting Sulphur Springs (40 cfs = 25.8 mgd).

In his 1987 study titled "Micro Organisms in Urban Springs and Sinkholes" Dr. C.I. Noss of U.S.F. concluded that Orchid sink was within bacteria longevity at 26 hours and that they could reach the pool without great change in character, see Appendix M. It was recommended by this report that the Jasmine water quality and travel time be evaluated. This report has done so and has found only a 2.0 hour travel time difference between Orchid and Jasmine. Further, a modeling tool for travel time has been found that yields surprisingly accurate results with little field data needed.

The moist, warm, dark and nutrient laden environment of the underground stream would be conducive to supporting bacterial longevity and the conclusion of the cited study was that they can survive the trip to Sulphur Springs.

There have been questions raised about the possibility of septic tank leachate being a possible source of the pool's contamination. The number of rainfall events which precede bacterial spikes is about 92% for 1988 and 1989. This leaves an 8% mystery factor which is believed in this report to be due to incomplete rainfall data.

However, if septic tank leachate were the cause of some contamination it would seem logical that it would be at its highest during the rainy season when the water table is at its highest and the hydraulic gradient the greatest to force bacteria down into the aquifer. Or conversely, it may be when the water table is at its lowest and bacterial concentration from septic tank leachate is the highest. A review of September/October (S.H.W.L.) and April/May (S.L.W.L.) for 1988 and 1989 in the City Water Quality data for Sulphur Springs (see Appendix O) shows only 2 bacterial spikes at the pool not correlated with rainfall in the two (2) years for the dry season and none for the wet season. Therefore, the likelihood that septic tanks play a role in the Sulphur Springs Pool problem is remote.

Consider also that only a limited area of North Tampa is not currently served by sanitary sewers. And based on the mass balance relationship a whole bunch of septic tanks would have to be sitting on a fissure to limerock and be directly channeled to the aquifer. The more likely fate of septic tank bacteria is to die off in the slow moving surficial aquifer or be filtered out in the unconsolidated sand/clay matrix. The study of Dr. Noss did not report that septic tanks were a realistic potential source of contamination.

In turn, leakage from sanitary sewers has been implicated as a potential source of the pool contamination. However, the typical sanitary sewer line in this area probably spends most of its life underwater, in that it is submerged by the surficial water table. Therefore, any leaks would result in infiltration as opposed to exfiltration where bacteria laden water could escape. If there was significant wastewater escaping and flowing into the aquifer quickly then it would seem that a flow of water would take with it silt and sands which would create voids and eventually undermine the pipe and ultimately the roadbed. It should be noted that due to the nature of domestic wastewater (i.e. solids, particles and grease) it would not flow readily through sands, but would tend to blind over voids and seal up. However, if it were to happen it would seem likely that it would result in a constant feed of bacteria to the aquifer and the data shows that there is not a constant problem.

The City of Tampa used television monitoring equipment and surveyed a 48" trunk sewer that lies within 100 ft. of the pool. A review of that tape reveals that some cracks exist, but that infiltration is occurring and not exfiltration. Hydraulically, if an interconnection was made between the aquifer and a sewer pipe in the pool vicinity, the aquifer flow would fill the sewer pipe.

More work on the bacterial mass balance as a means of quantifying the contribution of Jasmine and Orchid as the source of pool contamination needs to be done. However, this simple analysis at first prospect gives great hope for further exactitude.

XVII. DISCUSSION OF CURRENT EVENTS:

There are many other concurrent events taking place which affect the North Tampa Sulphur Springs Aquifer System and the natural resource we all wish to protect.

Currently the City of Tampa Stormwater Department has under construction the Curiosity Creek F-100 Drainage Basin between 109th Avenue and Country Club west of Florida Avenue. This area was once known to up- take a great deal of the flow of Curiosity Creek. Since the trend has been for siltation and man-made debris to seal off the sinks there has been less water flowing directly to the aquifer system. This area tends to stabilize a about water level 22.0 ft. which indicates some recharge may be going on through surficial sands and clays. The Action League had inquired of the potential for adverse water quality impacts on the aquifer by the construction, but was assured there would be none, see Appendix Q.

A search was made for the famous Blue Sink that so many Tampa residents remember historically. Two (2) sinks were considered to be the most likely candidates. However, in the process a couple of wet sinks were found behind Roger Whitley near Curiosity Sink which may afford locations for future dye and hydraulic travel time tests.

In addition, the Curiosity Sink behind 11513 N. Ravine Drive which was the location of water testing in this report has the potential for dye trace use. It will be explored to see if the mouth of the small spring might allow for dye introduction or if under elevated head conditions it may reverse and change from a spring to a syphon.

Appendix A which is a map for the original 1958 dye test has been updated to show other sinkholes that were documented on old FDOT drawings. Also stormwater retention basins that have been added between 1965 and 1985 are shown. The arc from Curiosity to Jasmine to Orchid to Alaska to Sulphur is evident. The straight path from Curiosity to Blue to Sulphur is also evident by sink alignment. This helps explain the 40 hour versus 47 hour travel times from 1958 to 1989 tests.

The City has no current plans for any water quality related improvements at Jasmine Sink. A small dry basin was installed to receive some street runoff prior to inflow to the sink. However, it had the undesirable effect of being mistaken for a dry retention pond by a City truck which discharged contaminated flow to the sink. Security at this and Orchid Sink needs to be increased so that it cannot become a target for the "midnight dumper' who might subsequently foul the aquifer.

At Orchid in April of 1989 the Sulphur Springs Action League (SSAL) sponsored a sink hole clean-up and removed more than 25 cubic yards of debris, trash, waste drums, tires, boards, bicycle parts, you name it. Waste Management supported the effort with a roll-off dumpster.

The Florida Department Of Transportation (FDOT), in conjunction with the City of Tampa has for the last year and one-half been preparing a purchase land adjacent to Orchid Sink which will facilitate the construction of a stormwater detention basin. The project will be funded by FDOT for land purchase and engineering design. The City will construct the project with $100,000 of its own funds and up to $40,000 of fund from the Hillsborough County Pollution Recovery Trust Fund. This project will address the 48" RCP pipe flowing from the north and State road right-of-way. It will not affect the stormwater flow from the City of Tampa 36" RCP line from the east (See Location Map).

Appendix E. The City intends to monitor the effect on water quality of this filtering basin prior to doing anything on its own facilities. Construction is scheduled for the latter part of 1990, but the evaluation period has not been specified.

Alaska Sink, as has been described, was the subject of a major clean-up effort by the SSAL. Using divers, pumps, clams-shell bucket cranes, filtration and waste dumpsters, over 140 cubic yards of debris was removed. The circulation and clarity of the sinkhole has increased. The SSAL intends to work to keep this privately owned aquifer window from being a future target for dumping.

The City of Tampa Water Department is currently petitioning the Southwest Florida Water Management District (SWFWMD) to modify its consumptive use permit to allow more frequent pumping of the pool for drinking water purposes. The long term strategy of the City is to utilize the pool more for a drinking water source.

The Sulphur Springs pool has been closed for swimming since June of 1986. As we approach the fifth summer of not being able to utilize this historic and vital natural resource the Action League has taken steps to try to breath new life into the facility in the following ways.

Since no recreational activities are taking place in the facility at all, the Parks and Recreation Department was approached with a report on proposed uses for the pool grounds, bathhouse, gazebo and riverfront park.

As Resolution 88-647 states the Action League has sought and continues to seek methods and plans to revitalize and refurbish the pool use. The plan presented has two scenarios, one without the use of swimming at the pool and lagoon and one with limited recreational swimming.

Toward the use of swimming at the pool on a limited basis the Action League approached Dr. Kwalick, Director of the Hillsborough County Health Department to see if a Management Plan could be developed based upon the predictability of bacteria spikes.

Such a plan would utilize the pool for swimming when bacteria levels are safe and would call for closing when Total Coliform counts over 1,000 might jeopardize public health. Out of the 324 samples taken by the City Water Department in 1988 and 1989 the pool was safe for swimming in 72% of the days tested. Further refinements in the travel times and flushing times would allow for substantial periods of swimming in the December to May time frame. This plan is being written at present for presentation to the City and Health Department for their review and comment.

It seems that due to the nature of the stormwater contamination of the Sulphur Springs pool that a two pronged strategy would be the most effective. In the short term, utilize the facility as much as practical through a Management Plan or similar device. Then for the long term plan to modify the stormwater systems that have been definitely shown to contaminate the Sulphur Springs Pool.

XVIII. <u>CONCLUSIONS</u>:

* The Curiosity Water Quality data indicates that an aquifer window has been located and that the water quality is high with little bacterial contamination. Nitrogen in the system is unexplained at present since it did not respond as runoff related.

* The Jasmine (Poinsettia) Water Quality data, though not entirely consistent for bacteria, indicated water of a slightly increased contaminant load. The dye trace interconnection with Sulphur Springs was proven. Though previously suspected it was finally documented and is now without doubt. Its travel time of 22 hours is within the survival rate of coliform bacteria. The stormwater inflow to Jasmine is substantial.

* Orchid Sink water levels and observations during these tests provided data which point to a well defined progression of flow from this major sink to Sulphur Springs. The stormwater inflow to Orchid is greater than that of Jasmine.

* Alaska (10th Street) Sink was positively shown to be interconnected hydraulically though drawdown tests and by dye trace tests. The Water Quality data was the most consistent by location of all points. This sink has less interchange of flow under normal head conditions, but the water level can be manipulated.

* Sulphur Springs pool has new water quality data heretofore unavailable which show the reaction of the spring to upstream stormwater inputs. The change of aquifer characteristics though not conclusive suggest some water quality trends which bear further investigation.

* In Jasmine II a dual Total Coliform spike was detected with two peaks, two hours apart in response to a storm event at Jasmine and Orchid Sinks. This is the first conclusive evidence that stormwater and pool bacteria levels are undoubtedly related.

* Water quality data for the aquifer system shows some inconclusive, but substantive trends from Curosity to Jasmine to Sulphur. It is believed upon further investigation a non-bacterial indicator or series of indicators may be possible for detection of bacterial onslaught without having to wait 24 hours for normal bacterial detection testing.

* The simple Manning equation for water flow in a conduit proved to be an accurate tool for the prediction of travel times in the aquifer system. With more precision as to water levels and their duration in upstream sinks it is believed travel times could be predicted to within less than an hours time accuracy.

* To put the above conclusion in the form of a challenge: we believe that travel times from Jasmine, Orchid and Alaska Sinks can be predicted to within 2 hours accuracy at this stage of investigation. State a time and pick a color (only red and green available presently) that Sulphur Springs should be colorized and we will make the arrangements.

* The Bacterial Mass balance approach is a simple quantification procedure which may yield very conclusive evidence as to the stormwater contamination origins of the pool.

* As indicated in previous research we believe all bacterial spikes can be accounted for by antecedent rainfall events of up to

three to four days duration. The "mystery spikes" are due to incomplete rainfall records in that there are not rainfall gauges being read in the immediate vicinity of Jasmine and Orchid.

* The evidence does not support the leachate of septic tanks or the leakage of sanitary sewers as a serious threat to swimmable waters at Sulphur Springs pool.

* Stormwater, stormwater, stormwater and finally stormwater is the source of at least 92% of the bacterial spikes based on present information. We believe with easily accessed further testing this source will be found to account for 100% of bacterial spikes less of course, any man-induced mischievous or illegal dumping.

XIX. <u>RECOMMENDATIONS</u>:

* Install water level stage recorders with continuous strip charts in Jasmine and Orchid Sinks. Connect these devices via phone line to the Sulphur Springs bathhouse. Analyze the relative water level readings from Jasmine and Orchid to Sulphur to fine tune understanding of travel times and concentrated peak arrivals.

* Supplement this with rainfall readings in the vicinity of Jasmine and Orchid. SSAL has rain gauges for this purpose and is attempting to locate suitable stations. Correlate rainfall data to water level readings in sinks for stormwater runoff quantification.

* Take storm event bacteria readings at sinks and at Sulphur Springs. Use Mass Balance calculations to determine exact sources of aquifer system contamination.

* Perform further dye trace tests to refine the understanding of the system and travel times. Attempt to use dye dilution and concentration analysis.

* Verify in this manner that no spikes exist which cannot be accounted for by Jasmine, Orchid or other stormwater inputs. If other spikes occur look for further stormwater inputs first, then other potential sources. Utilize travel times to pinpoint potential sources.

* Check the percolation rate and bacterial counts of other large stormwater retention basins in the area. If rates appear significant institute dye tests and travel time analysis to Sulphur Springs.

* Test other non-bacterial indicators such as color, temperature, calcium, sodium, magnesium, sulfates, chlorides, residual solids, nitrates and nitrites for use as chemical indicators of changing bacteria levels at the pool. Future testing should include conductivity.

* Perform further dye tests on Curiosity Sink and other nearby sinks to see current travel times to Sulphur Springs. Try to establish the interrelation and water quality effect of stormwater inflows in this area and water quality in the aquifer.

* Institute a Management Plan for the short term (0-1 yr) to allow swimming at Sulphur Springs Pool when safe swimming conditions are present.

* Develop long term (1-5 years) modification plans to rehabilitate stormwater systems known to cause contamination of the aquifer and Sulphur Springs Pool.

ACKNOWLEDGEMENT

We wish to thank the participation of the following people in this study without whom it would not have been possible:

Tom Cardinale, HCEPC, Lab Services

Greg Jones, SWFWMD, Project Manager

Mike Burwell, COT Stormwater, Access, Advice & Flourometer

Mike Grant, COT Recreation, Access to the pool

Frederica Russell, SSAL, Water Sampling

Rob Wallace, SSAL, EEC Volunteer, Water Sampling and Report Writer

Rafael Perez, EEC Volunteer, Water Sampling

John Burkart, EEC Volunteer, Water Sampling

Tammy Dennis-Burkart, EEC Volunteer, Water Sampling

Norma J. DeGennaro, EEC Volunteer, Report Processing

Lucy Pullara, EEC Volunteer, Report Processing

Dan Chesser, SSAL, Water Sampling

Barbara Chesser, SSAL, Water Sampling

Joe Stewart, Volunteer, USGS Retired, Water Sampling

John Miller, CH_2M-Hill Volunteer, Water Sampling

Marty Clasen, CH_2M-Hill Volunteer, Water Sampling

Amy Ayers, Volunteer, Water Sampling

Jo Rader, SSAL Volunteer, Water Sampling

Dexter Huc, Volunteer, Diver

Darwin Breu, Volunteer, Diver

Jeff Volunteer, Diver Assistant

ACKNOWLEDGEMENT
(Continued)

Leon Berry, Resident, Rainfall Readings

Mr. Pless, Resident, Access to well

Minerva Bolin, Resident, Access to Alaska Sink

Ron Jeddon, Resident, Access to Curiosity Sink

Thomas Mealor, SSAL, Water Sampling

Waste Management, Roll-Off Dumpsters and Disposal

XXI LIST OF APPENDICES

A. North Tampa Map, in pocket

B. Jasmine I - Correspondence

C. Alaska II - City Memo To File, HCHD Sample Sheet

D. Jasmine II - Correspondence To/From City Of Tampa

E. Water Quality #1 - Dry Weather Laboratory Sheet, EPC/SSAL Correspondence and Location Maps

F. Water Quality #2 - Begin Wet Weather Laboratory Sheet

G. Water Quality #3 - Mid Wet Weather Laboratory Sheet

H. Water Quality #4 - End Wet Weather Laboratory Sheet

I. U.S.G.S. Flow Data Sulphur Springs Pool - Select Dates

J. 1958 City Of Tampa Water Department Dye Test - EPC Sketch

K. 1984 U.S.G.S. Hydrogeology Of Sulphur Spring Stewart/Mills Excerpts.

L. 1987 City Of Tampa Stormwater Department Orchid Dye Test Burwell

M. 1987 Dr. Noss "Microorganisms in Urban Springs and Sinkholes"

N. 1988 HCEPC 20 Year Analysis of Stormwater and Bacteria Pattern, Cardinale

O. City Of Tampa Water Quality Data 1988-1989 and Sulphur Springs Rainfall Readings.

P. 1990 HCEPC Bacteria Data and Sulphur Springs Rainfall Readings

Q. Curiosity Creek F-100 Detention Basin Correspondence and News Article

R. 1988/89/90 Rainfall Readings, Mr. Leon Berry; 8208 N. 13th Street

S. Alaska Sink Cleanup

T. Orchid Sink Stormwater Retrofit Plans

XXI LIST OF APPENDICES (Continued)

APPENDIX B

JASMINE I

CORRESPONDENCE TO / FROM CITY OF TAMPA

CITY OF TAMPA

Sandra W. Freedman, Mayor OFFICE OF ENVIRONMENTAL COORDINATION

Nancy McCann
Urban Environmental Coordinator

July 20, 1988

Ms. Frederica Russell
57 Hamilton Heath
Tampa, Florida 33604

Dear Mrs. Russell:

The City of Tampa is happy to cooperate with your efforts to monitor the water quality at the Sulphur Springs Pool in conjunction with the Alaska Sinkhole cleanup. As you know, the City takes samples from the pool several times per week. This data should also be useful in your study and is available upon request.

The City will not authorize, or in any way encourage, cave diving on City property. Your divers will be allowed access to the spring mouth for the purposes of taking water samples with the clear understanding that they are not to enter caves or spring conduits. Please contact me at 223-8071 a week or more before your divers require access to the spring. I will arrange access to the pool and will most likely require that the divers sign a notarized "hold harmless agreement" before diving.

Good luck with your funding request and clean-up efforts.

Sincerely,

Michelle Eads

for

Greig Grotecloss
Planning Research Analyst II

GG/me:28-23

City Hall Plaza, 5N • Tampa, Florida 33602 • (813)223-8071

Sulphur Springs Action League, Inc.
"The Springs......let's make it sparkle"

320 W. WATERS AVE.
TAMPA, FL. 33604

(813) 935-3115

January 9, 1989

Mr. Greig Grotecloss
Planning Research Analyst
City of Tampa
Office of Environmental Coordination
306 East Jackson Street
Tampa, FL 33602

Re: Sulphur Springs Water Quality Study

Dear Mr. Grotecloss:

I'd like to thank you and Mike Burnwell for meeting with me concerning the Sulphur Springs Action League's upcoming efforts in the above regard.

As we discussed you wanted to see a copy of the Hold Harmless Agreement we have been utilizing in our dealings with the Southwest Florida Water Management District. Please forward it on to your legal department for their review and comments.

Also, enclosed is a schedule we hope to maintain in doing some dye tests in order to attempt to further define travel times in the known upstream springs. I will outline what occur and usage we would ask the City to approve at each step.

<u>January 14, 1989</u>:

We will need access to the Sulphur Springs pool to watch for dye appearing after introduction at Alaska Spring. We may take water samples for fluorometer readings at the spillway catwalk.

<u>January 21, 1989</u>:

We will need access to Trinity Spring (Jasmine/Poinsettia) to introduce dye into it. We would prefer that our divers be able to submerge into the spring and introduce the dye at the siphon hole in the bottom. We would also like to observe the two monitoring wells at Trinity and the two at Orchid for the appearance of dye. This may help determine if your wells are in the aquifer flow path. Keys will be needed if they are locked. As with the Alaska dye test we will need access to Sulphur Springs to watch for dye and possible take water samples for fluorometer analysis.

January 28, 1989:

The Seneca retention pond has been seen to have a slight boil of water at its surface and it was known to have been an excavated sinkhole. We would like our divers to be able to submerge and explore the bottom to see if this point has an aquifer vent which might make it a likely future dye test site.

Any other assistance you might afford us would be appreciated, whether it be in man power or equipment. We were hoping the City Sewer Department's fluorometer might be made available to us, but at first pass it did not appear feasible.

We will provide the City with staff gauges for their installation at Orchid and Trinity. This will aid in establishing hydraulic head variations.

Thank you for your efforts to date and we solicit your continued cooperation in trying to understand the bacteria problem at the pool which precludes its reopening.

Sincerely,

SULPHUR SPRINGS ACTION LEAGUE

Robert E. Wallace

Robert E. Wallace III, P.E.

Enclosures

cc: Ronnie Mason, Councilman
Mike Burnwell, City of Tampa
Frederica Russell, SSAL
Greg Jones, SWFWMD
Tom Cardinale, EPC
Tom York, USGS

ALASKA SPRING
TIMETABLE

31 December 1988 - 9 00 a.m.

Divers to survey Alaska Apring
Place Markers for crane - location of debris & sensitive areas to avoid.
Notory present - Hold Harmless forms to be signed and placed on file with SWFWMD.

14 January 1989 - 8:00 a.m.

Alaska Spring dye test with Rhodamine Dye (red) to determine travel time from Alaska to Sulphur Springs Pool.
Watch at Sulphur Springs Pool.

21 January 1989

Trinity Spring (Poinsetta) dye test.
Check monitoring wells.
Alaska and Sulphur Springs watch.

22 January 1989

Alaska and Sulphur Springs watch.

28 January 1989

Exploration dive - Seneca Spring

February 1989

Crane Cleanup - removal of debris at Alaska Spring.

March 1989

Pump rental for removal of silt.

April 1989

Water sampling begins and continues until 1990.

EXHIBIT "B"

HOLD HARMLESS AGREEMENT

DATE: ________________

______________________________ shall forever protect, save and hold the Southwest Florida Water Management District harmless and indemnify the District against and from any and all claims, demands, losses, costs, damages, suits, judgments, penalties, expenses and liability of any kind or nature whatsoever arising directly or indirectly out of or in connection with any activities of the undersigned individual in conjunction with that certain agreement dated September 28, 1988 between the Sulphur Springs Action League, a not-for-profit corporation, and the Southwest Florida Water Management District. The undersigned individual further agrees to waive any and all claims of whatever nature which he/she may have against the Southwest Florida Water Management District arising out of the undersigned individual's activities in conjunction with that agreement.

Signed at ________________________, Florida, this ________ day of ____________________, __________.

BY: ________________________

____

STATE OF FLORIDA

COUNTY OF ______________________.

Before me personally appeared ______________________ to me known and to me known to be the person or persons described in and who executed the foregoing instrument, and acknowledged to and before me that ______________ executed said instrument for the purposes therein expressed.

WITNESS my hand and official seal this ___ day of ________ A. D., 19__.

____

NOTARY PUBLIC
STATE OF FLORIDA

My commission expires: ______________________

CITY OF TAMPA

Sandra W. Freedman, Mayor

Department of Sanitary Sewers

Jack P. Morriss, P.E.
Director

Mr. Robert Wallace
Sulphur Springs Action League
320 W. Waters Avenue
Tampa, Florida 33604

January 18, 1989

Subject: Dye Trace for Jasmine/Poinsettia Sinkhole

Dear Rob:

After last week's dye trace of the Alaska Sink/Sulphur Springs connection I felt several things could have been done differently to provide a more scientific test and provide us all with defensible data we could use in the future. I realize you were handicapped by the lack of a flourometer and the focus of the test was to be on a visual identification but, as performed, the test left much to be desired.

Since you plan to test City wells and dye a City-owned sink this week, I believe a few changes are necessary.

1) You can't rely on a visible concentration in a small sample from the well. During our Orchid investigation, visible concentrations in the spring were not visible in the samples we took, even fairly large ones. I have arranged for the use of the Sanitary Sewers flourometer to test these samples. We'll get together to arrange for their analysis.

2) A sample of the dye must be kept to calibrate the flourometer.

3) Control samples must be taken from all sample locations prior to the introduction of the dye.

4) All possible sample points must be identified before the test and a sampling schedule arranged for each. For those locations where the dye is not really expected, a less-frequent sampling schedule might be appropriate. For our Orchid test we had nine locations; the dye only showed up at one but by sampling them all we could positively rule the others out.

5) Sampling must continue around the clock for at least two days. Access to the pool and sinks can be arranged.

I believe with these changes we can have a test which will yield results we can be proud of. If you have any questions, please feel free to call me at 223-8736. I look forward to working with you this weekend.

Michael J. Burwell
STORMWATER MANAGEMENT DIVISION
DEPARTMENT OF SANITARY SEWERS

cc: John Walker
Chip Hatcher
Jack Morriss

TIME SCHEDULE

Jasmine Springs (Trinity) to Sulphur Springs Dye Test

Time (hrs)	Jasmine	MW 1&2	Orchid	MW 1&2	Alaska	Sulphur
1	Observe	Sample	Observe	Sample	Observe	
2	Observe	Sample		Sample		
3	Observe			Sample		
4	Observe			Sample		
5				Sample		
6						
7					Observe	
8					Observe	
9					Observe	
10					Observe	
21					Observe	Obser/Samp
22					Observe	Obser/Samp
23					Observe	Obser/Samp
24					Observe	Obser/Samp
25					Observe	Obser/Samp
26					Observe	Obser/Samp
27					Observe	Obser/Samp
28					Observe	Obser/Samp
29					Observe	Obser/Samp
30					Observe	Obser/Samp

JASMINE/SULPHUR

DYE TEST

Wells to be developed with 2" centrifugal pump prior to sampling/observation. Well samples to be with Peristaltic pump on intervals prescribed. 1,000 ml sample bottle.

Water samples to be taken in 1,000 ml sample bottles.

All samples to be preserved in cool area without sunlight or direct light.

Divers to enter Jasmine from west side. Dye to be placed on the north side entrance.

HOLD HARMLESS AGREEMENT

WHEREAS, Dexter Hue, hereinafter referred to as "DIVER", desires to enter upon that certain premises owned or controlled by the City of Tampa commonly referred to as "Sulphur Springs", including all interconnected sinkholes, hereinafter collectively referred to as "Sulphur Springs", for the purpose of conducting dye tests and water quality studies; and

WHEREAS, DIVER acknowledges that such activities may be inherently dangerous and it is his/her intention by executing this Agreement to assume all risks, whether known or unknown, which may arise from such activities.

NOW, THEREFORE,

DIVER, in consideration of allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies, does hereby agree as follows:

1. That DIVER, his heirs, assigns, and successors in interest, waive, renounce, relinquish, absolve and discharge the City of Tampa from any and all liability for personal injury, death and/or property damage which may result from allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies, even if allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies is later found to be wrongful or negligent.

2. That DIVER shall defend, hold harmless and indemnify the City of Tampa from and against all liability, loss, claims, damages, costs, attorneys' fees and expenses of whatever kind or nature which the City of Tampa may sustain, suffer, or incur, or be required to pay by reason of allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies even if allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies is later found to be wrongful or negligent.

3. That DIVER shall wear a protective dive suit at all times DIVER enters upon Sulphur Springs for the aforesaid purpose.

Signed, sealed and delivered in the presence of:

Frederica Russell
WITNESS

Robert K. Wall
WITNESS

Dexter Hue
DIVER

DATE: 5/9/89

STATE OF FLORIDA :
: ss.
COUNTY OF HILLSBOROUGH :

BEFORE ME personally appeared Dexter Hue to me well known and known to me to be the person described in and who executed the foregoing instrument and acknowledged to and before me that he/~~she~~ executed said instrument for the purpose therein expressed.

WITNESS my hand and official seal this 9th day of May, 1989.

NOTARY PUBLIC
State of Florida

Notary Public, State of Florida
My Commission Expires Feb. 26, 1992
Bonded Thru Troy Fain - Insurance Inc.

This instrument prepared and approved by:

SAMUEL S. HAMILTON
ASSISTANT CITY ATTORNEY

HOLD HARMLESS AGREEMENT

WHEREAS, Darwin Breu, hereinafter referred to as "DIVER", desires to enter upon that certain premises owned or controlled by the City of Tampa commonly referred to as "Sulphur Springs", including all interconnected sinkholes, hereinafter collectively referred to as "Sulphur Springs", for the purpose of conducting dye tests and water quality studies; and

WHEREAS, DIVER acknowledges that such activities may be inherently dangerous and it is his/her intention by executing this Agreement to assume all risks, whether known or unknown, which may arise from such activities.

NOW, THEREFORE,

DIVER, in consideration of allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies, does hereby agree as follows:

1. That DIVER, his heirs, assigns, and successors in interest, waive, renounce, relinquish, absolve and discharge the City of Tampa from any and all liability for personal injury, death and/or property damage which may result from allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies, even if allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies is later found to be wrongful or negligent.

2. That DIVER shall defend, hold harmless and indemnify the City of Tampa from and against all liability, loss, claims, damages, costs, attorneys' fees and expenses of whatever kind or nature which the City of Tampa may sustain, suffer, or incur, or be required to pay by reason of allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies even if allowing DIVER to enter upon Sulphur Springs for the purpose of conducting dye tests and water quality studies is later found to be wrongful or negligent.

3. That DIVER shall wear a protective dive suit at all times DIVER enters upon Sulphur Springs for the aforesaid purpose.

Signed, sealed and delivered in the presence of:

Patricia Russell
WITNESS

Robert C. Wallen
WITNESS

Darwin Breu
DIVER

5/9/89
DATE:

STATE OF FLORIDA :
: ss.
COUNTY OF HILLSBOROUGH :

BEFORE ME personally appeared Darwin Breu to me well known and known to me to be the person described in and who executed the foregoing instrument and acknowledged to and before me that he/~~she~~ executed said instrument for the purpose therein expressed.

WITNESS my hand and official seal, this 9th day of MAY, 1989.

NOTARY PUBLIC,
State of Florida

Notary Public, State of Florida
My Commission Expires Feb. 28, 1992
Bonded Thru Troy Fain - Insurance Inc

This instrument prepared and approved by:

SAMUEL S. HAMILTON
ASSISTANT CITY ATTORNEY

APPENDIX C

ALASKA II DYE TEST

CITY MEMO TO FILE ON CONNECTION TO SULPHUR SPRINGS - 1988

SURVEY MAP

HILLSBOROUGH COUNTY HEALTH DEPARTMENT - BACTI TEST FORM

10th St. Sink - Sulphur Springs Connection Inquiry
(Alaska)

The 10th St. Sink is a small (45'diameter, 25'deep) sinkhole located north of Waters Ave. between 10th and Alaska Streets in North Tampa. Sulphur Springs is a large second magnitude spring located on the bank of the Hillsborough River west of Nebraska Avenue about 2100 feet SSW of the 10th st. Sink (see Fig.1) For some time a hydraulic connection had been suspected between the 10th St. Sink and Sulphur Springs. Dye placed in sinkholes north of both locations has appeared at the springs, but has never b detected in the sinkhole. However, reports of drop in the stage at the sink associated with drops in stage at the springs have long led investigators to believe in a connection. What had been lacking had been either a dye test or stage manipulation to verify this suspicion.

On January 9, 1988, divers were scheduled to reenter the privately owned 10th St. Sink to explore a lead which they believed would join a large subsurface conduit in the aquifer leading to Sulphur Springs. This excursion by the divers allowed the City the opportunity to monitor the drop of the sinkhole's stage by placing a staff gage in the sink and lowering the gates at Sulphur Springs. The divers had requested the drop in Sulphur Springs in order to ascertain the direction of flow from the sink (if any.)

At 1200 on Saturday January 9, 1988 a staff gage was installed in the sink and the stage noted. At 1250 one gate at Sulphur Spring was opened and the stage was dropped 3.57 feet where it stabilized by 1300. Within three minutes of beginning the stage drop, when the stage had decreased by less than a foot at the spring word was recieved from the sink that the stage had begun to fall the as well.

The record of drop is as follows:

Sulphur Springs

Time	Stage	Notes
1250	7.45	Actual datum (MSL), Gate opened
1300	3.57	Drop stabilized
1335	3.57	Gate closed
1340	7.40	

Tenth St. Sink

Time	Stage	Notes
1250	32.6	Elev. assumed, gate opened @ S.S.
1310	30.2	
1313	30.0	
1318	29.9	
1324	29.8	
1330	29.7	Gates at S.S. closed, stage still falling at 10th St.
1335	30.8	Test terminated

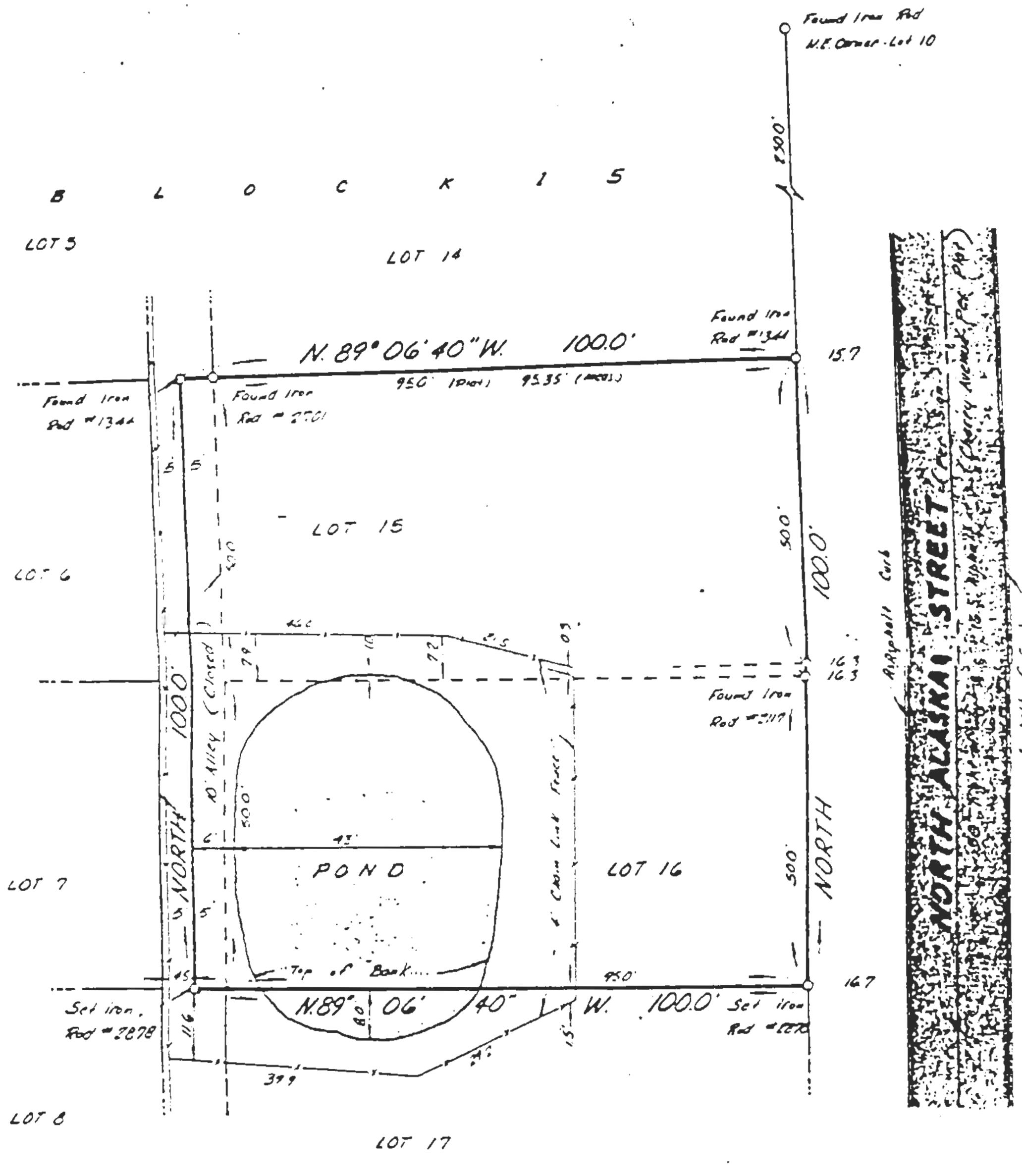
At 1330 the divers left the sink (not having penetrated the lead to its conclusion) and the test terminated. The gate at Sulphur Springs was closed and the sink stage stopped dropping immediately. Within five minutes the stage had risen by 1.1 feet and the staff gage was removed by the divers. The divers reported seeing a general flow in the direction of the crevice but were surprised by the volume which had left the sink.

CONCLUSION

Test proved a strong hydraulic connection between the sink and the spring. Actual determination of a physical connection between the two and travel time will have to wait for a dye test.

FILE: 10THDROP
DISK: TBM(RED)

SURVEY OF:
Lots 15 and 16, Block 15, SULPHUR SPRINGS ADDITION TO TAMPA FLORIDA, according to map or plat thereof as recorded in Plat Book 6, Page 5, public records of Hillsborough County, Florida, Together With the East 1/2 of the Closed Alley abutting on the West.



No underground installations or improvements have been located except as noted.
No instruments of record reflecting easements, rights-of-way, and or ownership were furnished this surveyor except as shown.

NOTE: NOT VALID UNLESS SEALED WITH EMBOSSED SURVEYOR'S SEAL

PREPARED FOR: Minerva Bollin

I hereby certify that the survey represented hereon meets the requirements of Chapter 21 HH-6, Florida Administrative Code.

Mark J Elbare
Date
Mark J Elbare
Florida Reg. No. 3105

BOUNDARY SURVEY

MORRIS LAND SURVEYING, INC.
601 Sunlake Blvd.
Lutz, Florida 33549
(813) 949-3636

SUB.: Sulphur Springs Add'n to Tampa, Fla		P.B.: 6	PG.: 5
SEC.: 19	TWP.: 28 South	RGE.: 19 East	
DATE OF FIELD SURVEY: April 23, 1987			
Party Chief: AB	Drawn By: PLS	Checked By: MJE	
Revision	Date	Drawn By	Checked By

State of Florida
Department of Health and Rehabilitative Services
Office of Laboratory Services
P.O. Box 210
Jacksonville, Florida 32231

FEB 1[illegible] [illegible] 89

DRINKING WATER BACTERIOLOGICAL ANALYSIS

SYSTEM NAME: Sulphur Springs SYSTEM I.D. NO.: N/A DER DISTRICT: SW

ADDRESS: City of Tampa COUNTY: Hills COLLECTOR: R. Perez

SAMPLE SITE (Locality or Subdivision): Tampa

RAW OR TREATED: Raw DATE AND TIME COLLECTED: 2/11/89

TYPE OF SUPPLY (Circle one): Community public water system Non-community public water system Other public water system Private well Swimming pool Bottled water

TYPE OF SAMPLE (Circle one): Compliance Recheck Main Clearance Well Survey Other (specify)

REMARKS:

42

TO BE COMPLETED BY COLLECTOR OF SAMPLE				TO BE COMPLETED BY LAB				
COLL. NO.	SAMPLE POINT	Cl RES'D	pH	SAMPLE NUMBER	NON COLIFORM (303)	COLIFORM MF/100 ML (303) TOTAL	COLIFORM MF/100 ML (303) FECAL	MPN 100 ML (305)
	T-0 ~~9:00 am~~ 9:30 am	—		[illegible]				
	T-1 10:30 am	—		[illegible]84				
	T-2 11:30 am	—		[illegible]				
	T-3 12:30 pm	—		[illegible]				
	T-4 1:30 pm	—		[illegible]				
	T-5 2:30 pm	—		[illegible]				
	T-6 3:30 pm	—		[illegible]				
	T-7 ~~4:30 pm~~	—		[illegible]				
	~~T-8~~							

SAMPLES ARE UNSATISFACTORY FOR TESTING. RECEIVED IN LABORATORY MORE THAN 30 HOURS AFTER COLLECTION.

INTERPRETATIONS-RECOMMENDATIONS BY DER OR HRS REVIEWER

( ) SATISFACTORY
( ) UNSATISFACTORY
( )
(X) RE-SUBMIT

NAME AND MAILING ADDRESS OF PERSON/FIRM TO RECEIVE REPORT

Tammy Dennis
% EEC
PO Box 7854
Tampa FL 23536

REVIEWING OFFICIAL: ER

TITLE: F[illegible] Environme[illegible]
Hillsborough County Health Dept.
Ph. 272-6310

HRS Form 655, Apr 83 (Replaces Feb 79 edition)

APPENDIX D

JASMINE II

CORRESPONDENCE TO / FROM / TO

CITY OF TAMPA

Sulphur Springs Action League

"The Springs - let's make it sparkle"

320 W. Waters Ave., Tampa, FL 33604
Phone: (813) 935-3115

March 17, 1989

Michael J. Burwell
Stormwater Management Division
Department of Sanitary Sewers
City of Tampa
6th Floor North
Tampa, FL 33602

Re: Sulphur Springs Pool Dye Test

Dear Mr. Burwell:

In accordance with our recent meeting I am writing to outline another dye test which will expand our knowledge of the Sulphur Springs sink-spring system.

We would propose to have divers deploy green dye in the Jasmine (Poinsettia) sink and lower the gates at Sulphur Springs to see the effect this increased head differential will have on travel time. The various travel times and head conditions so far established coupled with this test will aid in the prediction of travel times under storm conditions. Some of the future sampling will be done during the rainy season and we hope to as accurately as possible predict travel times.

As before we will take water samples from the shallow wells near Jasmine and Orchid, Sulphur Springs and Harbour House well. Since we have prior information we can reduce the number of samples generated to minimize the Sewer Department's fluorometer usage.

We will read water levels in the nearby sinks and retention ponds to see how the system responds over time with the Sulphur Springs gate down. The bacteria testing performed at the pool gate will also be repeated.

To summarize our request we will need access to Sulphur/Jasmine/Orchid, well keys, slide gate key, permission to dive in Jasmine and use of the fluorometer.

In other related matters we are preparing 3 stage rods; one for Alaska, one for Orchid and one for your discretionary use. We will deliver them shortly for installation. These will help keep all water levels on the same datum if surveyed by the City forces.

We would like to volunteer to probe and cleanup the Orchid Sink in the near future. The drier weather affords us the best opportunity. We can probe with a hand auger to determine the extent and depth of the sand layer. We could also perform particle sizing of these sands. This information may prove useful in future design work.

We hope you will look favorably on this request for another dye test. Your cooperation is appreciated.

Sincerely,

SULPHUR SPRINGS ACTION LEAGUE

Robert E. Wallace III

Robert E. Wallace III, P.E.

REW/dege

cc: Ronnie Mason, Councilman
Frederica Russell, SSAL

CITY OF TAMPA

Sandra W. Freedman, Mayor

Department of Sanitary Sewers

Jack P. Morriss, P.E.
Director

Sulphur Springs Action League
320 W. Waters Avenue
Tampa, Florida 33604

March 27, 1989

Attn: Robert Wallace

Subject: Additional Sulphur Springs Dye Tests

Dear Mr. Wallace:

We have received your latest request for assistance in additional dye tests for the Sulphur Springs area. We believe the test you propose may or may not actually increase our knowledge of the workings of the aquifer systems in the area. Earlier tests have established travel times for static conditions and if conditions of greater head differential should be tested, I believe it would be better to accomplish this during a natural, head-increasing event i.e. a heavy rainstorm. Artificially lowering the head at Sulphur Springs will only establish what happens to the aquifer when the head is artificially lowered at one point. This does not allow for other inputs into the system which may have a buffering effect on travel time. For this reason we believe a dye test as described in your request is unwarranted.

What progress has been made in analyzing the data you have already collected? Could we schedule a meeting to review your progress thus far? I would also like a copy of the bacteria data you've collected in conjunction with the dye tests and those stage records from the head-drop tests. I'll be beginning my analysis of the data soon and would appreciate your assistance.

Regarding the clean-up and boring of Orchid Sink - the sink will be cleaned as part of the construction of the treatment facility next fiscal year. We would be glad to furnish your group access if they would like to affect a clean-up prior to this summer. We would also be glad to provide access for you to perform borings to establish the depth of the sand layer and particle sizing of this layer. Please contact me when you've scheduled the work and I'll arrange to have the sink opened or provide you with a key.

I hope this answers your questions and I look forward to hearing from you.

STORMWATER MANAGEMENT DIVISION

Michael J. Burwell
Stormwater Planner

cc: John Walker
Chip Hatcher
Ralph Metcalf

CITY OF TAMPA

Sandra W. Freedman, Mayor

Department of Sanitary Sewers

Jack P. Morriss, P.E.
Director

RECEIVED
APR 07 1989
ENVIRONMENTAL ENGINEERING
CONSULTANTS, INC.

Sulphur Springs Action League
c/o
Mr. Robert Wallace
Environmental Engineering Consultants
[illegible] North Florida Avenue
Tampa, Florida [illegible]

April [illegible]

Subject: North Tampa Sinkholes

[illegible]
[illegible] discuss [illegible] during our meeting [illegible]
[illegible]

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible] in conjunction with [illegible] last year

[illegible] from Sulphur Springs [illegible] and should be hearing from the [illegible] also requested last year [illegible] of flow from the spring.

[illegible] your draft of the investigation [illegible] unconvinced of the desirability of the [illegible] will [illegible]

[illegible] activities currently planned.

Friday, April [illegible] - Auger Orchid Sink bottom and perform sieve analysis.
Saturday, April [illegible] - Tentative Orchid Sink cleanup date

Let me know if there is anything else I can do to help you with this investigation and please keep me posted on your activities.
Sincerely
STORMWATER MANAGEMENT DIVISION

[illegible]
[illegible]

[illegible] John Walker

Sulphur Springs Action League

"The Springs - let's make it sparkle"

320 W. Waters Ave., Tampa, FL 33604
Phone: (813) 935-3115

April 19, 1989

Mr. Michael J. Burwell
Stormwater Planner
Department of Sanitary Sewers
City Hall Plaza, 6th Floor
Tampa, FL 33602

Re: Sulphur Springs System

Dear Mr. Burwell:

Thank you for your letter of April 6, 1989 and the information transmitted therewith. I hope the data from USGS will come in shortly which will give us flow data on the dye test dates as well as weir flow data for Sulphur Springs with the gate or gates down. I can't really produce an thorough report without the flow data.

I am enclosing a schematic graph of the Sulphur Springs System in which I show known water levels and relative elevations. The generalized flow section for lack of a better term constitutes "the sponge" your words or "the channel" my words. The flow takes place at sufficient depths that even artificially lowering the level of Sulphur Springs Pool and inducing a gradient should tell us more about the flow characteristics of the system.

After the Alaska to Sulphur tests under two head conditions I came fairly close with only crude calculations in accounting for the travel time differences. Therefore I am anxious to predict and test the induced travel time based on the previous static Jasmine to Sulphur test.

We are only asking for access to Jasmine and Sulphur to place dye and record data. Mr. Greg Jones at the Southwest Florida Water Management District was able to procure a fluorometer for us from USGS so we won't have to impose on your time and equipment for fluorescein readings.

You are quite correct in stating that actual rainfall induced heads and multiple inputs would yield valuable data. We fully intend to perform those too. Our concern is to get the most accurate travel time data possible so our composite water quality tests will be representative. The best way to do this is to test the system under as many conditions as possible.

We thank you for your past cooperation and just ask you to indulge us for this test which I believe will be valuable. Your effort will be minimal in relation to what might be gained. Thanking you in advance for your cooperation, I am

Sincerely,

SULPHUR SPRINGS ACTION LEAGUE

Robert E. Wallace III

Robert E. Wallace III, P.E.

REW/dege

cc: Ronnie Mason, City Council
Greg Jones, SWFWMD
Frederika Russell, SSAL
Tom Cardinale, HCEPC

May 5, 1989
Telcon: Mike Burwell
Go Ahead!

APPENDIX E

WATER QUALITY TEST #1 DRY WEATHER

CORRESPONDENCE TO EPC FROM SSAL / SSAL FROM EPC

CURIOSITY SINK MAP

JASMINE SINK MAP

ORCHID SINK MAP

ALASKA SINK MAP

HCEPC LABORATORY RESULTS

Sulphur Springs Action League

"The Springs - let's make it sparkle"

320 W. Waters Ave., Tampa, FL 33604
Phone: (813) 935-3115

May 5, 1989

Mr. Thomas A. Cardinale
Hillsborough County
Environmental Protection Commission
1900 - 9th Avenue
Tampa, Florida 33605

Re: Water Quality Testing - Sulphur Springs Aquifer System

Dear Mr. Cardinale:

As we had discussed previously the Action League through partial funding by Southwest Florida Water Management District's Hillsborough River Basin Board, is conducting cleanup and testing of the aquifer system in the above regard. Toward that end, we will try to profile the water quality at four points in the system:

1. Curiosity Springs
2. Jasmine Spring/Sink
3. Alaska Spring/Sink
4. Sulphur Springs

These four points will be tested 4 times (1 dry weather/3 wet weather) for the following list of water quality parameters.

Total Dissolved Solids TDS	Oil & Grease (Petroleum)
Nitrates No^3	Sodium Na
Magnesium Mg	Chloride Cl
Calcium Cd	Sulphate SO_4
Lead Pb	Colon
Chromium Cr	Alkalinity
Fecal Coliform Fc	Conductivity
Fecal Streptococcus Fs	pH
Total Coliform	Temperature

I am writing to inquire if the Hillsborough County EPC laboratory could assist in performing these 16 water quality samples. The samples will be taken as close as possible to the aquifer flow and will be taken on a composite basis through the system after factoring travel times.

We hope this generates useful information by isolating the source of contamination which is keeping the Sulphur Springs pool closed. The initial dry weather test will be performed in late May or June, 1989 and the 3 wet weather tests will be performed in July, August and September, 1989.

Any assistance EPC could provide in the use of their analytical laboratory will be most appreciated.

Thank you for your past efforts on behalf of Sulphur Springs and your consideration of this request.

Sincerely,

SULPHUR SPRINGS ACTION LEAGUE

Robert E. Wallace III

Robert E. Wallace III

REW/lrp
cc: Sylvia Espinola, HRBB
Frederica Russell
Greg Jones, SWFWMD

ENVIRONMENTAL PROTECTION COMMISSION
HILLSBOROUGH COUNTY

ROGER P. STEWART
DIRECTOR

1900 - 9th AVE
TAMPA, FLORIDA 33605

TELEPHONE (813) 272-5960

May 10, 1989

Mr. Robert E. Wallace III
Sulphur Springs Action League
320 West Waters Avenue
Tampa, Florida 33604

Dear Mr. Wallace:

SUBJECT: WATER QUALITY TESTING

The Enviornmental Protection Commission (EPC) has carefully reviewed your request of May 5, 1989 for assistance in performing laboratory tests.

EPC is willing to perform all of the laboratory analysis on the 16 samples from the Sulphur Springs Aquifer System, free of charge. We will also provide bottles and technical advice if needed.

We support and welcome your efforts towards cleaning up the waters feeding the Sulphur Springs pool.

Sincerely,

Tom Cardinale

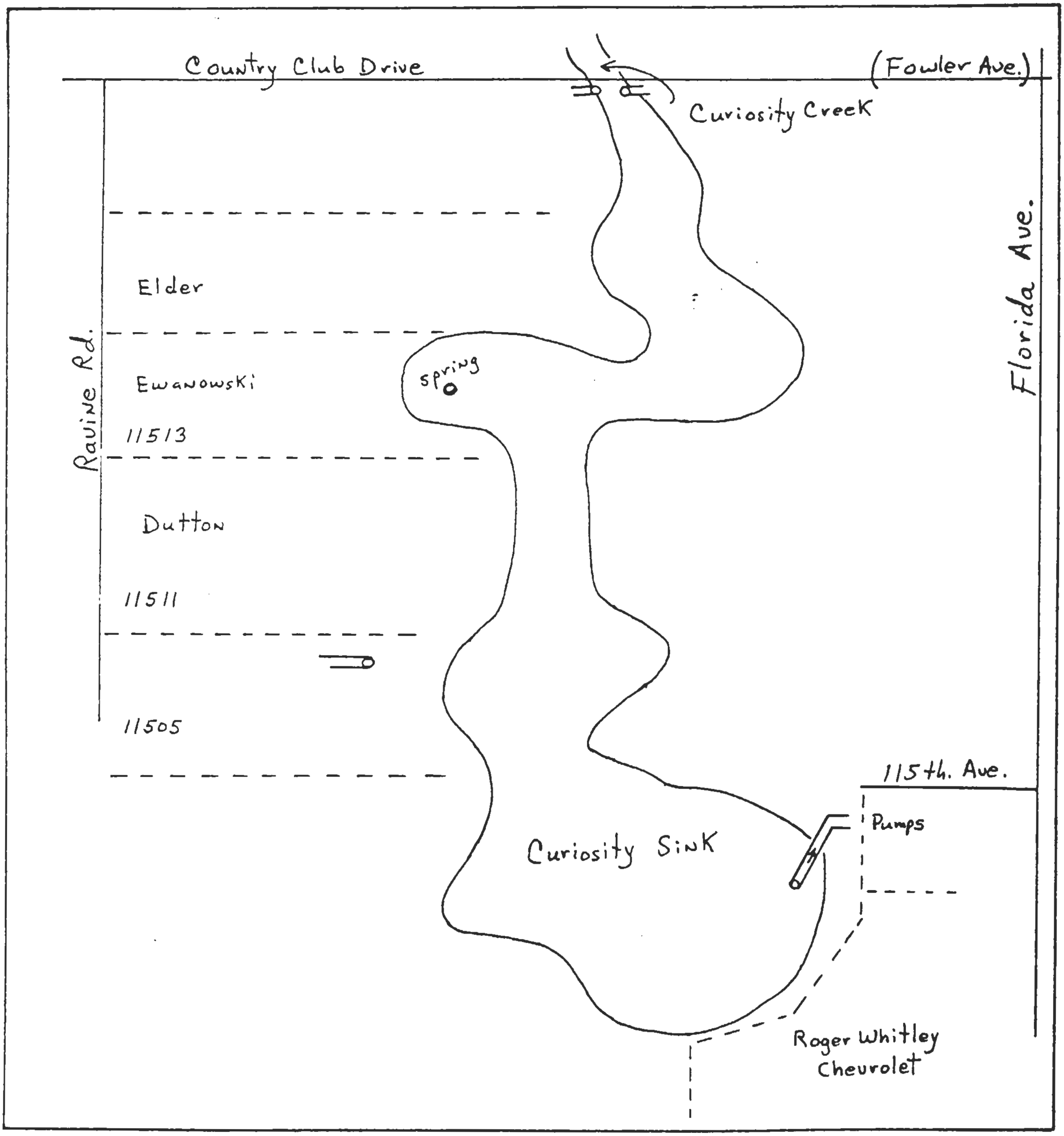
Tom Cardinale
Lab Manager

lw

(L.387)

HILLSBOROUGH COUNTY
ENVIRONMENTAL PROTECTION COMMISSION

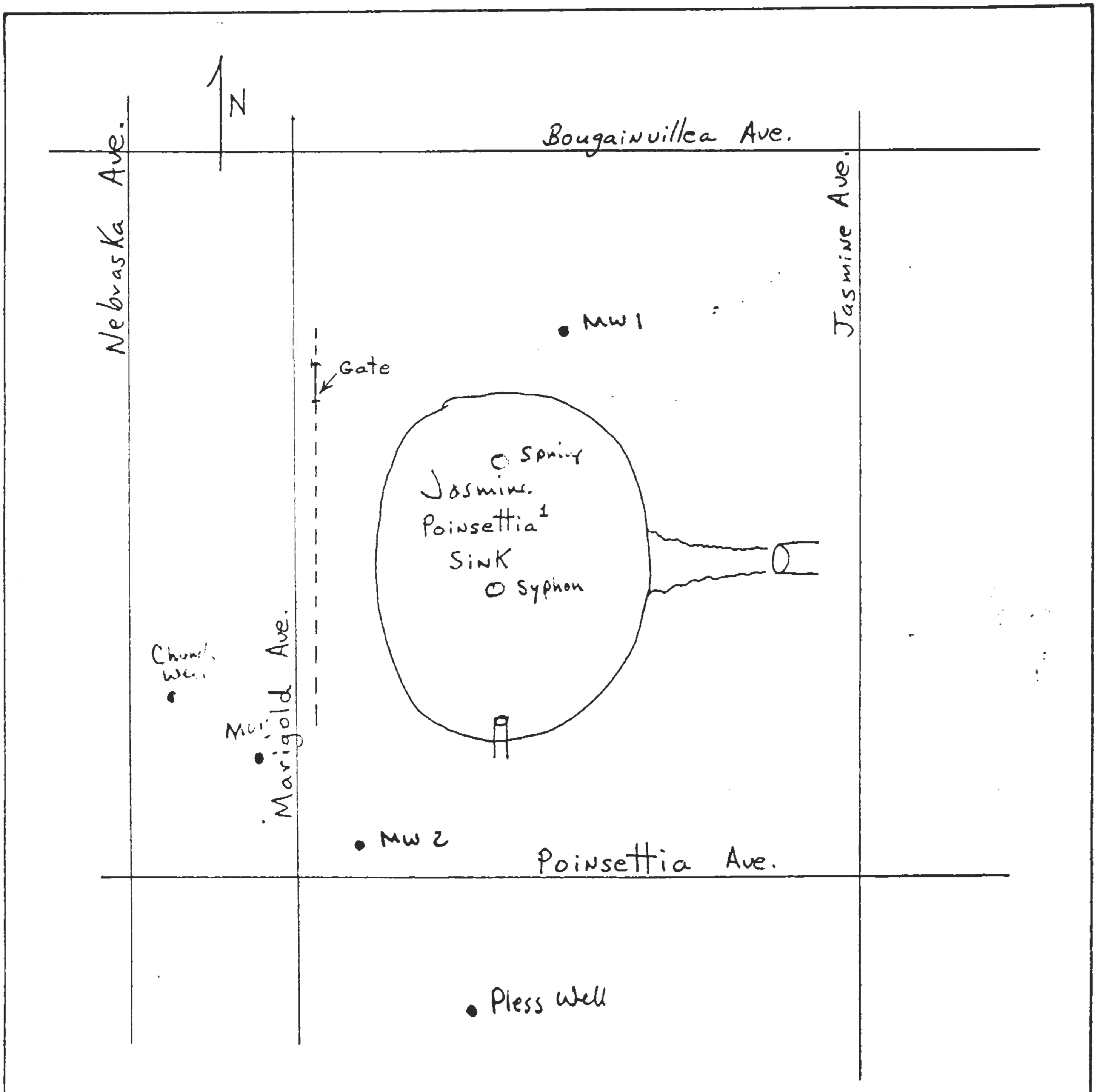
Sampling Location Map



Sample Collector ______________________ Date ______________

HILLSBOROUGH COUNTY
ENVIRONMENTAL PROTECTION COMMISSION

Sampling Location Map

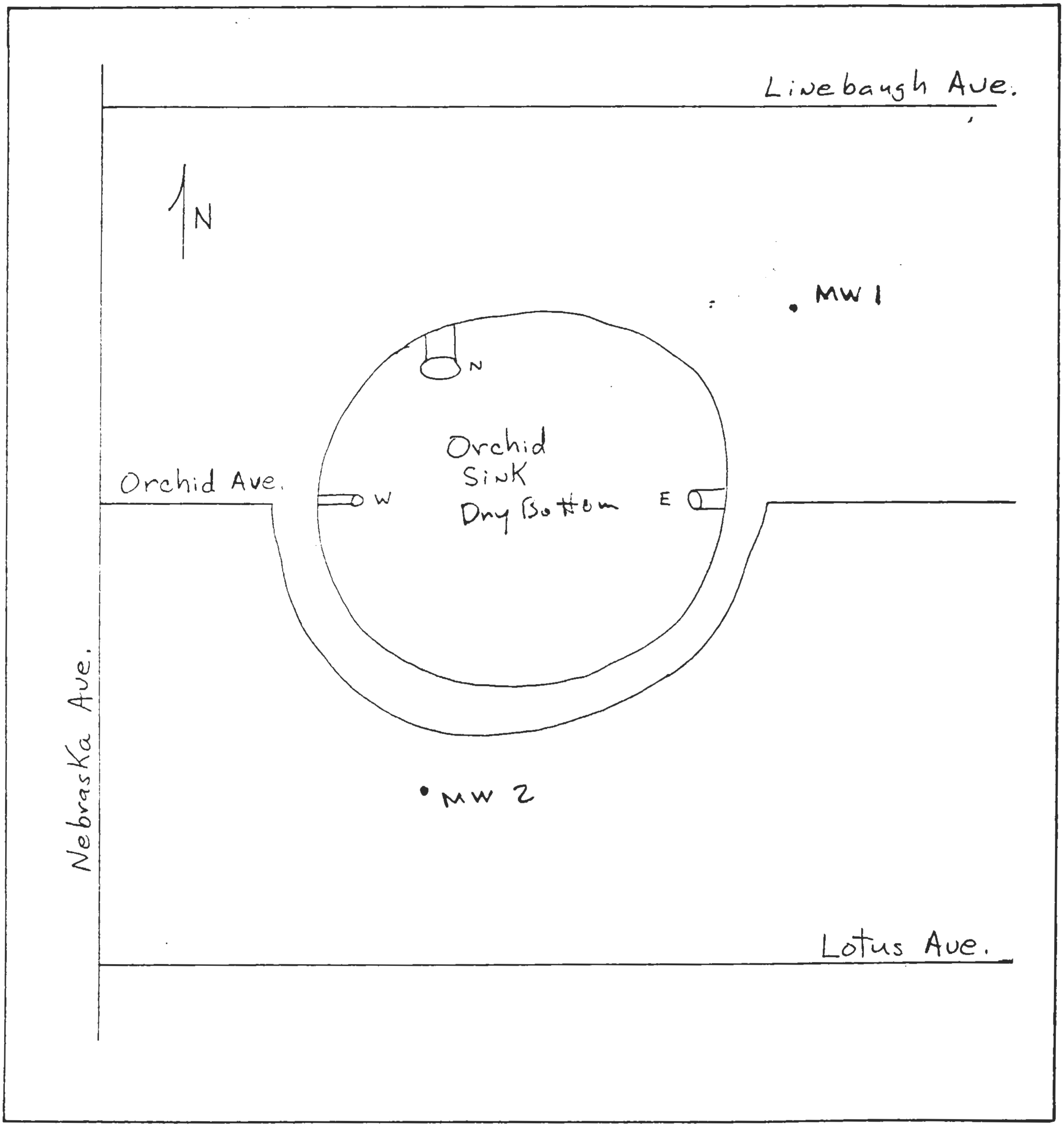


1 sometimes called Trinity or Jasmine sink

Sample Collector ______________________ Date ____________

HILLSBOROUGH COUNTY
ENVIRONMENTAL PROTECTION COMMISSION

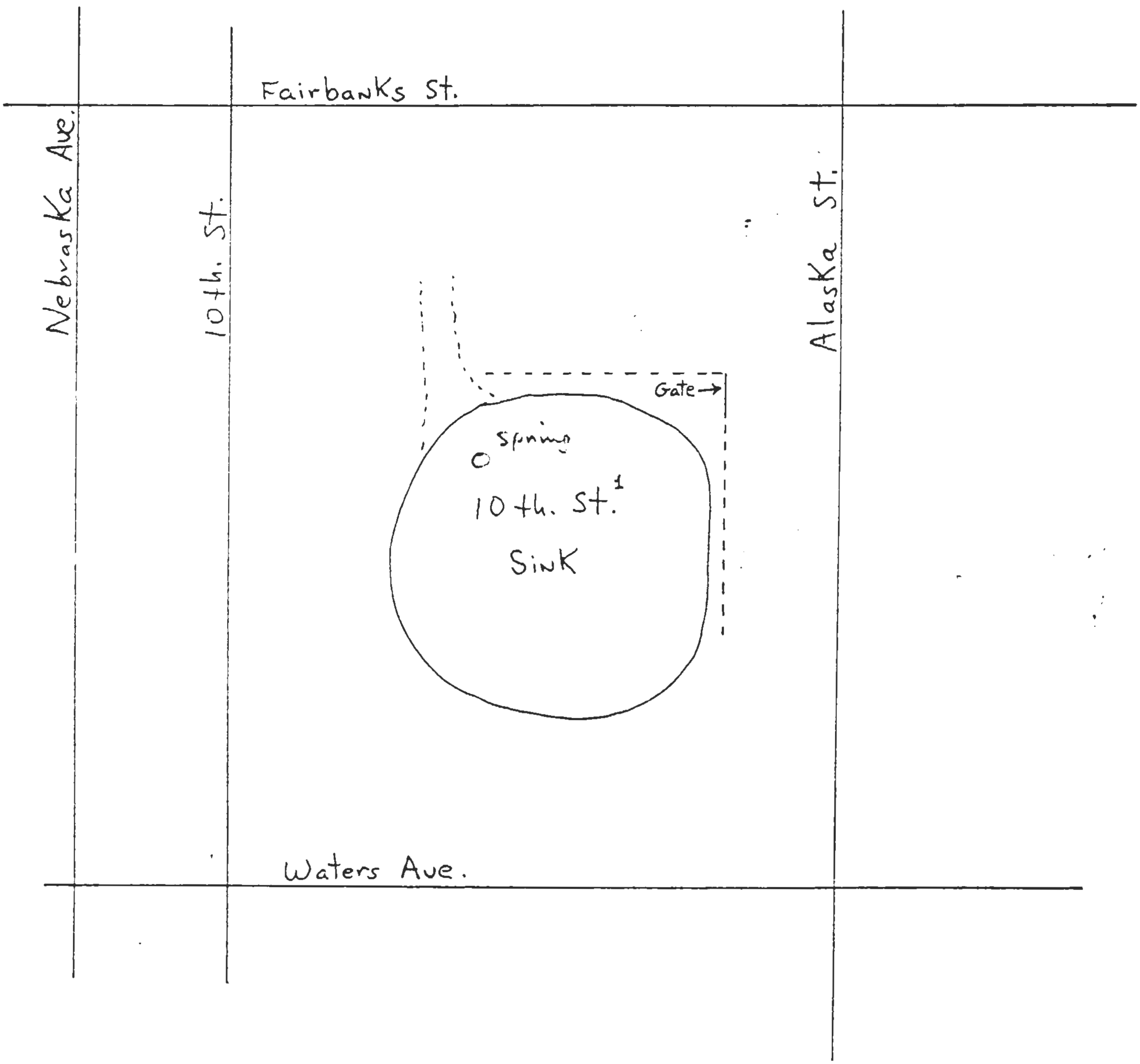
Sampling Location Map



Sample Collector ______________________ Date ______________

HILLSBOROUGH COUNTY
ENVIRONMENTAL PROTECTION COMMISSION

Sampling Location Map



1 also called Alaska sink

Sample Collector ______________________ Date ______________

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sampled by:	collection date - time:	sampling depth
R. Wallace	6/5/89 - 1115	

location: # 906002 Curiosity Sink

reason for sampling: Checking Water quality.

Parameter	Unit	Storet	Value	Parameter	Unit	Storet	Value
PH	STD	403	7.34	Pb	µg/L	1051	K 20
Total Coli	#/100ML	31501	8	Cr	µg/L	1034	K 40
Fecal Coli	#/100ML	31616	K 4	Mg	MG/L	927	3.0
Fecal Strep	#/100ML	31673	36	Na	MG/L	929	9.0
NO_2+NO_3N	MG/L	631	.42	Ca	MG/L	916	67.5
RES DISS	MG/L	515	216	K	MG/L	937	1.0
Oil & Grease	MG/L	556	K .1				
CL	MG/L	940	16				
COLOR	PT/Co	80	5				
TURBIDITY	NTU	76	1				
ALKALINITY	MG/L	410	149				
SO4	MG/L	945	16				

Comments:

J = Estimated value
K = Actual value less than reported
L = Actual value greater than reported

D = Field measurement

prepared by: G. ABUTAN date: 6/19/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sampled by:	collection date - time:	sampling depth
R. Wallace	6/6/89 - 0920	

Location: # 906003 Jasmin / Poinsettia Sink

reason for sampling: Checking water quality.

Parameter	Unit	Storet	Value	Parameter	Unit	Storet	Value
pH	STD	403	7.20	Pb	µg/L	1051	K 20
Total Coli	#/100 ML	31501	64	Cr	µg/L	1034	K 40
Fecal Coli	#/100 ML	31616	K 4	Mg	MG/L	927	14
Fecal Strep	#/100 ML	31673	132	Na	MG/L	929	110
NO2+NO3N	MG/L	631	.20	Ca	MG/L	916	102
RES DISS	MG/L	515	697				
Oil & Grease	MG/L	556	1.4				
CL	MG/L	940	224				
COLOR	PT/CO	80	5				
TURBIDITY	NTU	76	4				
ALKALINITY	MG/L	410	180				
SO4	MG/L	945	84				

Comments:

J = Estimated value
K = Actual value less than reported
L = Actual value greater than reported

D = Field measurement

prepared by: G. ABUTAN **date:** 6/19/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sampled by: R. Wallace

collection date - time: 6/7/89 - 0930

sampling depth

location: Alaska Springs Sink #906016

reason for sampling: Checking water quality at Alaska Springs

Parameter	Unit	Storet	Value	Parameter	Unit	Storet	Value
pH	STD	403	7.25	Pb	ug/L	1051	K 20
Total Coli	#/100ML	31501	232	Cr	ug/L	1034	K 40
Fecal Coli	#/100ML	31616	124	Mg	MG/L	927	5.5
Fecal Strep	#/100ML	31673	100	Na	MG/L	929	19.0
NO2+NO3N	MG/L	631	1.91	Ca	MG/L	916	109.5
RES DISS	MG/L	515	393	K	MG/L	937	0.5
Oil & Grease	MG/L	556	1.4				
Cl	MG/L	940	32				
COLOR	PT/CO	80	2				
TURBIDITY	NTU	76	2				
ALKALINITY	MG/L	410	230				
SO4	MG/L	945	49				

Comments:

J = Estimated value
K = Actual value less than reported
L = Actual value greater than reported

D = Field measurement

prepared by: G. ABUTAN **date:** 6/19/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sampled by:	collection date - time:	sampling depth
R. Wallace	6/19/89 - 0930	

Location: #906017 Sulphur Springs Sink

reason for sampling: Checking water quality.

Parameter	Unit	Storet	Value	Parameter	Unit	Storet	Value
PH	STD	403	7.26	Pb	µg/L	1051	K 20
Total Coli	#/100ML	31501	1400	Cr	µg/L	1034	K 40
Fecal Coli	#/100ML	31616	1000	Mg	MG/L	927	22.5
Fecal Strep	#/100ML	31673	500	Na	MG/L	929	192.0
NO2+NO3N	MG/L	631	.52	Ca	MG/L	916	118.0
RES DISS	MG/L	515	1040				
Oil & Grease	MG/L	556	2.4				
CL	MG/L	940	385				
COLOR	PT/CO	80	6				
TURBIDITY	NTU	76	1				
ALKALINITY	MG/L	410	160				
SO4	MG/L	945	140				

Comments:

J = Estimated value
K = Actual value less than reported
L = Actual value greater than reported

D = Field measurement

prepared by: G. ABUTAN **date:** 6/19/89

lab supervisor: F. Olszewski
F. Olszewski

APPENDIX F

WATER QUALITY #2

BEGIN WET WEATHER

HCEPC LABORATORY RESULTS

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sampled by:	collection date - time:	sampling depth
R. Wallace	7/19/89 11:05AM	

Location: Lab #907091 Curiosity Creek

reason for sampling: Sinkhole Study

Parameter	Unit	Storet	Value	Parameter	Unit	Storet	Value
PH	STD	403	7.42	Pb	UG/L	1051	K 20
Total Coli*	#/100ML	31501	50	Cr	UG/L	1034	K 20
Fecal Coli*	#/100ML	31616	30	Mg	MG/L	927	3
Fecal Strep*	#/100ML	31673	760	Na	MG/L	929	8
FC/FS	#	Ratio	.04	Ca	MG/L	916	63
$NO_2 + NO_3N$	MG/L	631	.11				
RES DISS	MG/L	515	238				
Oil & Grease	MG/L	556	K 1				
CL	MG/L	940	15				
Color	PT/CO	80	5				
Alkalinity	MG/L	410	148				
SO_4	MG/L	945	12				
Turbidity	NTU	76	1				

Comments:
* This sample did not conform to sampling/ preservation guidelines of EPA-600/4-79-020

J = Estimated value
K = Actual value less than reported
L = Actual value greater than reported

D = Field measurement

prepared by: G. Abutan **date:** 8/1/89

lab supervisor: F. Olszewski

F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sampled by:	collection date - time:	sampling depth
R. Wallace	7/18/89 9:00PM	

Location:

Lab #907090 Jasmin Sink

reason for sampling: Sinkhole Study

Parameter	Unit	Storet	Value
PH	STD	403	6.92
Total Coli*	#/100ML	31501	K 10
Fecal Coli*	#/100ML	31616	K 10
Fecal Strep*	#/100ML	31673	10
FC/FS	#	Ratio	-
$NO_2 + NO_3N$	MG/L	631	.06
RES DISS	MG/L	515	686
Oil & Grease	MG/L	556	1
CL	MG/L	940	210
Color	PT/CO	80	36
Turbidity	NTU	76	13
Alkalinity	MG/L	410	258
SO_4	MG/L	945	1

Parameter	Unit	Storet	Value
Pb	UG/L	1051	K 20
Cr	UG/L	1034	K 20
Mg	MG/L	927	11
Na	MG/L	929	103
Ca	MG/L	916	113

Comments:

* This sample did not conform to sampling/ preservation guidelines of EPA-600/ 4-79-020

J = Estimated value
K = Actual value less than reported
L = Actual value greater than reported

D = Field measurement

prepared by: G. Abutan **date:** 8/1/89

lab supervisor: F. Olszewski

F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sampled by:	collection date - time:	sampling depth
R. Wallace	7-19-89 2:45PM	

Location:
Lab #907096 Alaska Sink

reason for sampling: Sinkhole Study

Parameter	Unit	Storet	Value	Parameter	Unit	Storet	Value
PH	STD	403	7.31	Pb	ug/L	1051	K20
Total Coli*	#/100ml	31501	400	Cr	ug/L	1034	K20
Fecal Coli*	#/100ml	31616	168	Mg	mg/L	927	6
$NO_2 + NO_3N$	MG/L	631	1.97	Na	mg/L	929	19
RES DISS	MG/L	515	364	Ca	mg/L	916	109
Oil & Grease	MG/L	556	K1				
CL	MG/L	940	32				
Color	PT/CO	80	2				
Turbidity	NTU	76	2				
Alkalinity	MG/L	410	232				
SO_4	MG/L	945	51				

Comments:
*This sample did not confirm to sampling/ preservation guidelines of EPA-600/4-79-020

J = Estimated value
K = Actual value less than reported
L = Actual value greater than reported

D = Field measurement

prepared by: G. Abutan **date:** 8/1/89

lab supervisor: F. Olszewski

F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sampled by:	collection date - time:	sampling depth
R. Wallace	7/19/89 7:00PM	

Location:
Lab #907095 Sulphur Springs

reason for sampling: Sinkhole Study

Parameter	Unit	Storet	Value	Parameter	Unit	Storet	Value
PH	STD	403	7.25	Pb	UG/L	1051	K 20
Total Coli*	#/100ML	31501	2000	Cr	UG/L	1034	K 20
Fecal Coli*	#/100ML	31616	1000	Mg	MG/L	927	32
$NO_2 + NO_3N$	MG/L	631	.22	Na	MG/L	929	280
RES DISS	MG/L	515	1311	Ca	MG/L	916	127
Oil & Grease	MG/L	556	K 1				
CL	MG/L	940	529				
Color	PT/CO	80	11				
Turbidity	NTU	76	1				
Alkalinity	MG/L	410	158				
SO_4	MG/L	945	185				

Comments:
* This sample did not conform to sampling/ preservation guidelines of EPA-600/4-79-020

J = Estimated value
K = Actual value less than reported
L = Actual value greater than reported

D = Field measurement

prepared by: G. Abutan **date:** 8/1/89

lab supervisor: F. Olszewski
F. Olszewski

APPENDIX G

WATER QUALITY TEST #3

MID WET WEATHER

HCEPC LABORATORY RESULTS

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	9-19-89	

Location description: Curiosity Sink
#909099

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
PH	STD	403	7.29
Total Coli	#/100 ML	31501	110
Fecal Coli	#/100 ML	31616	110
Fecal Strep	#/100 ML	31673	30
FC/FS	#	RATIO	3.67
NO2+NO3N	MG/L	631	.64
RES DISS	MG/L	515	211
Oil & Grease	MG/L	556	1
Cl	MG/L	940	15
COLOR	PT/CO	80	
Turbidity	NTU	76	5
Alkalinity	MG/L	410	152
SO4	MG/L	945	14

Parameter	Unit	Method	Value
Pb	ug/L	1051	K 20
Cr	ug/L	1034	K 20
Mg	MG/L	927	3.2
Na	MG/L	929	9
Ca	MG/L	916	61

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTAN date: 9/27/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

DER Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	9-19-89 - 1030	

Location description: Jasmine / Poinsettia
Lab# 909095

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
PH	STD	403	7.25
Total Coli	#/100ml	31501	1900
Fecal Coli	#/100ml	31616	360
Fecal Strep	#/100ml	31673	230
FC/FS	#	RATIO	1.57
NO2+NO3N	MG/L	631	.45
RES DISS	MG/L	515	503
Oil & Grease	MG/L	556	K1
CL	MG/L	940	143
COLOR	PT/CO	80	4
Turbidity	NTU	76	6
Alkalinity	MG/L	410	167
SO4	MG/L	945	55

Parameter	Unit	Method	Value
Pb	ug/L	1051	K20
Cr	ug/L	1034	K20
MG	MG/L	927	9.4
Na	MG/L	929	68
Ca	MG/L	916	77

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. Abutan   date: 9/27/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	9-19-89 - 1215	

Location description: Alaska Springs
Lab # 904097

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
PH	STD	403	7.16
Total Coli	#/100ML	31501	260
Fecal Coli	#/100ML	31616	240
Fecal Strep	#/100ML	31673	180
FC/FS	#	RATIO	1.33
NO2+NO3N	MG/L	631	2.33
RES DISS	MG/L	515	397
Oil & Grease	MG/L	556	K 1
Cl	MG/L	940	33
COLOR	PT/CO	80	4
Turbidity	NTU	76	5
Alkalinity	MG/L	410	224
SO4	MG/L	945	50

Parameter	Unit	Method	Value
Pb	ug/L	1051	K 20
Cr	ug/L	1034	K 20
Mg	MG/L	927	5.8
Na	MG/L	929	19
Ca	MG/L	916	98

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTANI date: 9/29/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	9-19-89 - 1330	

Location description: Sulphur Springs
Lab# 909091

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
pH	STD	403	7.33
Total Coli	#/100ml	31501	190
Fecal Coli	#/100ml	31616	80
Fecal Strep	#/100ml	31673	K 10
FC/FS	#	Ratio	–
NO_3+NO_2N	MG/L	631	.91
RES DISS	MG/L	515	1406
Oil & Grease	MG/L	556	K 1
CL	MG/L	940	572
COLOR	PT/Co	80	7
Turbidity	NTU	70	2
Alkalinity	MG/L	410	154
Sod	MG/L	945	170

Parameter	Unit	Method	Value
Pb	mg/L	1051	K 20
Cr	mg/L	1034	K 20
Mg	MG/L	927	33
SO_4	MG/L	929	260
Ca	MG/L	916	125

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. Abutin — date: 9/27/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R Wallace	09-20-89 -	

Location description: Jasmine Poinsettia #909104

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
pH	STD	403	7.40
Total Coli	#/100ML	31501	Count not Possible
Fecal Coli	#/100ML	31616	Count not Possible
Fecal Strep	#/100ML	31673	4900
FC/FS	#	RATIO	-
NO_2+NO_3-N	MG/L	631	.06
RES DISS	MG/L	515	485
Oil & Grease	MG/L	556	1.4
CL	MG/L	940	132
COLOR	PT/Co	80	18
Turbidity	NTU	76	48
Alkalinity	MG/L	410	190
SO_4	MG/L	945	

Parameter	Unit	Method	Value
Pb	µg/L	1051	K20
Cr	µg/L	1034	K20
Mg	MG/L	927	8.5
Na	MG/L	929	65
Ca	MG/L	916	87

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABURTAN date: 9/27/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	09-21-89	

Location description: Alaska Springs
#909123

reason for sampling: Sinkholes Study

Parameter	Unit	Method	Value	Parameter	Unit	Method	Value
PH	STD	403	7.38	Pb	ug/L	1051	K 20
Total Coli	#/100ML	31501	6000	Cr	ug/L	1034	K 20
Fecal Coli	#/100ML	31616	6000	Mg	MG/L	927	5.9
NO2+NO3N	MG/L	631	2.23	Na	MG/L	929	19
RES DISS	MG/L	515	381	Ca	MG/L	916	110
Oil & Grease	MG/L	556	1				
Cl	MG/L	940	31				
COLOR	PT/CO	80	7				
Turbidity	NTU	76	5				
Alkalinity	MG/L	410	233				
SO4	MG/L	945	51				

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTA date: 9/27/89

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	09-21-89	

Location description: Sulphur Springs
909122

reason for sampling: Sinkhole Study.

Parameter	Unit	Method	Value
PH	STD	403	7.38
Total Coli	#/100ml	31501	9000
Fecal Coli	#/100ml	31616	5000
NO2+NO3N	MG/L	631	.86
RES DISS	MG/L	515	1308
Oil & Grease	MG/L	556	1
Cl	MG/L	940	506
COLOR	PT/CO	80	8
Turbidity	NTU	70	2
Alkalinity	MG/L	410	155
SO4	MG/L	945	169

Parameter	Unit	Method	Value
Pb	MG/L	1051	K20
Cr	MG/L	1034	K20
Mg	MG/L	927	.32
Na	MG/L	929	260
Ca	MG/L	916	121

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTA   date: 9/27/89

lab supervisor: F. Olszewski
F. Olszewski

APPENDIX H

WATER QUALITY TEST #4

END WET WEATHER

HCEPC LABORATORY RESULTS

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	10-16-89 1430	

Location description: Jasmine / Poinsettia
Lab # 910071

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
PH	STD	403	7.02
* Total Coli	#/100ML	31501	39000
* Fecal Coli	#/100ML	31616	1430
* Fecal Strep	#/100ML	31673	70
FC/FS	#	RATIO	20.43
NO_2+NO_3N	MG/L	631	.28
RES DISS	MG/L	515	563
Cl	MG/L	940	165
COLOR	PT/CO	80	6
Turbidity	NTU	76	6
Alkalinity	MG/L	410	179
SO_4	MG/L	945	63
Oil & Grease	MG/L	556	1
F (DISS)	MG/L	950	.16

Parameter	Unit	Method	Value
Pb	ug/L	1051	K20
Cr	ug/L	1034	K20
Mg	MG/L	927	11
Na	MG/L	929	85
Ca	MG/L	916	99

* THIS SAMPLE DID NOT CONFORM TO [illegible] GUIDELINES OF [illegible]

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTM date: Oct. 26, 1989

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	10-16-89 - 1530	

Location description: Alaska Springs
910072

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
PH	STD	403	7.10
* Total Coli	#/100ML	31501	400
* Fecal Coli	#/100ML	31616	300
* Fecal Strep	#/100ML	31673	260
FC/FS	#	RATIO	1.15
NO_2+NO_3N	MG/L	631	2.25
RES DISS	MG/L	515	385
CL	MG/L	940	31
COLOR	PT/CO	80	3
Turbidity	NTU	76	5
Alkalinity	MG/L	410	230
SO_4	MG/L	945	52
Oil & Grease	MG/L	556	K1
F (DISS)	MG/L	950	.24

Parameter	Unit	Method	Value
Pb	ug/L	1051	K20
Cr	ug/L	1034	K20
Mg	MG/L	927	6
Na	MG/L	929	19
Ca	MG/L	916	110

* THIS SAMPLE DID NOT CONFORM TO SAMPLING PRESERVATION GUIDELINES

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTAN date: Oct. 26, 1989

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	10-16-89 - 1700	

Location description: Sulphur Springs
910073

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
PH	STD	403	7.16
*Total Coli	#/100ML	31501	1040
*Fecal Coli	#/100ML	31616	110
*Fecal Streps	#/100ML	31673	K10
FC/FS	#	RATIO	-
NO_2+NO_3N	MG/L	631	.78
RES DISS	MG/L	515	1350
CL	MG/L	940	550
COLOR	PT/CO	80	13
Turbidity	NTU	76	1
Alkalinity	MG/L	410	155
SO4	MG/L	945	176
Oil & Grease	MG/L	556	K1
F (DISS)	MG/L	950	.21
*	THIS SAMPLE DID NOT CONFORM TO SAMPLING/PRESERVATION GUIDELINES OF EPA-600/4-79-020		

Parameter	Unit	Method	Value
Pb	ug/L	1051	K20
Cr	ug/L	1034	K20
Mg	MG/L	927	33
Na	MG/L	929	280
Ca	MG/L	916	130

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTAN date: Oct. 26, 1989

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	10-17-89	

Location description: Jasmine / Poinsettia
910078

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
pH	STD	403	7.22
Total Coli	#/100ML	31501	5000
Fecal Coli	#/100ML	31616	460
Fecal Strep	#/100ML	31673	150
FC/FS	#	RATIO	3.07
NO_2+NO_3N	MG/L	631	.33
RES DISS	MG/L	515	586
CL	MG/L	940	163
COLOR	PT/CO	80	4
Turbidity	NTU	76	13
Alkalinity	MG/L	410	176
SO_4	MG/L	945	65
Oil & Grease	MG/L	556	2
F (DISS)	MG/L	950	.14

Parameter	Unit	Method	Value
Pb	μg/L	1051	K 20
Cr	μg/L	1034	K 20
Mg	MG/L	927	10
Na	MG/L	929	87
Ca	MG/L	916	99

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTAN date: Oct. 26, 1989

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	10-18-89 - 1030	

Location description: Alaska Springs
910099

reason for sampling: Sinkhole Study.

Parameter	Unit	Method	Value
PH	STD	403	7.15
Total Coli	#/100ML	31501	2000
Fecal Coli	#/100ML	31616	80
Fecal Strep	#/100ML	31673	1390
FC/FS	#	RATIO	0.06
NO_2+NO_3N	MG/L	631	1.51
RES DISS	MG/L	515	391
Cl	MG/L	940	30
COLOR	PT/co	80	2
TURBIDITY	NTU	76	4
Alkalinity	MG/L	410	230
SO_4	MG/L	945	53
Oil & Grease	MG/L	556	1
F (DISS)	MG/L	950	.27

Parameter	Unit	Method	Value
Pb	µg/L	1051	K 20
Cr	µg/L	1034	K 20
Mg	MG/L	927	6
Na	MG/L	929	19
Ca	MG/L	916	114

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. ABUTAN date: Oct. 26, 1989

lab supervisor: F. Olszewski
F. Olszewski

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

HRS Laboratory Certification #E44057

1900 9th Ave.
Tampa, Fla. 33605
Ph: 272-5960

WATER QUALITY REPORT

sample taken by:	collection date - time:	sampling depth
R. Wallace	10-18-89 - 1930	

Location description: Sulphur Springs
Lab# 910100

reason for sampling: Sinkhole Study

Parameter	Unit	Method	Value
PH	STD	403	7.33
Total Coli	#/100ML	31501	16000
Fecal Coli	#/100ML	31616	4000
Fecal Strep	#/100ML	31673	450
FC/FS	#	RATIO	8.89
NO_2+NO_3 N	MG/L	631	.38
RES DISS	MG/L	515	1322
CL	MG/L	940	507
COLOR	PT/CO	80	15
Turbidity	NTU	76	4
Alkalinity	MG/L	410	155
SO_4	MG/L	945	169
Oil & Grease	MG/L	556	1
F (DISS)	MG/L	950	.24

Parameter	Unit	Method	Value
Pb	µg/L	1051	K 20
Cr	µg/L	1034	K 20
Mg	MG/L	927	32
Na	MG/L	929	270
Ca	MG/L	916	123

J = Estimated value
K = Actual value less than value given
L = Actual value greater than value given
D = Field measurement

report prepared by: G. Abbott date: Oct. 26, 1989

lab supervisor: F. Olszewski
F. Olszewski

APPENDIX I

U.S.G.S. FLOWRATE FOR

SULPHUR SPRINGS POOL

SELECTED TEST DATES

CITY MEMO ON GUAGE HEIGHTS AND GATE GEOMETRY

DEPARTMENT OF SANITARY SEWERS
CITY OF TAMPA, FLORIDA

LETTER OF TRANSMITTAL

DATE May 5, 1989 JOB NO

ATTENTION Robert E. Wallace

RE:

RECEIVED
MAY 08 1989
ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

TO Robert E. Wallace
Environmental Engineering Consultants
5119 North Florida Avenue
Tampa, FL 33604

GENTLEMEN:

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via ________ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☐ ________

COPIES	DATE	NO	DESCRIPTION
1			Rating chart for Sulphur Springs
1			Additional flow data for Sulphur Springs 1/13-2/12/89

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit ____ copies for approval

☒ For your use ☐ Approved as noted ☐ Submit ____ copies for distribution

☒ As requested ☐ Returned for corrections ☐ Return ____ corrected prints

☐ For review and comment ☐ ________

☐ FOR BIDS DUE ________ 19 ____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS Hope you've received the other by now, it was returned since I sent it to the address on your card (5500 N. Florida) (old card?) This is also the rating chart which counts, the other being for extremely low stages only.

COPY TO ________ SIGNED: [signature]

TAMPA MUNICIPAL OFFICE BLDG TAMPA, FLORIDA 33602 CITY HALL PLAZA 6th FLOOR EAST

SS 5 (3/78) WHITE-Developer YELLOW-Office Copy

United States Department of the Interior

GEOLOGICAL SURVEY

WATER RESOURCES DIVISION
4710 Eisenhower Blvd., Suite B-5
Tampa, Florida 33634-6381

May 3, 1989
(FL-001)

Mr. Michael Burwell
Stormwater Planner
Department of Sanitary Sewers
City of Tampa
6th Floor, City Hall Plaza
Tampa, Florida 33602

Dear Mr. Burwell:

We are pleased to furnish you the remainder of the instantaneous gage-height data requested in your April 7, 1989 letter and a copy of the complete rating table requested in our recent telephone conversation. The rating sent to you with my April 12, 1989 letter is used during periods of extreme low flow. I have enclosed a copy of the stage-discharge rating used during other flow conditions. Please note that, in general, ratings are defined by a series of actual field measurements made under different hydrologic conditions and represent an interpretive average of these conditions. Streamflow for a specific set of conditions is probably different from these ratings because of varying effects of changing vegetation, shifting streambed, backwater, concrete structure settings, etc. These ratings are provisional and subject to change as additional data become available.

Also enclosed are the instantaneous data requested in your April 7 letter. This data transmittal includes data not sent to you with my April 12 letter. If you have any questions, please contact this office.

Sincerely,

James L. Kiesler, Jr.
Chief, Information Management Section

Enclosure

JLK:vtc

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 13, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	764 a	05:15:00	764 a	10:15:00	764 a	15:15:00	764 a	20:15:00	764 a
00:30:00	764 a	05:30:00	764 a	10:30:00	764 a	15:30:00	764 a	20:30:00	764 a
00:45:00	764 a	05:45:00	764 a	10:45:00	764 a	15:45:00	764 a	20:45:00	764 a
01:00:00	764 a	06:00:00	764 a	11:00:00	764 a	16:00:00	764 a	21:00:00	764 a
01:15:00	764 a	06:15:00	764 a	11:15:00	764 a	16:15:00	764 a	21:15:00	764 a
01:30:00	764 a	06:30:00	764 a	11:30:00	764 a	16:30:00	764 a	21:30:00	763 a
01:45:00	764 a	06:45:00	764 a	11:45:00	764 a	16:45:00	764 a	21:45:00	763 a
02:00:00	764 a	07:00:00	764 a	12:00:00	764 a	17:00:00	764 a	22:00:00	763 a
02:15:00	764 a	07:15:00	764 a	12:15:00	764 a	17:15:00	764 a	22:15:00	763 a
02:30:00	764 a	07:30:00	764 a	12:30:00	764 a	17:30:00	764 a	22:30:00	763 a
02:45:00	764 a	07:45:00	764 a	12:45:00	764 a	17:45:00	764 a	22:45:00	763 a
03:00:00	764 a	08:00:00	764 a	13:00:00	764 a	18:00:00	764 a	23:00:00	763 a
03:15:00	764 a	08:15:00	764 a	13:15:00	764 a	18:15:00	764 a	23:15:00	763 a
03:30:00	764 a	08:30:00	764 a	13:30:00	764 a	18:30:00	764 a	23:30:00	763 a
03:45:00	764 a	08:45:00	764 a	13:45:00	764 a	18:45:00	764 a	23:45:00	763 a
04:00:00	764 a	09:00:00	764 a	14:00:00	764 a	19:00:00	764 a	24:00:00	763 a
04:15:00	764 a	09:15:00	764 a	14:15:00	764 a	19:15:00	764 a		
04:30:00	764 a	09:30:00	764 a	14:30:00	764 a	19:30:00	764 a		
04:45:00	764 a	09:45:00	764 a	14:45:00	764 a	19:45:00	764 a		
05:00:00	764 a	10:00:00	764 a	15:00:00	764 a	20:00:00	764 a		

PROVISIONAL DATA — JANUARY 14, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	764 a	05:15:00	764 a	10:15:00	764 a	15:15:00	764 a	20:15:00	764 a
00:30:00	764 a	05:30:00	764 a	10:30:00	764 a	15:30:00	764 a	20:30:00	764 a
00:45:00	763 a	05:45:00	764 a	10:45:00	764 a	15:45:00	764 a	20:45:00	764 a
01:00:00	764 a	06:00:00	764 a	11:00:00	764 a	16:00:00	764 a	21:00:00	764 a
01:15:00	764 a	06:15:00	764 a	11:15:00	764 a	16:15:00	764 a	21:15:00	763 a
01:30:00	764 a	06:30:00	764 a	11:30:00	764 a	16:30:00	764 a	21:30:00	763 a
01:45:00	764 a	06:45:00	764 a	11:45:00	764 a	16:45:00	764 a	21:45:00	763 a
02:00:00	764 a	07:00:00	764 a	12:00:00	764 a	17:00:00	764 a	22:00:00	763 a
02:15:00	764 a	07:15:00	764 a	12:15:00	764 a	17:15:00	764 a	22:15:00	763 a
02:30:00	764 a	07:30:00	764 a	12:30:00	764 a	17:30:00	764 a	22:30:00	763 a
02:45:00	764 a	07:45:00	764 a	12:45:00	764 a	17:45:00	764 a	22:45:00	763 a
03:00:00	764 a	08:00:00	764 a	13:00:00	764 a	18:00:00	764 a	23:00:00	763 a
03:15:00	764 a	08:15:00	764 a	13:15:00	764 a	18:15:00	764 a	23:15:00	763 a
03:30:00	764 a	08:30:00	764 a	13:30:00	764 a	18:30:00	764 a	23:30:00	763 a
03:45:00	764 a	08:45:00	764 a	13:45:00	764 a	18:45:00	764 a	23:45:00	763 a
04:00:00	764 a	09:00:00	764 a	14:00:00	764 a	19:00:00	764 a	24:00:00	763 a
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04:45:00	764 a	09:45:00	764 a	14:45:00	764 a	19:45:00	764 a		
05:00:00	764 a	10:00:00	764 a	15:00:00	764 a	20:00:00	764 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 15, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	763 a	05:15:00	764 a	10:15:00	764 a	15:15:00	764 a	20:15:00	764 a
00:30:00	763 a	05:30:00	764 a	10:30:00	764 a	15:30:00	764 a	20:30:00	764 a
00:45:00	763 a	05:45:00	764 a	10:45:00	764 a	15:45:00	764 a	20:45:00	764 a
01:00:00	763 a	06:00:00	764 a	11:00:00	764 a	16:00:00	764 a	21:00:00	764 a
01:15:00	763 *	06:15:00	764 a	11:15:00	764 a	16:15:00	764 a	21:15:00	764 a
01:30:00	763 a	06:30:00	764 a	11:30:00	764 a	16:30:00	764 a	21:30:00	764 a
01:45:00	763 a	06:45:00	764 a	11:45:00	764 a	16:45:00	764 a	21:45:00	764 a
02:00:00	763 a	07:00:00	764 a	12:00:00	764 a	17:00:00	764 a	22:00:00	763 a
02:15:00	763 a	07:15:00	764 a	12:15:00	764 a	17:15:00	764 a	22:15:00	763 a
02:30:00	763 a	07:30:00	764 a	12:30:00	764 a	17:30:00	764 a	22:30:00	763 a
02:45:00	764 a	07:45:00	764 a	12:45:00	764 a	17:45:00	764 *	22:45:00	763 a
03:00:00	764 a	08:00:00	764 a	13:00:00	764 a	18:00:00	764 a	23:00:00	763 a
03:15:00	764 a	08:15:00	764 a	13:15:00	764 a	18:15:00	764 a	23:15:00	763 a
03:30:00	764 a	08:30:00	764 a	13:30:00	764 a	18:30:00	764 a	23:30:00	763 a
03:45:00	764 a	08:45:00	764 a	13:45:00	764 a	18:45:00	764 a	23:45:00	763 a
04:00:00	764 a	09:00:00	764 a	14:00:00	764 a	19:00:00	764 a	24:00:00	763 a
04:15:00	764 a	09:15:00	764 a	14:15:00	764 a	19:15:00	764 a		
04:30:00	764 a	09:30:00	764 a	14:30:00	764 a	19:30:00	764 a		
04:45:00	764 a	09:45:00	764 a	14:45:00	764 a	19:45:00	764 a		
05:00:00	764 a	10:00:00	764 a	15:00:00	764 a	20:00:00	764 a		

PROVISIONAL DATA — JANUARY 16, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
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00:30:00	763 a	05:30:00	764 a	10:30:00	764 *	15:30:00	764 a	20:30:00	764 a
00:45:00	763 a	05:45:00	764 a	10:45:00	764 a	15:45:00	764 a	20:45:00	764 a
01:00:00	763 a	06:00:00	764 a	11:00:00	764 a	16:00:00	764 a	21:00:00	764 a
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02:00:00	763 a	07:00:00	764 a	12:00:00	764 a	17:00:00	764 a	22:00:00	764 a
02:15:00	763 a	07:15:00	764 a	12:15:00	764 a	17:15:00	764 a	22:15:00	764 a
02:30:00	763 a	07:30:00	764 a	12:30:00	764 a	17:30:00	764 a	22:30:00	764 a
02:45:00	763 a	07:45:00	764 a	12:45:00	764 a	17:45:00	764 a	22:45:00	764 a
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03:45:00	764 a	08:45:00	764 a	13:45:00	764 a	18:45:00	764 a	23:45:00	764 a
04:00:00	764 a	09:00:00	764 a	14:00:00	764 a	19:00:00	764 a	24:00:00	764 a
04:15:00	764 a	09:15:00	764 a	14:15:00	764 a	19:15:00	764 a		
04:30:00	764 a	09:30:00	764 a	14:30:00	764 a	19:30:00	764 a		
04:45:00	764 a	09:45:00	764 a	14:45:00	764 a	19:45:00	764 a		
05:00:00	764 a	10:00:00	764 a	15:00:00	764 a	20:00:00	764 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 17, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
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00:30:00	764 a	05:30:00	764 a	10:30:00	764 a	15:30:00	767 a	20:30:00	767 a
00:45:00	764 a	05:45:00	764 a	10:45:00	764 a	15:45:00	767 a	20:45:00	766 a
01:00:00	764 a	06:00:00	764 a	11:00:00	764 a	16:00:00	767 a	21:00:00	766 a
01:15:00	764 a	06:15:00	764 a	11:15:00	764 a	16:15:00	767 a	21:15:00	766 a
01:30:00	764 a	06:30:00	764 a	11:30:00	764 a	16:30:00	767 a	21:30:00	767 a
01:45:00	764 a	06:45:00	764 a	11:45:00	765 a	16:45:00	767 a	21:45:00	768 a
02:00:00	764 a	07:00:00	764 a	12:00:00	766 a	17:00:00	767 a	22:00:00	767 a
02:15:00	764 a	07:15:00	764 a	12:15:00	767 a	17:15:00	767 a	22:15:00	768 a
02:30:00	764 a	07:30:00	764 a	12:30:00	767 a	17:30:00	767 a	22:30:00	768 a
02:45:00	764 a	07:45:00	764 a	12:45:00	767 a	17:45:00	767 a	22:45:00	767 a
03:00:00	764 a	08:00:00	765 a	13:00:00	767 a	18:00:00	766 a	23:00:00	768 a
03:15:00	764 a	08:15:00	764 a	13:15:00	767 a	18:15:00	767 a	23:15:00	768 a
03:30:00	764 a	08:30:00	764 a	13:30:00	767 a	18:30:00	767 a	23:30:00	768 a
03:45:00	764 a	08:45:00	764 a	13:45:00	767 a	18:45:00	766 a	23:45:00	768 a
04:00:00	764 a	09:00:00	764 a	14:00:00	767 a	19:00:00	766 a	24:00:00	768 a
04:15:00	764 a	09:15:00	764 a	14:15:00	767 a	19:15:00	766 a		
04:30:00	764 a	09:30:00	764 a	14:30:00	767 a	19:30:00	766 a		
04:45:00	764 a	09:45:00	764 a	14:45:00	767 a	19:45:00	766 a		
05:00:00	764 a	10:00:00	764 a	15:00:00	767 a	20:00:00	767 a		

PROVISIONAL DATA — JANUARY 18, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	768 a	05:15:00	767 a	10:15:00	769 a	15:15:00	770 a	20:15:00	771 a
00:30:00	768 a	05:30:00	767 a	10:30:00	769 a	15:30:00	769 a	20:30:00	771 a
00:45:00	767 a	05:45:00	767 a	10:45:00	768 a	15:45:00	769 a	20:45:00	771 a
01:00:00	767 a	06:00:00	767 a	11:00:00	770 a	16:00:00	769 a	21:00:00	770 a
01:15:00	767 a	06:15:00	767 a	11:15:00	770 a	16:15:00	769 a	21:15:00	770 a
01:30:00	767 a	06:30:00	767 a	11:30:00	770 a	16:30:00	771 a	21:30:00	770 a
01:45:00	767 a	06:45:00	767 a	11:45:00	769 a	16:45:00	770 a	21:45:00	771 a
02:00:00	767 a	07:00:00	767 a	12:00:00	768 a	17:00:00	769 a	22:00:00	770 a
02:15:00	767 a	07:15:00	767 a	12:15:00	768 a	17:15:00	769 a	22:15:00	771 a
02:30:00	768 a	07:30:00	767 a	12:30:00	769 a	17:30:00	769 a	22:30:00	771 a
02:45:00	767 a	07:45:00	767 a	12:45:00	769 a	17:45:00	770 a	22:45:00	770 a
03:00:00	767 a	08:00:00	767 a	13:00:00	768 a	18:00:00	770 a	23:00:00	770 a
03:15:00	767 a	08:15:00	767 a	13:15:00	769 a	18:15:00	770 a	23:15:00	771 a
03:30:00	767 a	08:30:00	767 a	13:30:00	769 a	18:30:00	770 a	23:30:00	771 a
03:45:00	767 a	08:45:00	766 a	13:45:00	769 a	18:45:00	771 a	23:45:00	770 a
04:00:00	767 a	09:00:00	768 a	14:00:00	769 a	19:00:00	770 a	24:00:00	771 a
04:15:00	767 a	09:15:00	768 a	14:15:00	769 a	19:15:00	770 a		
04:30:00	767 a	09:30:00	769 a	14:30:00	769 a	19:30:00	771 a		
04:45:00	767 a	09:45:00	769 a	14:45:00	770 a	19:45:00	772 a		
05:00:00	767 a	10:00:00	769 a	15:00:00	770 a	20:00:00	770 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822737 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 19, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	771 a	05:15:00	771 a	10:15:00	771 a	15:15:00	770 a	20:15:00	769 a
00:30:00	771 a	05:30:00	770 a	10:30:00	771 a	15:30:00	770 a	20:30:00	770 a
00:45:00	770 a	05:45:00	772 a	10:45:00	770 a	15:45:00	770 a	20:45:00	770 a
01:00:00	771 a	06:00:00	771 a	11:00:00	770 a	16:00:00	770 a	21:00:00	769 a
01:15:00	770 a	06:15:00	772 a	11:15:00	771 a	16:15:00	770 a	21:15:00	769 a
01:30:00	770 a	06:30:00	771 a	11:30:00	771 a	16:30:00	770 a	21:30:00	769 a
01:45:00	771 a	06:45:00	771 a	11:45:00	769 a	16:45:00	770 a	21:45:00	769 *
02:00:00	772 a	07:00:00	771 a	12:00:00	771 a	17:00:00	770 a	22:00:00	769 a
02:15:00	772 a	07:15:00	770 a	12:15:00	771 a	17:15:00	770 a	22:15:00	769 a
02:30:00	770 a	07:30:00	771 a	12:30:00	770 a	17:30:00	770 a	22:30:00	768 a
02:45:00	771 a	07:45:00	771 a	12:45:00	770 a	17:45:00	770 a	22:45:00	768 a
03:00:00	771 a	08:00:00	771 a	13:00:00	770 a	18:00:00	770 a	23:00:00	769 a
03:15:00	771 a	08:15:00	771 a	13:15:00	770 a	18:15:00	770 a	23:15:00	768 a
03:30:00	771 a	08:30:00	771 a	13:30:00	770 a	18:30:00	770 a	23:30:00	768 a
03:45:00	771 a	08:45:00	770 a	13:45:00	770 a	18:45:00	770 a	23:45:00	768 a
04:00:00	771 a	09:00:00	771 a	14:00:00	770 a	19:00:00	770 a	24:00:00	768 a
04:15:00	771 a	09:15:00	771 a	14:15:00	770 a	19:15:00	770 a		
04:30:00	771 a	09:30:00	770 a	14:30:00	770 a	19:30:00	770 a		
04:45:00	770 a	09:45:00	771 a	14:45:00	770 a	19:45:00	770 a		
05:00:00	770 *	10:00:00	770 a	15:00:00	770 a	20:00:00	770 a		

PROVISIONAL DATA — JANUARY 20, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	768 a	05:15:00	767 a	10:15:00	767 a	15:15:00	766 a	20:15:00	767 a
00:30:00	768 a	05:30:00	767 a	10:30:00	767 a	15:30:00	766 a	20:30:00	767 a
00:45:00	768 a	05:45:00	767 a	10:45:00	767 a	15:45:00	766 a	20:45:00	767 a
01:00:00	768 a	06:00:00	767 a	11:00:00	767 a	16:00:00	766 a	21:00:00	767 a
01:15:00	768 a	06:15:00	767 a	11:15:00	767 a	16:15:00	766 a	21:15:00	766 a
01:30:00	768 a	06:30:00	767 a	11:30:00	767 a	16:30:00	766 a	21:30:00	767 a
01:45:00	767 a	06:45:00	767 a	11:45:00	767 a	16:45:00	766 a	21:45:00	766 a
02:00:00	767 a	07:00:00	767 a	12:00:00	767 a	17:00:00	766 a	22:00:00	766 a
02:15:00	767 a	07:15:00	767 a	12:15:00	767 a	17:15:00	766 a	22:15:00	767 a
02:30:00	767 a	07:30:00	767 a	12:30:00	767 a	17:30:00	766 a	22:30:00	767 a
02:45:00	767 a	07:45:00	767 a	12:45:00	767 a	17:45:00	766 a	22:45:00	767 a
03:00:00	767 a	08:00:00	767 a	13:00:00	767 a	18:00:00	767 a	23:00:00	767 a
03:15:00	767 a	08:15:00	767 a	13:15:00	767 a	18:15:00	766 a	23:15:00	766 a
03:30:00	767 a	08:30:00	767 a	13:30:00	767 a	18:30:00	766 a	23:30:00	766 a
03:45:00	767 a	08:45:00	767 a	13:45:00	767 a	18:45:00	766 a	23:45:00	766 a
04:00:00	767 a	09:00:00	767 a	14:00:00	767 a	19:00:00	766 a	24:00:00	766 a
04:15:00	767 a	09:15:00	767 a	14:15:00	766 *	19:15:00	767 a		
04:30:00	767 a	09:30:00	767 a	14:30:00	766 a	19:30:00	767 a		
04:45:00	767 a	09:45:00	767 a	14:45:00	766 a	19:45:00	767 a		
05:00:00	767 a	10:00:00	767 a	15:00:00	766 a	20:00:00	767 a		

Start of Test

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS, FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 21, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	766 a	05:15:00	766 a	10:15:00	767 a	15:15:00	766 a	20:15:00	766 a
00:30:00	766 a	05:30:00	766 a	10:30:00	767 a	15:30:00	766 a	20:30:00	766 a
00:45:00	766 a	05:45:00	766 a	10:45:00	767 a	15:45:00	766 a	20:45:00	766 a
01:00:00	766 a	06:00:00	766 a	11:00:00	767 a	16:00:00	766 a	21:00:00	766 a
01:15:00	766 a	06:15:00	766 a	11:15:00	767 a	16:15:00	766 a	21:15:00	766 a
01:30:00	766 a	06:30:00	766 a	11:30:00	767 a	16:30:00	766 a	21:30:00	766 a
01:45:00	766 a	06:45:00	766 a	11:45:00	767 a	16:45:00	766 a	21:45:00	766 a
02:00:00	766 a	07:00:00	766 *	12:00:00	767 a	17:00:00	766 a	22:00:00	766 a
02:15:00	766 a	07:15:00	766 a	12:15:00	767 a	17:15:00	766 a	22:15:00	766 a
02:30:00	766 a	07:30:00	766 a	12:30:00	767 a	17:30:00	766 a	22:30:00	767 a
02:45:00	766 a	07:45:00	767 a	12:45:00	767 a	17:45:00	766 a	22:45:00	766 a
03:00:00	766 a	08:00:00	767 a	13:00:00	766 a	18:00:00	766 a	23:00:00	766 a
03:15:00	766 a	08:15:00	767 a	13:15:00	767 a	18:15:00	766 a	23:15:00	766 a
03:30:00	766 a	08:30:00	767 a	13:30:00	767 a	18:30:00	766 a	23:30:00	766 *
03:45:00	766 a	08:45:00	767 a	13:45:00	766 a	18:45:00	766 a	23:45:00	766 a
04:00:00	766 a	09:00:00	767 a	14:00:00	766 a	19:00:00	766 a	24:00:00	766 a
04:15:00	766 a	09:15:00	767 a	14:15:00	766 a	19:15:00	766 a		
04:30:00	766 a	09:30:00	767 a	14:30:00	766 a	19:30:00	766 a		
04:45:00	766 a	09:45:00	767 a	14:45:00	766 a	19:45:00	766 a		
05:00:00	766 a	10:00:00	767 a	15:00:00	766 a	20:00:00	766 a		

PROVISIONAL DATA — JANUARY 22, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	766 a	05:15:00	766 a	10:15:00	767 a	15:15:00	766 a	20:15:00	767 a
00:30:00	766 a	05:30:00	766 a	10:30:00	767 a	15:30:00	766 a	20:30:00	766 a
00:45:00	766 a	05:45:00	766 a	10:45:00	767 a	15:45:00	766 a	20:45:00	766 a
01:00:00	766 a	06:00:00	766 a	11:00:00	767 a	16:00:00	766 a	21:00:00	767 a
01:15:00	766 a	06:15:00	766 a	11:15:00	767 a	16:15:00	766 *	21:15:00	767 a
01:30:00	766 a	06:30:00	766 a	11:30:00	767 a	16:30:00	766 a	21:30:00	767 a
01:45:00	766 a	06:45:00	767 a	11:45:00	767 a	16:45:00	766 a	21:45:00	767 a
02:00:00	766 a	07:00:00	767 a	12:00:00	767 a	17:00:00	766 a	22:00:00	767 a
02:15:00	766 a	07:15:00	766 a	12:15:00	767 a	17:15:00	766 a	22:15:00	767 a
02:30:00	766 a	07:30:00	767 a	12:30:00	767 a	17:30:00	766 a	22:30:00	767 a
02:45:00	766 a	07:45:00	767 a	12:45:00	767 a	17:45:00	766 a	22:45:00	767 a
03:00:00	766 a	08:00:00	767 a	13:00:00	767 a	18:00:00	766 a	23:00:00	767 a
03:15:00	766 a	08:15:00	767 a	13:15:00	767 a	18:15:00	766 a	23:15:00	767 a
03:30:00	766 a	08:30:00	767 a	13:30:00	767 a	18:30:00	766 a	23:30:00	767 a
03:45:00	766 a	08:45:00	767 a	13:45:00	766 a	18:45:00	766 a	23:45:00	767 a
04:00:00	766 a	09:00:00	767 a	14:00:00	766 a	19:00:00	766 a	24:00:00	767 a
04:15:00	766 a	09:15:00	767 a	14:15:00	766 a	19:15:00	766 a		
04:30:00	766 a	09:30:00	767 a	14:30:00	766 a	19:30:00	766 a		
04:45:00	766 a	09:45:00	766 a	14:45:00	766 a	19:45:00	766 a		
05:00:00	766 a	10:00:00	767 a	15:00:00	766 a	20:00:00	766 a		

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UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 23, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	767 a	05:15:00	767 a	10:15:00	767 a	15:15:00	766 a	20:15:00	766 a
00:30:00	767 a	05:30:00	766 a	10:30:00	767 a	15:30:00	766 a	20:30:00	766 a
00:45:00	767 a	05:45:00	767 a	10:45:00	767 a	15:45:00	766 a	20:45:00	766 a
01:00:00	767 a	06:00:00	767 a	11:00:00	767 a	16:00:00	766 a	21:00:00	766 a
01:15:00	767 a	06:15:00	766 a	11:15:00	767 a	16:15:00	766 a	21:15:00	766 a
01:30:00	767 a	06:30:00	767 a	11:30:00	767 a	16:30:00	766 a	21:30:00	766 a
01:45:00	766 a	06:45:00	767 a	11:45:00	767 a	16:45:00	766 a	21:45:00	766 a
02:00:00	766 a	07:00:00	767 a	12:00:00	767 a	17:00:00	766 a	22:00:00	766 a
02:15:00	766 a	07:15:00	767 a	12:15:00	767 a	17:15:00	766 a	22:15:00	766 a
02:30:00	766 a	07:30:00	767 a	12:30:00	767 a	17:30:00	766 a	22:30:00	766 a
02:45:00	766 a	07:45:00	767 a	12:45:00	767 a	17:45:00	766 a	22:45:00	767 a
03:00:00	767 a	08:00:00	767 a	13:00:00	767 a	18:00:00	766 a	23:00:00	767 a
03:15:00	766 a	08:15:00	767 a	13:15:00	767 a	18:15:00	766 a	23:15:00	767 a
03:30:00	766 a	08:30:00	767 a	13:30:00	767 a	18:30:00	766 a	23:30:00	767 a
03:45:00	766 a	08:45:00	767 *	13:45:00	767 a	18:45:00	766 a	23:45:00	767 a
04:00:00	766 a	09:00:00	767 a	14:00:00	767 a	19:00:00	766 a	24:00:00	767 a
04:15:00	766 a	09:15:00	767 a	14:15:00	767 a	19:15:00	766 a		
04:30:00	766 a	09:30:00	767 a	14:30:00	766 a	19:30:00	766 a		
04:45:00	766 a	09:45:00	767 a	14:45:00	766 a	19:45:00	766 a		
05:00:00	767 a	10:00:00	767 a	15:00:00	766 a	20:00:00	766 a		

PROVISIONAL DATA — JANUARY 24, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	767 a	05:15:00	767 a	10:15:00	767 a	15:15:00	767 a	20:15:00	767 a
00:30:00	767 a	05:30:00	766 a	10:30:00	767 a	15:30:00	767 a	20:30:00	767 a
00:45:00	767 a	05:45:00	766 a	10:45:00	767 a	15:45:00	767 a	20:45:00	767 a
01:00:00	767 a	06:00:00	766 a	11:00:00	767 a	16:00:00	767 a	21:00:00	767 a
01:15:00	767 a	06:15:00	766 a	11:15:00	767 a	16:15:00	767 a	21:15:00	767 a
01:30:00	767 *	06:30:00	766 a	11:30:00	767 a	16:30:00	767 a	21:30:00	767 a
01:45:00	767 a	06:45:00	767 a	11:45:00	767 a	16:45:00	767 a	21:45:00	767 a
02:00:00	767 a	07:00:00	766 a	12:00:00	767 a	17:00:00	767 a	22:00:00	767 a
02:15:00	767 a	07:15:00	767 a	12:15:00	767 a	17:15:00	767 a	22:15:00	767 a
02:30:00	767 a	07:30:00	767 a	12:30:00	767 a	17:30:00	767 a	22:30:00	767 a
02:45:00	766 a	07:45:00	767 a	12:45:00	767 a	17:45:00	767 a	22:45:00	767 a
03:00:00	766 a	08:00:00	767 a	13:00:00	767 a	18:00:00	767 *	23:00:00	767 a
03:15:00	766 a	08:15:00	767 a	13:15:00	767 a	18:15:00	767 a	23:15:00	767 a
03:30:00	767 a	08:30:00	767 a	13:30:00	767 a	18:30:00	767 a	23:30:00	767 a
03:45:00	767 a	08:45:00	767 a	13:45:00	767 a	18:45:00	767 a	23:45:00	767 a
04:00:00	767 a	09:00:00	767 a	14:00:00	767 a	19:00:00	767 a	24:00:00	767 a
04:15:00	767 a	09:15:00	767 a	14:15:00	767 a	19:15:00	767 a		
04:30:00	767 a	09:30:00	767 a	14:30:00	767 a	19:30:00	767 a		
04:45:00	767 a	09:45:00	767 a	14:45:00	767 a	19:45:00	767 a		
05:00:00	767 a	10:00:00	767 a	15:00:00	767 a	20:00:00	767 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS-FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 25, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	767 a	05:15:00	767 a	10:15:00	766 a	15:15:00	766 a	20:15:00	766 a
00:30:00	767 a	05:30:00	767 a	10:30:00	766 a	15:30:00	766 a	20:30:00	766 a
00:45:00	767 a	05:45:00	766 a	10:45:00	766 *	15:45:00	766 a	20:45:00	766 a
01:00:00	767 a	06:00:00	766 a	11:00:00	767 a	16:00:00	766 a	21:00:00	766 a
01:15:00	767 a	06:15:00	766 a	11:15:00	767 a	16:15:00	766 a	21:15:00	766 a
01:30:00	767 a	06:30:00	766 a	11:30:00	767 a	16:30:00	766 a	21:30:00	766 a
01:45:00	767 a	06:45:00	766 a	11:45:00	767 a	16:45:00	766 a	21:45:00	766 a
02:00:00	767 a	07:00:00	766 a	12:00:00	767 a	17:00:00	766 a	22:00:00	766 a
02:15:00	767 a	07:15:00	766 a	12:15:00	767 a	17:15:00	766 a	22:15:00	766 a
02:30:00	767 a	07:30:00	766 a	12:30:00	766 a	17:30:00	766 a	22:30:00	766 a
02:45:00	767 a	07:45:00	766 a	12:45:00	766 a	17:45:00	766 a	22:45:00	766 a
03:00:00	767 a	08:00:00	766 a	13:00:00	766 a	18:00:00	766 a	23:00:00	766 a
03:15:00	767 a	08:15:00	766 a	13:15:00	766 a	18:15:00	766 a	23:15:00	766 a
03:30:00	767 a	08:30:00	766 a	13:30:00	766 a	18:30:00	766 a	23:30:00	766 a
03:45:00	767 a	08:45:00	766 a	13:45:00	766 a	18:45:00	766 a	23:45:00	766 a
04:00:00	767 a	09:00:00	766 a	14:00:00	766 a	19:00:00	766 a	24:00:00	766 a
04:15:00	767 a	09:15:00	766 a	14:15:00	766 a	19:15:00	766 a		
04:30:00	767 a	09:30:00	766 a	14:30:00	766 a	19:30:00	766 a		
04:45:00	767 a	09:45:00	766 a	14:45:00	766 a	19:45:00	766 a		
05:00:00	767 a	10:00:00	766 a	15:00:00	766 a	20:00:00	766 a		

PROVISIONAL DATA — JANUARY 26, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	766 a	05:15:00	766 a	10:15:00	766 a	15:15:00	766 a	20:15:00	766 a
00:30:00	766 a	05:30:00	766 a	10:30:00	766 a	15:30:00	766 a	20:30:00	766 a
00:45:00	766 a	05:45:00	766 a	10:45:00	766 a	15:45:00	766 a	20:45:00	766 a
01:00:00	766 a	06:00:00	766 a	11:00:00	766 a	16:00:00	766 a	21:00:00	766 a
01:15:00	766 a	06:15:00	766 a	11:15:00	766 a	16:15:00	766 a	21:15:00	766 a
01:30:00	766 a	06:30:00	766 a	11:30:00	766 a	16:30:00	766 a	21:30:00	766 a
01:45:00	766 a	06:45:00	766 a	11:45:00	766 a	16:45:00	766 a	21:45:00	766 a
02:00:00	766 a	07:00:00	766 a	12:00:00	766 a	17:00:00	766 a	22:00:00	766 a
02:15:00	766 a	07:15:00	766 a	12:15:00	766 a	17:15:00	766 a	22:15:00	766 a
02:30:00	766 a	07:30:00	766 a	12:30:00	766 a	17:30:00	766 a	22:30:00	766 a
02:45:00	766 a	07:45:00	766 a	12:45:00	766 a	17:45:00	766 a	22:45:00	766 a
03:00:00	766 a	08:00:00	766 a	13:00:00	766 a	18:00:00	766 a	23:00:00	766 a
03:15:00	766 a	08:15:00	766 a	13:15:00	766 a	18:15:00	766 a	23:15:00	766 a
03:30:00	766 *	08:30:00	766 a	13:30:00	766 a	18:30:00	766 a	23:30:00	766 a
03:45:00	766 a	08:45:00	766 a	13:45:00	766 a	18:45:00	766 a	23:45:00	766 a
04:00:00	766 a	09:00:00	766 a	14:00:00	766 a	19:00:00	766 a	24:00:00	766 a
04:15:00	766 a	09:15:00	766 a	14:15:00	766 a	19:15:00	766 a		
04:30:00	766 a	09:30:00	766 a	14:30:00	766 a	19:30:00	766 a		
04:45:00	766 a	09:45:00	766 a	14:45:00	766 a	19:45:00	766 a		
05:00:00	766 a	10:00:00	766 a	15:00:00	766 a	20:00:00	766 *		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 03/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 27, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	766 a	05:15:00	766 a	10:15:00	765 a	15:15:00	766 a	20:15:00	766 a
00:30:00	766 a	05:30:00	766 a	10:30:00	766 a	15:30:00	766 a	20:30:00	766 a
00:45:00	766 a	05:45:00	766 a	10:45:00	766 a	15:45:00	766 a	20:45:00	766 a
01:00:00	766 a	06:00:00	766 a	11:00:00	765 a	16:00:00	766 a	21:00:00	766 a
01:15:00	766 a	06:15:00	766 a	11:15:00	766 a	16:15:00	766 a	21:15:00	766 a
01:30:00	766 a	06:30:00	766 a	11:30:00	766 a	16:30:00	766 a	21:30:00	766 a
01:45:00	766 a	06:45:00	766 a	11:45:00	766 a	16:45:00	766 a	21:45:00	766 a
02:00:00	766 a	07:00:00	766 a	12:00:00	766 a	17:00:00	766 a	22:00:00	766 a
02:15:00	766 a	07:15:00	766 a	12:15:00	766 a	17:15:00	766 a	22:15:00	766 a
02:30:00	766 a	07:30:00	766 a	12:30:00	766 a	17:30:00	766 a	22:30:00	766 a
02:45:00	766 a	07:45:00	766 a	12:45:00	765 *	17:45:00	766 a	22:45:00	766 a
03:00:00	766 a	08:00:00	766 a	13:00:00	766 a	18:00:00	766 a	23:00:00	766 a
03:15:00	766 a	08:15:00	766 a	13:15:00	766 a	18:15:00	766 a	23:15:00	766 a
03:30:00	766 a	08:30:00	766 a	13:30:00	766 a	18:30:00	766 a	23:30:00	766 a
03:45:00	765 a	08:45:00	766 a	13:45:00	766 a	18:45:00	766 a	23:45:00	766 a
04:00:00	766 a	09:00:00	766 a	14:00:00	766 a	19:00:00	766 a	24:00:00	766 a
04:15:00	766 a	09:15:00	766 a	14:15:00	766 a	19:15:00	766 a		
04:30:00	766 a	09:30:00	766 a	14:30:00	766 a	19:30:00	766 a		
04:45:00	766 a	09:45:00	766 a	14:45:00	766 a	19:45:00	766 a		
05:00:00	766 a	10:00:00	766 a	15:00:00	766 a	20:00:00	766 a		

PROVISIONAL DATA — JANUARY 28, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	766 a	05:15:00	765 *	10:15:00	766 a	15:15:00	765 a	20:15:00	765 a
00:30:00	766 a	05:30:00	765 a	10:30:00	766 a	15:30:00	765 a	20:30:00	765 a
00:45:00	765 a	05:45:00	765 a	10:45:00	766 a	15:45:00	765 a	20:45:00	765 a
01:00:00	765 a	06:00:00	765 a	11:00:00	766 a	16:00:00	765 a	21:00:00	765 a
01:15:00	766 a	06:15:00	765 a	11:15:00	766 a	16:15:00	765 a	21:15:00	765 a
01:30:00	766 a	06:30:00	765 a	11:30:00	766 a	16:30:00	765 a	21:30:00	765 a
01:45:00	765 a	06:45:00	765 a	11:45:00	766 a	16:45:00	765 a	21:45:00	765 a
02:00:00	765 a	07:00:00	765 a	12:00:00	766 a	17:00:00	766 a	22:00:00	765 *
02:15:00	765 a	07:15:00	765 a	12:15:00	766 a	17:15:00	766 a	22:15:00	765 a
02:30:00	765 a	07:30:00	765 a	12:30:00	766 a	17:30:00	766 a	22:30:00	765 a
02:45:00	765 a	07:45:00	765 a	12:45:00	765 a	17:45:00	765 a	22:45:00	765 a
03:00:00	765 a	08:00:00	765 a	13:00:00	765 a	18:00:00	765 a	23:00:00	765 a
03:15:00	765 a	08:15:00	765 a	13:15:00	766 a	18:15:00	765 a	23:15:00	765 a
03:30:00	765 a	08:30:00	766 a	13:30:00	765 a	18:30:00	765 a	23:30:00	765 a
03:45:00	765 a	08:45:00	766 a	13:45:00	766 a	18:45:00	765 a	23:45:00	765 a
04:00:00	765 a	09:00:00	766 a	14:00:00	766 a	19:00:00	765 a	24:00:00	765 a
04:15:00	765 a	09:15:00	766 a	14:15:00	766 a	19:15:00	765 a		
04:30:00	765 a	09:30:00	766 a	14:30:00	766 a	19:30:00	765 a		
04:45:00	765 a	09:45:00	766 a	14:45:00	765 a	19:45:00	765 a		
05:00:00	765 a	10:00:00	766 a	15:00:00	765 a	20:00:00	765 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 29, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	765 a	05:15:00	765 a	10:15:00	766 a	15:15:00	765 a	20:15:00	765 a
00:30:00	765 a	05:30:00	765 a	10:30:00	766 a	15:30:00	765 a	20:30:00	765 a
00:45:00	765 a	05:45:00	765 a	10:45:00	766 a	15:45:00	765 a	20:45:00	765 a
01:00:00	765 a	06:00:00	765 a	11:00:00	765 a	16:00:00	765 a	21:00:00	765 a
01:15:00	765 a	06:15:00	765 a	11:15:00	766 a	16:15:00	765 a	21:15:00	765 a
01:30:00	765 a	06:30:00	765 a	11:30:00	766 a	16:30:00	765 a	21:30:00	765 a
01:45:00	765 a	06:45:00	765 a	11:45:00	766 a	16:45:00	765 a	21:45:00	765 a
02:00:00	765 a	07:00:00	765 a	12:00:00	765 a	17:00:00	765 a	22:00:00	765 a
02:15:00	765 a	07:15:00	765 a	12:15:00	765 a	17:15:00	765 a	22:15:00	765 a
02:30:00	765 a	07:30:00	765 a	12:30:00	765 a	17:30:00	765 a	22:30:00	765 a
02:45:00	765 a	07:45:00	765 a	12:45:00	765 a	17:45:00	765 a	22:45:00	765 a
03:00:00	765 a	08:00:00	765 a	13:00:00	765 a	18:00:00	765 a	23:00:00	765 a
03:15:00	765 a	08:15:00	765 a	13:15:00	765 a	18:15:00	765 a	23:15:00	765 a
03:30:00	765 a	08:30:00	765 a	13:30:00	765 a	18:30:00	765 a	23:30:00	765 a
03:45:00	765 a	08:45:00	766 a	13:45:00	765 a	18:45:00	765 a	23:45:00	765 a
04:00:00	765 a	09:00:00	766 a	14:00:00	765 a	19:00:00	765 a	24:00:00	765 a
04:15:00	765 a	09:15:00	766 a	14:15:00	765 a	19:15:00	765 a		
04:30:00	765 a	09:30:00	766 a	14:30:00	765 *	19:30:00	765 a		
04:45:00	765 a	09:45:00	766 a	14:45:00	765 a	19:45:00	765 a		
05:00:00	765 a	10:00:00	766 a	15:00:00	765 a	20:00:00	765 a		

PROVISIONAL DATA — JANUARY 30, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	765 a	05:15:00	765 a	10:15:00	766 a	15:15:00	765 a	20:15:00	765 a
00:30:00	765 a	05:30:00	765 a	10:30:00	766 a	15:30:00	765 a	20:30:00	765 a
00:45:00	765 a	05:45:00	765 a	10:45:00	766 a	15:45:00	765 a	20:45:00	765 a
01:00:00	765 a	06:00:00	765 a	11:00:00	766 a	16:00:00	765 a	21:00:00	765 a
01:15:00	765 a	06:15:00	765 a	11:15:00	766 a	16:15:00	765 a	21:15:00	765 a
01:30:00	765 a	06:30:00	765 a	11:30:00	766 a	16:30:00	765 a	21:30:00	765 a
01:45:00	765 a	06:45:00	765 a	11:45:00	766 a	16:45:00	765 a	21:45:00	765 a
02:00:00	765 a	07:00:00	765 a	12:00:00	766 a	17:00:00	765 a	22:00:00	765 a
02:15:00	765 a	07:15:00	765 *	12:15:00	766 a	17:15:00	765 a	22:15:00	765 a
02:30:00	765 a	07:30:00	765 a	12:30:00	766 a	17:30:00	765 a	22:30:00	765 a
02:45:00	765 a	07:45:00	765 a	12:45:00	766 a	17:45:00	765 a	22:45:00	765 a
03:00:00	765 a	08:00:00	765 a	13:00:00	766 a	18:00:00	765 a	23:00:00	765 a
03:15:00	765 a	08:15:00	765 a	13:15:00	766 a	18:15:00	765 a	23:15:00	765 a
03:30:00	765 a	08:30:00	765 a	13:30:00	766 a	18:30:00	765 a	23:30:00	765 a
03:45:00	765 a	08:45:00	765 a	13:45:00	766 a	18:45:00	765 a	23:45:00	765 a
04:00:00	765 a	09:00:00	765 a	14:00:00	766 a	19:00:00	765 a	24:00:00	765 *
04:15:00	765 a	09:15:00	765 a	14:15:00	766 a	19:15:00	765 a		
04:30:00	765 a	09:30:00	765 a	14:30:00	765 a	19:30:00	765 a		
04:45:00	765 a	09:45:00	765 a	14:45:00	765 a	19:45:00	765 a		
05:00:00	765 a	10:00:00	765 a	15:00:00	765 a	20:00:00	765 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — JANUARY 31, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	765 a	05:15:00	765 a	10:15:00	765 a	15:15:00	765 a	20:15:00	765 a
00:30:00	766 a	05:30:00	765 a	10:30:00	765 a	15:30:00	765 a	20:30:00	765 a
00:45:00	765 a	05:45:00	765 a	10:45:00	765 a	15:45:00	765 a	20:45:00	765 a
01:00:00	765 a	06:00:00	765 a	11:00:00	765 a	16:00:00	765 a	21:00:00	765 a
01:15:00	765 a	06:15:00	765 a	11:15:00	765 a	16:15:00	765 a	21:15:00	765 a
01:30:00	765 a	06:30:00	765 a	11:30:00	765 a	16:30:00	765 *	21:30:00	765 a
01:45:00	765 a	06:45:00	765 a	11:45:00	765 a	16:45:00	765 a	21:45:00	765 a
02:00:00	765 a	07:00:00	765 a	12:00:00	765 a	17:00:00	765 a	22:00:00	765 a
02:15:00	765 a	07:15:00	765 a	12:15:00	765 a	17:15:00	765 a	22:15:00	765 a
02:30:00	765 a	07:30:00	765 a	12:30:00	765 a	17:30:00	765 a	22:30:00	765 a
02:45:00	765 a	07:45:00	765 a	12:45:00	765 a	17:45:00	765 a	22:45:00	765 a
03:00:00	765 a	08:00:00	765 a	13:00:00	765 a	18:00:00	765 a	23:00:00	765 a
03:15:00	765 a	08:15:00	765 a	13:15:00	765 a	18:15:00	765 a	23:15:00	765 a
03:30:00	765 a	08:30:00	765 a	13:30:00	765 a	18:30:00	765 a	23:30:00	765 a
03:45:00	765 a	08:45:00	765 a	13:45:00	765 a	18:45:00	765 a	23:45:00	765 a
04:00:00	765 a	09:00:00	765 a	14:00:00	765 a	19:00:00	765 a	24:00:00	765 a
04:15:00	765 a	09:15:00	765 a	14:15:00	765 a	19:15:00	765 a		
04:30:00	765 a	09:30:00	765 a	14:30:00	765 a	19:30:00	765 a		
04:45:00	765 a	09:45:00	765 a	14:45:00	765 a	19:45:00	765 a		
05:00:00	765 a	10:00:00	765 a	15:00:00	765 a	20:00:00	765 a		

PROVISIONAL DATA — FEBRUARY 01, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	765 a	05:15:00	765 a	10:15:00	765 a	15:15:00	765 a	20:15:00	765 a
00:30:00	765 a	05:30:00	765 a	10:30:00	765 a	15:30:00	765 a	20:30:00	765 a
00:45:00	765 a	05:45:00	765 a	10:45:00	765 a	15:45:00	765 a	20:45:00	765 a
01:00:00	765 a	06:00:00	765 a	11:00:00	765 a	16:00:00	765 a	21:00:00	765 a
01:15:00	765 a	06:15:00	764 a	11:15:00	765 a	16:15:00	765 a	21:15:00	765 a
01:30:00	765 a	06:30:00	764 a	11:30:00	765 a	16:30:00	765 a	21:30:00	765 a
01:45:00	765 a	06:45:00	764 a	11:45:00	765 a	16:45:00	765 a	21:45:00	765 a
02:00:00	765 a	07:00:00	764 a	12:00:00	766 a	17:00:00	765 a	22:00:00	765 a
02:15:00	765 a	07:15:00	765 a	12:15:00	765 a	17:15:00	765 a	22:15:00	765 a
02:30:00	765 a	07:30:00	764 a	12:30:00	765 a	17:30:00	765 a	22:30:00	765 a
02:45:00	765 a	07:45:00	765 a	12:45:00	765 a	17:45:00	765 a	22:45:00	765 a
03:00:00	765 a	08:00:00	765 a	13:00:00	765 a	18:00:00	765 a	23:00:00	765 a
03:15:00	765 a	08:15:00	765 a	13:15:00	765 a	18:15:00	765 a	23:15:00	765 a
03:30:00	765 a	08:30:00	765 a	13:30:00	765 a	18:30:00	765 a	23:30:00	765 a
03:45:00	765 a	08:45:00	765 a	13:45:00	765 a	18:45:00	765 a	23:45:00	765 a
04:00:00	765 a	09:00:00	765 a	14:00:00	765 a	19:00:00	765 a	24:00:00	765 a
04:15:00	765 a	09:15:00	765 *	14:15:00	765 a	19:15:00	765 a		
04:30:00	765 a	09:30:00	765 a	14:30:00	765 a	19:30:00	765 a		
04:45:00	765 a	09:45:00	765 a	14:45:00	765 a	19:45:00	765 a		
05:00:00	765 a	10:00:00	765 a	15:00:00	765 a	20:00:00	765 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — FEBRUARY 02, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	765 a	05:15:00	765 a	10:15:00	765 a	15:15:00	765 a	20:15:00	765 a
00:30:00	765 a	05:30:00	765 a	10:30:00	765 a	15:30:00	765 a	20:30:00	765 a
00:45:00	765 a	05:45:00	765 a	10:45:00	765 a	15:45:00	765 a	20:45:00	765 a
01:00:00	765 a	06:00:00	765 a	11:00:00	765 a	16:00:00	765 a	21:00:00	765 a
01:15:00	765 a	06:15:00	765 a	11:15:00	765 a	16:15:00	765 a	21:15:00	765 a
01:30:00	765 a	06:30:00	765 a	11:30:00	765 a	16:30:00	765 a	21:30:00	765 a
01:45:00	765 *	06:45:00	765 a	11:45:00	765 a	16:45:00	765 a	21:45:00	765 a
02:00:00	765 a	07:00:00	765 a	12:00:00	765 a	17:00:00	765 a	22:00:00	765 a
02:15:00	765 a	07:15:00	765 a	12:15:00	765 a	17:15:00	765 a	22:15:00	765 a
02:30:00	765 a	07:30:00	765 a	12:30:00	765 a	17:30:00	765 a	22:30:00	765 a
02:45:00	765 a	07:45:00	765 a	12:45:00	765 a	17:45:00	765 a	22:45:00	765 a
03:00:00	765 a	08:00:00	765 a	13:00:00	765 a	18:00:00	764 a	23:00:00	765 a
03:15:00	765 a	08:15:00	765 a	13:15:00	765 a	18:15:00	764 a	23:15:00	765 a
03:30:00	765 a	08:30:00	765 a	13:30:00	765 a	18:30:00	764 *	23:30:00	765 a
03:45:00	765 a	08:45:00	765 a	13:45:00	765 a	18:45:00	765 a	23:45:00	765 a
04:00:00	765 a	09:00:00	765 a	14:00:00	765 a	19:00:00	765 a	24:00:00	765 a
04:15:00	765 a	09:15:00	765 a	14:15:00	765 a	19:15:00	765 a		
04:30:00	765 a	09:30:00	765 a	14:30:00	765 a	19:30:00	765 a		
04:45:00	765 a	09:45:00	765 a	14:45:00	765 a	19:45:00	765 a		
05:00:00	765 a	10:00:00	765 a	15:00:00	765 a	20:00:00	765 a		

PROVISIONAL DATA — FEBRUARY 03, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	765 a	05:15:00	765 a	10:15:00	765 a	15:15:00	765 a	20:15:00	764 a
00:30:00	765 a	05:30:00	765 a	10:30:00	765 a	15:30:00	765 a	20:30:00	764 a
00:45:00	765 a	05:45:00	764 a	10:45:00	765 a	15:45:00	765 a	20:45:00	764 a
01:00:00	765 a	06:00:00	764 a	11:00:00	765 *	16:00:00	765 a	21:00:00	764 a
01:15:00	765 a	06:15:00	764 a	11:15:00	765 a	16:15:00	765 a	21:15:00	764 a
01:30:00	765 a	06:30:00	764 a	11:30:00	765 a	16:30:00	765 a	21:30:00	764 a
01:45:00	765 a	06:45:00	764 a	11:45:00	765 a	16:45:00	765 a	21:45:00	764 a
02:00:00	765 a	07:00:00	764 a	12:00:00	765 a	17:00:00	765 a	22:00:00	764 a
02:15:00	765 a	07:15:00	764 a	12:15:00	765 a	17:15:00	764 a	22:15:00	764 a
02:30:00	765 a	07:30:00	764 a	12:30:00	765 a	17:30:00	764 a	22:30:00	764 a
02:45:00	765 a	07:45:00	764 a	12:45:00	765 a	17:45:00	764 a	22:45:00	764
03:00:00	765 a	08:00:00	764 a	13:00:00	765 a	18:00:00	764 a	23:00:00	764 a
03:15:00	765 a	08:15:00	764 a	13:15:00	765 a	18:15:00	764 a	23:15:00	764 a
03:30:00	765 a	08:30:00	764 a	13:30:00	765 a	18:30:00	764 a	23:30:00	764 a
03:45:00	765 a	08:45:00	764 a	13:45:00	766 a	18:45:00	764 a	23:45:00	764 a
04:00:00	765 a	09:00:00	764 a	14:00:00	765 a	19:00:00	764 a	24:00:00	764 a
04:15:00	765 a	09:15:00	764 a	14:15:00	765 a	19:15:00	764 a		
04:30:00	765 a	09:30:00	764 a	14:30:00	765 a	19:30:00	764 a		
04:45:00	765 a	09:45:00	764 a	14:45:00	765 a	19:45:00	764 a		
05:00:00	765 a	10:00:00	765 a	15:00:00	765 a	20:00:00	764 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — FEBRUARY 04, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	765 a	05:15:00	765 a	10:15:00	764 a	15:15:00	765 a	20:15:00	764 *
00:30:00	765 a	05:30:00	764 a	10:30:00	764 a	15:30:00	765 a	20:30:00	764 a
00:45:00	765 a	05:45:00	764 a	10:45:00	764 a	15:45:00	765 a	20:45:00	764 a
01:00:00	765 a	06:00:00	764 a	11:00:00	765 a	16:00:00	765 a	21:00:00	764 a
01:15:00	765 a	06:15:00	764 a	11:15:00	764 a	16:15:00	765 a	21:15:00	764 a
01:30:00	765 a	06:30:00	764 a	11:30:00	764 a	16:30:00	765 a	21:30:00	764 a
01:45:00	765 a	06:45:00	764 a	11:45:00	764 a	16:45:00	765 a	21:45:00	764 a
02:00:00	765 a	07:00:00	764 a	12:00:00	765 a	17:00:00	765 a	22:00:00	764 a
02:15:00	765 a	07:15:00	764 a	12:15:00	764 a	17:15:00	764 a	22:15:00	764 a
02:30:00	765 a	07:30:00	764 a	12:30:00	764 a	17:30:00	764 a	22:30:00	764 a
02:45:00	765 a	07:45:00	764 a	12:45:00	764 a	17:45:00	764 a	22:45:00	764 a
03:00:00	765 a	08:00:00	764 a	13:00:00	765 a	18:00:00	764 a	23:00:00	764 a
03:15:00	765 a	08:15:00	764 a	13:15:00	765 a	18:15:00	764 a	23:15:00	764 a
03:30:00	765 a	08:30:00	764 a	13:30:00	765 a	18:30:00	764 a	23:30:00	764 a
03:45:00	765 *	08:45:00	764 a	13:45:00	764 a	18:45:00	764 a	23:45:00	764 a
04:00:00	765 a	09:00:00	764 a	14:00:00	765 a	19:00:00	764 a	24:00:00	764 a
04:15:00	765 a	09:15:00	764 a	14:15:00	765 a	19:15:00	764 a		
04:30:00	765 a	09:30:00	764 a	14:30:00	765 a	19:30:00	764 a		
04:45:00	765 a	09:45:00	764 a	14:45:00	765 a	19:45:00	764 a		
05:00:00	765 a	10:00:00	764 a	15:00:00	765 a	20:00:00	764 a		

PROVISIONAL DATA — FEBRUARY 05, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	764 a	03:00:00	765 a	05:45:00	764 a	08:30:00	764 a	11:15:00	764 a
00:30:00	764 a	03:15:00	765 a	06:00:00	764 a	08:45:00	764 a	11:30:00	764 a
00:45:00	764 a	03:30:00	765 a	06:15:00	764 a	09:00:00	764 a	11:45:00	764 a
01:00:00	764 a	03:45:00	765 a	06:30:00	764 a	09:15:00	764 a	12:00:00	764 a
01:15:00	764 a	04:00:00	765 a	06:45:00	764 a	09:30:00	764 a	12:15:00	764 a
01:30:00	764 a	04:15:00	765 a	07:00:00	764 a	09:45:00	764 a	12:30:00	764 a
01:45:00	764 a	04:30:00	765 a	07:15:00	764 a	10:00:00	764 a	12:45:00	764 a
02:00:00	764 a	04:45:00	764 a	07:30:00	764 a	10:15:00	764 a	13:00:00	764 a
02:15:00	765 a	05:00:00	764 a	07:45:00	764 a	10:30:00	764 a		
02:30:00	765 a	05:15:00	764 a	08:00:00	764 a	10:45:00	764 a		
02:45:00	765 a	05:30:00	764 a	08:15:00	764 a	11:00:00	764 a		

FEBRUARY 06, 1989
There are no unit-values for this date

FEBRUARY 07, 1989
There are no unit-values for this date

PROVISIONAL DATA — FEBRUARY 08, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
14:30:00	764 a	16:30:00	764 a	18:30:00	764 a	20:30:00	764 a	22:30:00	764 a
14:45:00	764 a	16:45:00	765 a	18:45:00	764 a	20:45:00	764 a	22:45:00	764 a
15:00:00	765 a	17:00:00	764 a	19:00:00	764 a	21:00:00	764 a	23:00:00	764 a
15:15:00	764 a	17:15:00	764 a	19:15:00	764 a	21:15:00	764 a	23:15:00	764 a
15:30:00	764 a	17:30:00	764 a	19:30:00	764 a	21:30:00	764 a	23:30:00	764 a
15:45:00	764 a	17:45:00	764 a	19:45:00	764 a	21:45:00	764 a	23:45:00	764 a
16:00:00	764 a	18:00:00	764 a	20:00:00	764 a	22:00:00	764 a	24:00:00	764 a
16:15:00	764 a	18:15:00	764 a	20:15:00	764 a	22:15:00	764 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — FEBRUARY 09, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	764 a	05:15:00	764 a	10:15:00	764 a	15:15:00	764 a	20:15:00	764 a
00:30:00	764 a	05:30:00	764 a	10:30:00	764 a	15:30:00	764 a	20:30:00	764 a
00:45:00	764 a	05:45:00	764 a	10:45:00	764 a	15:45:00	764 a	20:45:00	764 a
01:00:00	764 a	06:00:00	764 a	11:00:00	764 a	16:00:00	764 a	21:00:00	764 a
01:15:00	764 a	06:15:00	764 a	11:15:00	764 a	16:15:00	764 a	21:15:00	764 a
01:30:00	764 a	06:30:00	764 a	11:30:00	763 a	16:30:00	764 a	21:30:00	764 a
01:45:00	764 a	06:45:00	764 a	11:45:00	764 a	16:45:00	764 a	21:45:00	764 a
02:00:00	764 a	07:00:00	764 a	12:00:00	764 a	17:00:00	764 a	22:00:00	764 a
02:15:00	764 a	07:15:00	764 a	12:15:00	764 a	17:15:00	764 a	22:15:00	764 a
02:30:00	764 a	07:30:00	764 a	12:30:00	764 a	17:30:00	764 a	22:30:00	764 a
02:45:00	764 a	07:45:00	764 a	12:45:00	764 a	17:45:00	764 a	22:45:00	764 a
03:00:00	764 a	08:00:00	764 a	13:00:00	764 a	18:00:00	764 a	23:00:00	764 a
03:15:00	764 a	08:15:00	764 a	13:15:00	764 a	18:15:00	764 a	23:15:00	764 a
03:30:00	764 a	08:30:00	764 a	13:30:00	764 a	18:30:00	764 a	23:30:00	764 a
03:45:00	764 a	08:45:00	764 a	13:45:00	764 a	18:45:00	764 a	23:45:00	764 a
04:00:00	764 a	09:00:00	763 a	14:00:00	764 a	19:00:00	764 a	24:00:00	764 a
04:15:00	764 a	09:15:00	763 a	14:15:00	764 a	19:15:00	764 a		
04:30:00	764 a	09:30:00	763 a	14:30:00	764 a	19:30:00	764 a		
04:45:00	764 a	09:45:00	764 a	14:45:00	764 a	19:45:00	764 a		
05:00:00	764 a	10:00:00	764 a	15:00:00	764 a	20:00:00	764 a		

PROVISIONAL DATA — FEBRUARY 10, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	764 a	05:15:00	764 a	10:15:00	764 a	15:15:00	764 a	20:15:00	764 a
00:30:00	764 a	05:30:00	764 a	10:30:00	764 a	15:30:00	764 a	20:30:00	764 a
00:45:00	764 a	05:45:00	764 a	10:45:00	764 a	15:45:00	764 a	20:45:00	764 a
01:00:00	764 a	06:00:00	764 a	11:00:00	764 a	16:00:00	764 a	21:00:00	764 a
01:15:00	764 a	06:15:00	764 a	11:15:00	764 a	16:15:00	764 a	21:15:00	764 a
01:30:00	764 a	06:30:00	764 a	11:30:00	763 a	16:30:00	764 a	21:30:00	764 a
01:45:00	764 a	06:45:00	764 a	11:45:00	764 a	16:45:00	764 a	21:45:00	764 a
02:00:00	764 a	07:00:00	764 a	12:00:00	764 a	17:00:00	764 a	22:00:00	764 a
02:15:00	764 a	07:15:00	764 a	12:15:00	764 a	17:15:00	764 a	22:15:00	764 a
02:30:00	764 a	07:30:00	764 a	12:30:00	764 a	17:30:00	764 a	22:30:00	764 a
02:45:00	764 a	07:45:00	764 a	12:45:00	764 a	17:45:00	765 a	22:45:00	764 a
03:00:00	764 a	08:00:00	764 a	13:00:00	764 a	18:00:00	764 a	23:00:00	764 a
03:15:00	764 a	08:15:00	764 a	13:15:00	764 a	18:15:00	764 a	23:15:00	764 a
03:30:00	764 a	08:30:00	764 a	13:30:00	764 a	18:30:00	764 a	23:30:00	764 a
03:45:00	764 a	08:45:00	764 a	13:45:00	764 a	18:45:00	764 a	23:45:00	764 a
04:00:00	764 a	09:00:00	764 a	14:00:00	764 a	19:00:00	764 a	24:00:00	764 a
04:15:00	764 a	09:15:00	764 a	14:15:00	764 a	19:15:00	764 a		
04:30:00	764 a	09:30:00	764 a	14:30:00	764 a	19:30:00	764 a		
04:45:00	764 a	09:45:00	764 a	14:45:00	764 a	19:45:00	764 a		
05:00:00	764 a	10:00:00	764 a	15:00:00	764 a	20:00:00	764 a		

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/02/89

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
GAGE HEIGHT, IN DIAL UNITS EDITED UNIT VALUES (INSTANTANEOUS)

PROVISIONAL DATA — FEBRUARY 11, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	764 a	05:15:00	764 a	10:15:00	257 a	15:15:00	252 a	20:15:00	751 a
00:30:00	764 a	05:30:00	764 a	10:30:00	255 a	15:30:00	253 a	20:30:00	751 a
00:45:00	764 a	05:45:00	764 a	10:45:00	253 a	15:45:00	254 a	20:45:00	752 a
01:00:00	764 a	06:00:00	764 a	11:00:00	251 a	16:00:00	255 a	21:00:00	752 a
01:15:00	764 a	06:15:00	764 a	11:15:00	250 a	16:15:00	255 a	21:15:00	753 a
01:30:00	764 a	06:30:00	764 a	11:30:00	250 a	16:30:00	257 a	21:30:00	753 a
01:45:00	764 a	06:45:00	764 a	11:45:00	247 a	16:45:00	256 a	21:45:00	754 a
02:00:00	764 a	07:00:00	764 a	12:00:00	246 a	17:00:00	257 a	22:00:00	754 a
02:15:00	764 a	07:15:00	764 a	12:15:00	246 a	17:15:00	260 a	22:15:00	754 a
02:30:00	764 a	07:30:00	764 a	12:30:00	245 a	17:30:00	521 a	22:30:00	755 a
02:45:00	764 a	07:45:00	764 a	12:45:00	244 a	17:45:00	727 a	22:45:00	755 a
03:00:00	764 a	08:00:00	764 a	13:00:00	244 a	18:00:00	737 a	23:00:00	755 a
03:15:00	764 a	08:15:00	764 a	13:15:00	243 a	18:15:00	740 a	23:15:00	755 a
03:30:00	764 a	08:30:00	764 a	13:30:00	244 a	18:30:00	743 a	23:30:00	756 a
03:45:00	764 a	08:45:00	764 a	13:45:00	243 a	18:45:00	745 a	23:45:00	756 a
04:00:00	764 a	09:00:00	764 a	14:00:00	243 a	19:00:00	746 a	24:00:00	756 a
04:15:00	764 a	09:15:00	764 a	14:15:00	245 a	19:15:00	747 a		
04:30:00	764 a	09:30:00	688 a	14:30:00	245 a	19:30:00	748 a		
04:45:00	764 a	09:45:00	274 a	14:45:00	246 a	19:45:00	749 a		
05:00:00	764 a	10:00:00	262 a	15:00:00	249 a	20:00:00	750 a		

PROVISIONAL DATA — FEBRUARY 12, 1989 — SUBJECT TO REVISION

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
00:15:00	756 a	05:15:00	759 a	10:15:00	760 a	15:15:00	761 a	20:15:00	761 a
00:30:00	756 a	05:30:00	759 a	10:30:00	760 a	15:30:00	761 a	20:30:00	761 a
00:45:00	757 a	05:45:00	759 a	10:45:00	760 a	15:45:00	762 a	20:45:00	761 a
01:00:00	757 a	06:00:00	759 a	11:00:00	760 a	16:00:00	761 a	21:00:00	761 a
01:15:00	757 a	06:15:00	759 a	11:15:00	760 a	16:15:00	761 a	21:15:00	761 a
01:30:00	757 a	06:30:00	759 a	11:30:00	760 a	16:30:00	761 a	21:30:00	761 a
01:45:00	757 a	06:45:00	759 a	11:45:00	760 a	16:45:00	761 a	21:45:00	761 a
02:00:00	757 a	07:00:00	759 a	12:00:00	760 a	17:00:00	761 a	22:00:00	761 a
02:15:00	758 a	07:15:00	759 a	12:15:00	760 a	17:15:00	761 a	22:15:00	761 a
02:30:00	758 a	07:30:00	759 a	12:30:00	760 a	17:30:00	761 a	22:30:00	761 a
02:45:00	758 a	07:45:00	759 a	12:45:00	761 a	17:45:00	761 a	22:45:00	761 a
03:00:00	758 a	08:00:00	760 a	13:00:00	761 a	18:00:00	761 a	23:00:00	761 a
03:15:00	758 a	08:15:00	760 a	13:15:00	761 a	18:15:00	761 a	23:15:00	761 a
03:30:00	758 a	08:30:00	759 a	13:30:00	761 a	18:30:00	761 a	23:30:00	761 a
03:45:00	758 a	08:45:00	759 a	13:45:00	761 a	18:45:00	761 a	23:45:00	761 a
04:00:00	758 a	09:00:00	760 a	14:00:00	761 a	19:00:00	761 a	24:00:00	761 a
04:15:00	758 a	09:15:00	760 a	14:15:00	761 a	19:15:00	761 a		
04:30:00	758 a	09:30:00	760 a	14:30:00	761 a	19:30:00	761 a		
04:45:00	759 a	09:45:00	760 a	14:45:00	761 a	19:45:00	761 a		
05:00:00	759 a	10:00:00	760 a	15:00:00	761 a	20:00:00	761 a		

NOTE. SYMBOLS USED ABOVE HAVE THE FOLLOWING MEANINGS --
* = VALUE EDITED BY USGS PERSONEL
a = THIS VALUE IS FROM PAPER TAPE

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
EXPANDED RATING TABLE
DATE PROCESSED: 04-26-1989 @ 15:40 BY JKIESLER

TYPE: LINEAR

02306000
SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA.
NO OFFSETS USED

DD: 2 TYPE: 001 RATING NO: 16.0
START DATE/TIME: 10-01-87 (0015)

INPUT VALUE	GAGE HEIGHT (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Y PER .1 UNITS
6.80	23.800*	24.000	24.200	24.400	24.600	24.800	25.000	25.200	25.400	25.600	2.000
6.90	25.800*	26.000	26.200	26.400	26.600	26.800	27.000	27.200	27.400	27.600	2.000
7.00	27.800*	28.000	28.200	28.400	28.600	28.800	29.000	29.200	29.400	29.600	2.000
7.10	29.800*	30.000	30.200	30.400	30.600	30.800	31.000	31.200	31.400	31.600	2.000
7.20	31.800*	32.000	32.200	32.400	32.600	32.800	33.000	33.200	33.400	33.600	2.000
7.30	33.800	34.000	34.200	34.400	34.600	34.800	35.000	35.200	35.400	35.600	2.000
7.40	35.800	36.000	36.200	36.400	36.600	36.800	37.000	37.200	37.400	37.600	2.000
7.50	37.800	38.000	38.200	38.400	38.600	38.800	39.000	39.200	39.400	39.600	2.000
7.60	39.800	40.000	40.200	40.400	40.600	40.800*	41.000	41.200	41.400	41.600	2.000
7.70	41.800	42.000	42.200	42.400	42.600	42.800	43.000	43.200	43.400	43.600	2.000
7.80	43.800*	44.000	44.200	44.400	44.600	44.800	45.000	45.200	45.400	45.600	2.000
7.90	45.800*	46.000	46.200	46.400	46.600	46.800	47.000	47.200	47.400	47.600	2.000
8.00	47.800*	48.000	48.200	48.400	48.600	48.800	49.000	49.200	49.400	49.600	2.000*
8.10	49.800*										

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
EXPANDED RATING TABLE
DATE PROCESSED: 04-26-1989 @ 15:40 BY JKIESLER

TYPE: LINEAR

02306000
SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA.
NO OFFSETS USED

DD: 2 TYPE: 001 RATING NO: 17.0
START DATE/TIME: 03-01-86 (0100)

INPUT VALUE	GAGE HEIGHT (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Y PER .1 UNITS
6.30	4.320*	4.399	4.478	4.557	4.636	4.715	4.794	4.873	4.952	5.031	.790
6.40	5.110*	5.189	5.267	5.346	5.424	5.503	5.581	5.660	5.739	5.817	.786
6.50	5.896	5.974	6.053	6.131	6.210*	6.291	6.371	6.452	6.532	6.613	.798
6.60	6.694	6.774	6.855	6.936	7.016	7.097	7.177	7.258	7.339	7.419	.806*
6.70	7.500*										

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/11/90

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS, FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e44	40	e41	40	38	37	39	e24	e23	36	42	44
2	e44	40	e41	40	38	38	40	e29	e23	36	41	46
3	e44	40	e42	40	38	38	40	36	e23	36	41	47
4	e44	41	e41	40	38	37	40	e34	e23	36	41	46
5	e44	41	e41	39	e38	37	40	e23	e23	37	40	47
6	e44	40	e42	39	e38	e38	40	e23	e23	37	40	47
7	e44	40	e42	39	e38	e38	39	e23	e23	37	39	46
8	e43	40	e41	39	e38	e38	39	e23	e23	37	39	46
9	e43	40	e42	38	38	e38	38	e23	e23	37	39	46
10	e43	40	e42	38	38	39	38	e23	e23	37	41	46
11	e43	39	e41	38	e37	e39	38	e23	e23	37	40	46
12	e43	39	e41	38	36	39	38	e23	24	37	40	45
13	e43	39	e42	38	37	36	38	e23	e36	37	40	45
14	43	39	e41	38	37	37	39	e23	e36	37	40	45
15	43	39	e41	38	37	40	39	e23	e36	37	40	45
16	43	e39	42	38	37	40	39	e23	e36	37	40	44
17	42	e39	41	38	37	40	39	e23	e37	37	40	44
18	42	e39	41	40	37	40	39	e23	e36	37	40	44
19	41	e39	41	41	37	40	39	e23	37	38	40	44
20	41	e39	41	39	37	40	39	e23	36	38	40	45
21	41	e40	41	39	37	40	39	e23	35	38	40	44
22	41	e40	41	39	37	40	38	e23	35	38	42	44
23	41	e40	41	39	37	40	38	e23	37	40	42	46
24	41	e40	41	39	37	40	38	e23	37	40	41	45
25	40	e40	41	39	37	40	38	e23	35	41	42	45
26	40	e40	41	39	37	40	38	e23	33	41	43	45
27	40	e40	41	39	37	40	e29	e23	33	40	43	44
28	40	e40	41	38	37	40	e25	e23	36	40	44	44
29	40	e40	41	38	---	39	e25	e23	35	40	43	44
30	40	e40	41	38	---	40	e25	e23	36	41	43	44
31	40	---	40	38	---	40	---	e23	---	41	43	---
TOTAL	1305	1192	1277	1203	1045	1208	1113	744	919	1178	1269	1353
MEAN	42.1	39.7	41.2	38.8	37.3	39.0	37.1	24.0	30.6	38.0	40.9	45.1
MAX	44	41	42	41	38	40	40	36	37	41	44	47
MIN	40	39	40	38	36	36	25	23	23	36	39	44
AC-FT	2590	2360	2530	2390	2070	2400	2210	1480	1820	2340	2520	2680

CAL YR 1988 TOTAL 12537 MEAN 34.3 MAX 45 MIN 13 AC-FT 24870
WTR YR 1989 TOTAL 13806 MEAN 37.8 MAX 47 MIN 23 AC-FT 27380

e Estimated

STATION NUMBER 02306000   SULPHUR SPRINGS AT SULPHUR SPRINGS, FLA.   SPRING   SOURCE AGENCY USGS
LATITUDE 280115   LONGITUDE 0822707   GEOLOGIC UNIT   DATUM   STATE 12   COUNTY 057

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	41	34	39	40	37	35	33	29	27	28	30	38
2	41	34	40	40	37	35	32	29	27	28	30	38
3	41	33	40	40	37	34	32	29	26	28	30	38
4	42	33	40	39	37	35	32	29	26	28	30	38
5	42	33	41	39	37	35	32	29	26	28	31	39
6	43	32	41	39	37	35	32	29	18	28	31	41
7	43	32	42	39	36	34	32	29	15	28	31	42
8	42	32	42	39	36	34	32	29	25	28	32	43
9	42	31	42	39	36	34	31	29	26	28	32	44
10	41	31	42	39	36	35	31	29	26	29	32	44
11	41	31	42	39	36	34	30	20	26	29	32	45
12	42	31	42	39	36	34	31	24	26	25	32	44
13	41	31	42	38	36	34	30	28	25	16	33	44
14	40	32	41	38	36	34	30	28	26	16	34	44
15	40	32	41	38	36	34	30	28	26	16	34	44
16	40	33	41	38	36	34	30	28	18	16	35	e44
17	39	33	41	38	35	34	30	28	13	16	35	e44
18	39	34	41	38	35	34	30	28	13	16	35	e44
19	39	34	41	38	35	35	30	28	13	16	36	e44
20	38	35	41	38	35	34	30	22	13	16	36	e44
21	38	35	41	38	35	34	30	28	13	16	36	e44
22	37	35	41	38	35	34	30	27	13	16	36	e44
23	37	36	40	37	35	34	30	27	20	16	36	e44
24	37	36	40	37	35	34	29	27	26	16	36	e44
25	36	37	40	39	35	33	29	23	26	16	36	e44
26	36	37	40	38	35	33	29	27	27	16	36	e44
27	36	38	40	37	35	33	29	27	27	25	37	e43
28	36	38	40	37	35	33	29	27	27	30	37	e44
29	35	38	40	37	35	33	29	27	27	30	37	e44
30	35	39	40	37	---	33	29	27	28	30	37	e44
31	34	---	40	37	---	32	---	27	---	30	37	---
TOTAL	1214	1020	1264	1187	1037	1053	913	857	675	704	1052	1285
MEAN	39.2	34.0	40.8	38.3	35.8	34.0	30.4	27.6	22.5	22.7	33.9	42.8
MAX	43	39	42	40	37	35	33	29	28	30	37	45
MIN	34	31	39	37	35	32	29	20	13	16	30	38
AC-FT	2410	2020	2510	2350	2060	2090	1810	1700	1340	1400	2090	2550

CAL YR 1987   TOTAL 14156   MEAN 38.8   MAX 49   MIN 30   AC-FT 28080
WTR YR 1988   TOTAL 12261   MEAN 33.5   MAX 45   MIN 13   AC-FT 24320

e Estimated

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 05/11/90

STATION NUMBER 02306000 SULPHUR SPRINGS AT SULPHUR SPRINGS,FLA. SPRING SOURCE AGENCY USGS
LATITUDE 280115 LONGITUDE 0822707 GEOLOGIC UNIT DATUM STATE 12 COUNTY 057
PROVISIONAL DATA SUBJECT TO REVISION

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

PROVISIONAL

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	42	11	34	37	35	--	---	---	---	---	---	---
2	42	10	34	36	35	--	---	---	---	---	---	---
3	41	10	34	36	35	--	---	---	---	---	---	---
4	41	10	34	36	35	--	---	---	---	---	---	---
5	41	10	34	36	35	--	---	---	---	---	---	---
6	41	10	34	36	35	--	---	---	---	---	---	---
7	40	10	34	36	35	--	---	---	---	---	---	---
8	41	10	34	36	27	--	---	---	---	---	---	---
9	40	10	35	36	27	--	---	---	---	---	---	---
10	40	10	34	36	27	--	---	---	---	---	---	---
11	40	9.5	34	36	34	--	---	---	---	---	---	---
12	39	9.4	35	36	36	--	---	---	---	---	---	---
13	39	9.2	35	36	36	--	---	---	---	---	---	---
14	39	9.3	34	36	36	--	---	---	---	---	---	---
15	39	23	35	36	36	--	---	---	---	---	---	---
16	39	33	35	36	36	--	---	---	---	---	---	---
17	39	33	35	36	36	--	---	---	---	---	---	---
18	39	33	35	36	35	--	---	---	---	---	---	---
19	38	33	35	36	35	--	---	---	---	---	---	---
20	38	33	37	36	35	--	---	---	---	---	---	---
21	38	33	37	35	35	--	---	---	---	---	---	---
22	38	33	36	35	35	--	---	---	---	---	---	---
23	38	34	37	35	24	--	---	---	---	---	---	---
24	36	33	36	35	--	--	---	---	---	---	---	---
25	37	34	36	35	--	--	---	---	---	---	---	---
26	23	34	36	35	--	--	---	---	---	---	---	---
27	12	34	36	36	--	---	---	---	---	---	---	---
28	12	34	37	36	--	---	---	---	---	---	---	---
29	11	33	37	36	---	---	---	---	---	---	---	---
30	11	34	37	35	---	---	---	---	---	---	---	---
31	11	---	37	35	---	---	---	---	---	---	---	---
TOTAL	1065	662.4	1094	1109	---	---	---	---	---	---	---	---
MEAN	34.4	22.1	35.3	35.8	---	---	---	---	---	---	---	---
MAX	42	34	37	37	---	---	---	---	---	---	---	---
MIN	11	9.2	34	35	---	---	---	---	---	---	---	---
AC-FT	2110	1310	2170	2200	---	---	---	---	---	---	---	---

CAL YR 1989 TOTAL 12853.4 MEAN 35.2 MAX 47 MIN 9.2 AC-FT 25490

CITY OF TAMPA

STORMWATER MANAGEMENT DIVISION

PLANNING AND DESIGN SECTION

TO: Sulphur Springs File

FROM: Michael J. Burwell

SUBJECT: Gage Heights at Sulphur Springs

DATE: February 8, 1989

According to Roman Mycek of the USGS the gage at Sulphur Springs is rated based on the following outfalls being available:

2 - Fixed overflows left crest 6.73' ngvd, 4' wide
right crest 6.58', 4.1' wide

2 rectangular cutouts in the sliding gate valves each .5' X 3.35'
crest of left cutout 6.33'
crest of right cutout 6.33'

2 vertical lift gates 4'8" wide by 5'1 3/4" high, opening from the bottom

Normal water level for the sulphur springs pool is about 7.5' ngvd.

APPENDIX J

1958 CITY OF TAMPA WATER DEPARTMENT

DYE TEST

(SEE MAP IN APPENDIX A)

EPC SKETCH OF PROBABLE FLOW PATH

SINK-HOLE INVESTIGATION

Commercial sodium fluorescein ($Na_2C_{20}H_{10}O_5$) or Uranin as it is often termed was used as the tracer, since it is the most frequently employed dye for this type of work. It is highly water soluble and in alkaline solution, it may be detected by its green fluorescence in concentrates as low as 0.10 ppb, but in most of the water in this area, 0.01 ppm was the lowest concentrate that could be detected, using a blank as a comparison. In the range of 0.025 to 0.10 ppm the dye could be detected with the naked eye. All the regular sampling points had a blank check before the dye was applied to the water, but two or three of the stations were added to the list after the application and therefore, we did not have a blank for comparison, so the results would not be very reliable at the present.

Approximately 8 pounds of the dye was put into solution before applying to the water (0.95 ppm or 1.0 ppm was enough to color 40-50 MG of Sulphur Springs water, so that it could be detected with the naked eye or 50-100 MG with the ultra violet light.)

0.02 to 0.10 ppm - naked eye
0.01 to 0.02 ppm - Ultra Violet Light

The point of application was a sink-hole just South of Fowler Avenue (See map for location.) This area consisted of a chain of sinks that ran South to what is called "Blue Sink". On Wednesday, January 22nd, at 9:50 A.M., the dye was applied to the water and by 2:15 P.M., the same day, the dye was completely gone from the point of application. Seven check stations were selected and the water sampled every thirty minutes until the dye appeared and then, only a visual check was made throughout the test. In some instances, random samples were taken.

SAMPLING STATIONS

1. 2nd sink-hole South of the point of application
2. 1st sink-hole North of "Blue Sink" (Very large boil)
3. Blue Sink
4. 1st sink-hole West of "Blue Sink" (Looked like stagnant water and abandoned as a sample station, but visual checks were made throughout the test.)
5. Trinity Springs or swimming hole, located East of Nebraska Avenue and North of Lindbergh Avenue
6. Sink South of Trinity Springs behind Service Station, located at Lindbergh Avenue and 9th Street. Orchid
7. 10th Street sink, located at Waters Avenue and 10th Street Alaska Spring
8. "Frog Pond", located at Annie Street and Mary Street
9. Sink East of Sanitary Sewer Lift Station, located at 97th Avenue and Mary Street (General Location) Elmer 98th
10. Pond off of 20th Street, West of Henderson Field.
11. Sulphur Springs Pool.

January 22, 1958

9:50 A.M. Dye applied to Water.
10:50 A.M. Dye appeared in sink, approximately 300 feet North of Blue Sink and was highly concentrated. This was approximately one-fourth of a mile South of the point of application.
11:35 A.M. Dye appeared in Blue Sink highly concentrated. The other sampling points showed negative results.
2:15 P.M. The dye was gone from point of application
4:15 P.M. Frog Pond (Annie & Mary Streets) - This looked like a pong of stagnant water with some green algae, but the dye could be seen slowly seeping upward at various points. The sample was filtered before testing with Ultra Violet Light and it contained approximately 0.10 ppm of the dye. This is one of the sampling stations that did not have a blank.

The sink East of the Sanitary Sewer Lift Station was clear with no trace of the dye. It was used to carry excess water away from the area since it was equipped with an influent pipe. The Owner claims that the water makes a direct line to Sulphur Springs and that he could prove it since the sand, silt and mud showed up at the Springs.
5:00 P.M. Negative results on all points South of Blue Sink.
6:00 P.M.
to 12:00 P.M. Negative results at Sulphur Springs. Samples taken on the hour

January 23, 1958

1:00 A.M.
to 7:30 A.M. Negative results at Sulphur Springs Pool
7:30 A.M. Visual check at Trinity Springs showed no indication of the dye. (Mr. Kelly)
11:00 A.M. Frog Pond - Dye still present 0.08 ppm.
11:15 A.M. Trinity Springs-0.10 ppm dye visible with the naked eye. The dye arrived at this point some time between 7:30 A.M. and 11:15 A.M.
11:30 A.M. Waters Avenue and 10th Street - 0.02 ppm. This was compared with the blank.
11:30 A.M. Blue Sink - 0.08 ppm. Most of the dye was gone from this area. No check on the sink directly South of Trinity. (Linebaugh Ave. and 9th St.)
1:45 P.M. Sink South of Trinity (Linebaugh Ave. and 9th St.) - 0.08 ppm and visible with the naked eye.

Sink East of Sanitary Sewer Lift Station - 0.0 ppm
Pond off 30th Street, West of Henderson Field - 0.08 ppm
Same concentration as Frog Pond.
2:00 P.M. Sulphur Springs - 0.02 ppm
3:00 P.M. Sulphur Springs - 0.02 ppm

10th Street - 0.02 ppm

With the very high concentration of dye in some sinks, no fish kills were observed.

4:00 P.M. to 12:00 P.M.	Sulphur Springs - 0.02 ppm
5:30 P.M. to 11:30 P.M.	10th Street Sink - 0.02 ppm

January 24, 1958

1:00 A.M.	Sulphur Springs Pool - 0.02 ppm
2:00 A.M.	Sulphur Springs Pool - 0.08 ppm - Dye can be seen with the naked eye in daylight. Very bright green. Samples taken every hour.
9:00 A.M.	Sulphur Springs - 0.10 ppm
9:15 A.M.	Salt Springs West of Sulphur Springs Pool - 0.05 ppm No blank
9:25 A.M.	Spring at White Tower - 0.0 ppm
2:00 A.M. to 8:00 A.M.	10th Street Sink - 0.02 ppm. Samples taken every three hours
9:45 A.M.	10th Street Sink - 0.02 ppm.
10:00 A.M.	Trinity Springs only a trace of the dye could be found. Linebaugh and 9th Street - 0.02 ppm
10:15 A.M.	Sink East of Sanitary Sewer Lift Station - 0.0 ppm.
10:30 A.M.	Frog Pond - 0.0 ppm
1:15 P.M.	Sulphur Springs - 0.05 ppm - Still visible with the naked eye. Very bright green
1:30 P.M.	Tourist Club Salt Spring - 0.05 ppm - No blank
1:40 P.M.	Hamilton Heath Well (Chicken House) - 0.0 ppm
11:30 P.M.	Sulphur Springs Pool began to clear up.

January 25, 1958

1:30 A.M.	Dye out of Sulphur Springs Pool. Approximately 23 hours visible with the naked eye.

APPROXIMATE TIME TABLE

One hour from dye application poita to a small sink, 300 feet North of Blue Sink.

Forty-five minutes from this point to Blue Sink

Between 20 and 23 hours from Blue Sink to Trinity Springs. The first sample on the 23rd at Trinity Springs was taken at 11:15 A.M. At 7:30 A.M., a visual check was made and the dye was not present, so it came in between 7:30 A.M. and 11:15 A.M. on the 23rd.

Between 22 to 25 hours from application point to Trinity Springs.

Between 15 to 18 hours from Trinity Springs to Sulphur Springs.

Approximately 40 hours from application point to Sulphur Springs. 9:50 A.M. on 1/22/58 to 2:00 A.M. on 1/24/58. The dye was visible in the pool approximately 23 hours with the naked eye.

Oct. 21, 1957 Flow 81.3 cfs or 36,490 gpm or 2,189,400 gph or 50,356,200 gals. per 23 hours.
So, going by the visible detection limits of the dye, the flow would probably be close to 81.3 cfs.

January 23, 1958

Waters Ave. & 10th St. Sink
11:30 A.M.

Total Hardness	320.00	ppm
Total Alk.	116.00	"
Calcium as Ca	88.00	"
Magnesium as Mg	24.30	"
Chlorides as Cl	380.00	"
Specific Conductance	1350.00	"
Non-Carbonate Hardness	204.00	"

Trinity Springs
11:15 A.M.

Total Hardness	130.00	ppm
Total Alk.	90.00	"
Non-carb.	40.00	"
Calcium as Ca	40.00	"
Magnesium as Mg	7.30	"
Chlorides as Cl	36.00	"
Specific Conductance	270.00	"

Blue Sink

Total Hardness	88.00	ppm
Total Alkalinity	72.00	"
Non-carb.	16.00	"
Calcium as Ca	28.00	"
Magnesium as Mg	4.40	"
Specific Conductance	170.00	"

Frog Pond

Total Hardness	160.00	ppm
Total Alk.	116.00	"
Non-carb.	46.00	"
Calcium as Ca	53.60	"
Magnesium as Mg	6.32	"
Chlorides as Cl	9.00	"
Specific Conductance	270.00	"

Pond off of 30th St. West of Henderson Field

Total Hardness	0.0	ppm
Total Alk.	2.0	ppm
Specific Conductance	35.00	ppm

Sink East of Sanitary Sewer Lift Station

Total Hardness	172.00	ppm
Total Alk.	96.00	"
Non-carb.	76.00	"
Calcium as Ca	59.20	""
Magnesium as Mg	5.80	"
Chlorides as Cl	8.00	"
Specific Conductance	300.00	"

Linebaugh and 9th Street Sink

Total Hardness	132.00	ppm
Total Alk.	110.00	"
Non-carb.	22.00	"
Calcium as Ca	44.00	"
Magnesium as Mg	5.40	"
Chlorides as Cl	36.00	"
Specific Conductance	300.00	"

/s/ C. P. Roddy

ENVIRONMENTAL PROTECTION COMMISSION

OF HILLSBOROUGH COUNTY (813) 272-5960

ROUTING SLIP

TO:

1. Rob W.
2.
3.
4.
5.
6.
7.
8.
9.
10.

- ☐ ACTION
- ☐ FILING
- ☐ RECOMMENDATIONS
- ☐ APPROVAL
- ☐ FULL REPORT
- ☐ CALL ME
- ☐ AS REQUESTED
- ☐ HANDLE DIRECT
- ☐ SEE ME
- ☐ CONCURRENCE
- ☐ INITIAL
- ☐ SIGNATURE
- ☐ CORRECTION
- ☐ NOTE & RETURN
- ☐ YOUR COMMENT
- ☐ PER CONVERSATION
- ☒ YOUR INFORMATION

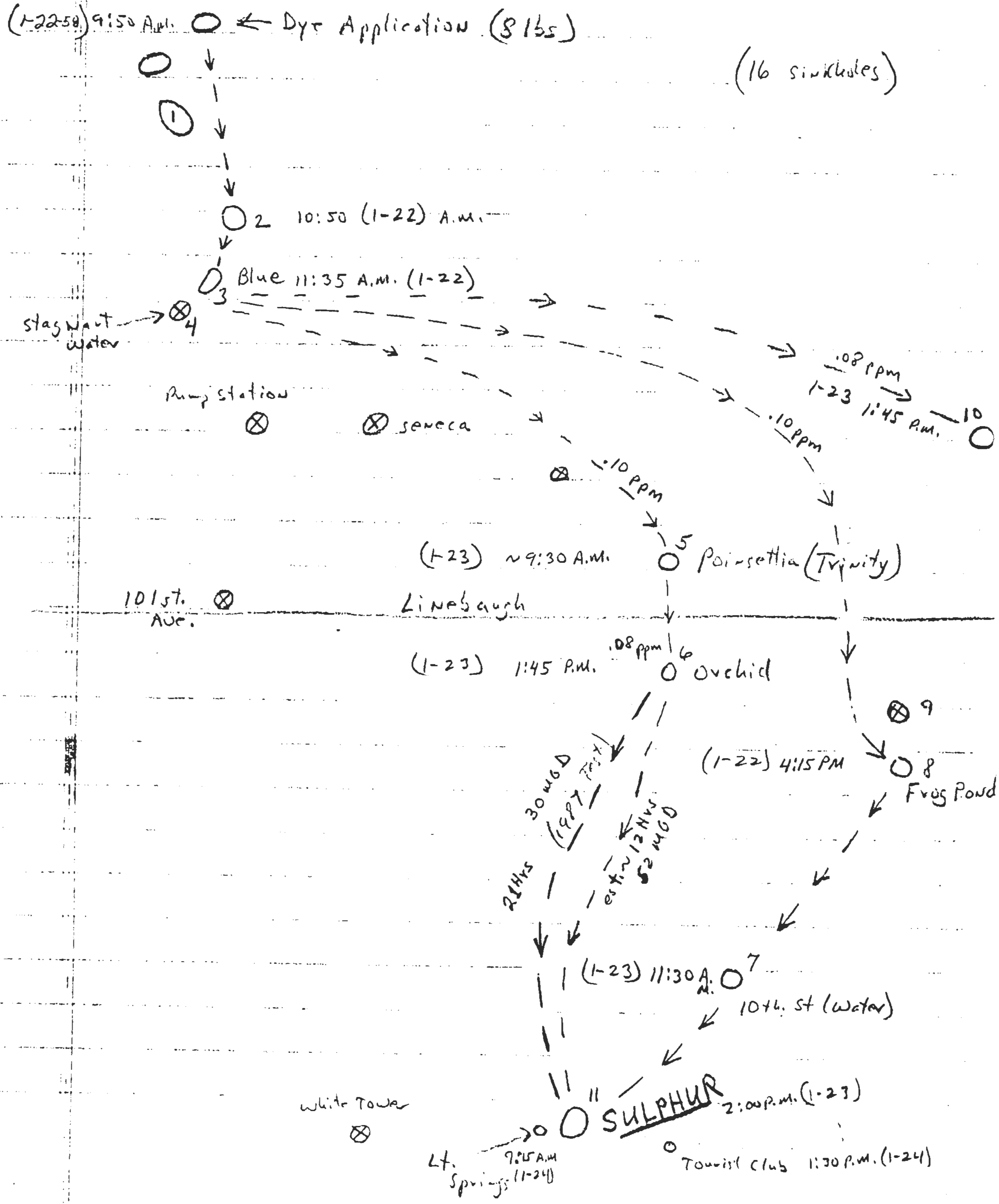
☐ ANSWER OR ACKNOWLEDGE ON OR BEFORE __________

☐ PREPARE REPLY FOR SIGNATURE OF __________

REMARKS: This is my interpretation of how the dye might have moved during the 1958 Dye Study.

FROM: Tom Cardinale | DATE: 3-21-89

1958 Dye Study



APPENDIX K

U.S.G.S. HYDROGEOLOGY OF SULPHUR SPRINGS

STEWART / MILLER 1984

EXCERPTS

HYDROGEOLOGY OF THE SULPHUR SPRINGS AREA, TAMPA, FLORIDA

By

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(EXCERPTS)

INTRODUCTION

The Sulphur Springs area encompasses about 56 mi² in west-central Florida and includes a highly urbanized section of the north-central part of the city of Tampa in west-central Hillsborough County (fig. 1). The area includes the city of Temple Terrace and the University of South Florida, several industrial and commercial plant sites, and a large commercial recreational site. The Hillsborough River flows southwesterly along the eastern and southern parts of the area. Most of the western half contains numerous lakes and is partly urbanized. The northeast quarter is largely swampy, but much of it is proposed for subdivision development. The northwest quarter is mostly rural, but is gradually becoming urbanized. The southeast quarter includes Temple Terrace and is highly urbanized. The west-central part has numerous sinkholes, an internally drained area, and an area that is subject to flooding. Storm runoff from two residential areas in Tampa is diverted into sinkholes that connect with the Floridan aquifer in the southwestern part of the area. Sulphur Springs, a large spring on the north side of the Hillsborough River near Interstate 275, is used as a supplemental water supply for the city of Tampa and is also a recreational area.

In 1980, the U.S. Geological Survey, in cooperation with the city of Tampa, began a study to determine the hydrogeology of the Sulphur Springs area. The purpose of the study was to provide hydrologic and geologic information that would assist managers in (1) protecting the water resources of the area, and (2) developing plans for control of construction and development where a high-water table and other hydrologic conditions are a factor. The information could be useful to evaluate the hydrologic impact of using sinkholes as stormwater retention basins, the design and construction of storm-runoff detention basins, the design and improvement of sanitary sewage system, and the location of underground utilities.

Previous and Present Investigations

Information on the hydrology and water quality of the area is included in a report by Menke and others (1961). Map reports of Lake Magdalene (Hunn and Reichenbaugh, 1972) and Lake Carroll (S.E. Henderson, U.S. Geological Survey, written commun., 1982) describe the general hydrology and geology at those lakes. Stewart and Hughes (1974) evaluated the effects on the Floridan aquifer of using ground water to maintain lake levels in the northwestern part of the area. Goetz and others (1978) evaluated the water-supply potential of the lower Hillsborough River. Maps that show the water table of the surficial aquifer and the potentiometric surface of the Floridan aquifer are prepared twice a year through a cooperative program with the Southwest Florida Water Management District. Hydrologic reports that contain data for several hydrologic monitoring stations in the area are published annually by the Geological Survey.

During this investigation (1981), field work included an inventory of wells and sinkholes, collection of water samples for coliform bacteria analyses from Sulphur Springs and three sinks, determination of peak water levels of the 1979 flood in the west-central part of the area, and measurements of water levels in wells for use in preparation of water-level and potentiometric-surface maps.

Climate

The climate of the area is characterized by warm, humid summers and mild, dry winters. An outstanding feature of the climate is the summer thunderstorms that frequently occur late in the afternoon during June through September. Based on records for the 40-year period from 1941 to 1980 at the Tampa weather station about 5 miles west of Sulphur Springs, the mean monthly temperature ranged from 60.9°F in January to 82.0°F in August (National Oceanic and Atmospheric Administration, 1981). The mean annual temperature for the period was 72.2°F. The average annual minimum and maximum temperatures were 63.3°F and 81.1°F, respectively. During the 40-year period, the mean monthly precipitation ranged from 1.61 inches in November to 8.01 inches in August. The mean annual precipitation was 48.71 inches, of which about 60 percent occurred during June through September.

Topography

Land-surface elevations range from less than 5 feet above sea level near the Hillsborough River in the southwestern part of the area below the Tampa Dam to 75 feet above sea level at Temple Terrace. The 5-, 25-, 35-, 50-, and 75-foot land contours are shown in figure 1. A conspicuous feature is the 8-mi² swampy area in the northeastern part of the area (fig. 1). Parts of the swamp are 25 to 35 feet above sea level, but most are less than 25 feet above sea level. Much of this area is poorly drained and remains wet throughout most years. Land-surface elevations are less than 25 feet above sea level in an internally drained sinkhole complex and several lakes in the west-central part of the area.

Streams

The principal stream in the Sulphur Springs area is the Hillsborough River. The average annual discharge of the river at the Tampa Dam (fig. 1) was 593 ft³/s for the period 1938 to 1978. The maximum discharge was 16,500 ft³/s in September 1933. The river did not have any flow for short periods during several years. Monthly mean discharges of the river at the Tampa Dam are shown in figure 2. The Hillsborough River is the principal source of water for the city of Tampa.

Other streams in the area include Cypress Creek and its principal tributary, Thirteenmile Run, in the northeastern part of the area; Sweetwater Creek in the northwestern part; and Curiosity Creek in the west-central part. The average daily discharge of Cypress Creek, about 5 miles northeast of Sulphur Springs, was 91.4 ft³/s from 1964 to 1980. The maximum discharge was 1,750 ft³/s that occurred in August 1965; periods of no flow occur during most years. The headwater of Sweetwater Creek is a series of interconnected lakes (fig. 1) that include Chapman Lake, Lake Magdalene, Bay Lake, and Lake Ellen. The creek discharges into Old Tampa Bay about 8 miles southwest of Lake Ellen. The average daily discharge of Sweetwater Creek at a station about 3.5 miles southwest of Lake Ellen was 7.3³/s from 1951 to 1979. Extremes in discharge ranged from 438 ft³/s in March 1960 to periods of no flow during some years. Curiosity Creek is an intermittent stream that begins in a swampy area on the east side of Sweetwater Creek near Lake Gass (fig. 1). The creek drains an area of 3.48 mi² and flows into a sinkhole in an internally drained area about 3 miles south of the lake. During calendar years 1979-80, the maximum flow of Curiosity Creek from 1.37 mi² of its basin was 28 ft³/s, but there were extended periods of no flow during both years.

Lakes

All lakes are in the western half of the study area. Lakes Carroll and Magdalene, the largest lakes (fig. 1), are in a highly urbanized area. Lake Carroll has a surface area of about 195 acres and Lake Magdalene about 232 acres. During 1946-80, the maximum daily elevation of Lake Carroll was 40.08 feet above sea level, and the minimum daily elevation was 32.35 feet. During the same period, the maximum daily elevation of Lake Magdalene was 51.00 feet above sea level, and the minimum daily elevation was 41.96 feet. Depths of Lake Carroll and Lake Magdalene are shown in figures 3 and 4. Lakes Charles, Saddleback, Round, and Crenshaw in the extreme northwest corner of the study area (fig. 1) are augmented with water pumped from Floridan aquifer wells (Stewart and Hughes, 1974). Depths of Saddleback Lake and Lake Charles are shown in figures 5 and 6.

GENERAL GEOLOGY

The Sulphur Springs area is overlain by surficial deposits of sand and clay that range in thickness from less than 30 feet near the Hillsborough River to more than 90 feet at Temple Terrace (fig. 7). The lower part of the surficial deposits consists of clay, sandy clay, and clayey sand that confine the Floridan aquifer throughout most of the area. The confining layer is about 10 feet thick near the south-central part of the area, about 40 feet thick in the northeastern and southwestern parts, and about 20 feet thick south of the Hillsborough River (fig. 8). Generally, the confining layer is thicker in the western half than in the eastern half. Carr and Alverson (1959) report the occurrence of patches of the Hawthorn Formation (confining layer) in the southeastern corner of the area, largely at Temple Terrace. Isolated patches of the Hawthorn Formation also occur along the south side of the Hillsborough River south of Temple Terrace. In the Sulphur Springs area, the Tampa Limestone forms the upper part of the Floridan aquifer. The generalized configuration of the top of the Floridan aquifer ranges from 60 feet below sea level in the northwestern part to about 20 feet above sea level in the western part (fig. 9). Geologic formations below the Tampa Limestone, in descending order, are the Suwannee Limestone, Ocala Limestone, Avon Park Limestone, and the Oldsmar Limestone.

Generalized geologic sections of the study area are shown in figures 10 and 11. Section A-A' (fig. 10) extends from the lake area in the west to the large swampy area in the northeast. The confining layer is fairly uniform along the section and ranges in thickness from about 20 to 30 feet. Section B-B' is south of the lake area, and the confining layer is thickest in the western part (about 40 feet) and is thinnest in the eastern part (about 20 feet).

Extensive cavity systems have been encountered during test drilling and during excavating for commercial and industrial plant sites between Busch Boulevard and Fletcher Avenue, about 2 miles east of Interstate 275. Large quantities of cement have been pumped into the cavities to strengthen structure foundations. There is an extensive cavity system in the Floridan aquifer from Sulphur Springs northward for about 2 miles or more and a fairly extensive and well-developed cavernous zone at depths of 120 to 180 feet below land surface in the Temple Terrace area (Stewart and others, 1978).

HYDRAULIC PROPERTIES OF THE FLORIDAN AQUIFER

The quantity of water that an aquifer will yield to wells depends, in part, upon the hydraulic characteristics of the aquifer and its overlying and underlying confining beds. The principal characteristics are: transmissivity (the ability of the aquifer to transmit water), storage coefficient (the ability of the aquifer to store water), leakance (the ability of the confining beds to transmit water vertically from an underlying or overlying aquifer into the pumped aquifer), and hydraulic conductivity (the ability of the aquifer to transmit water through a unit area of the aquifer).

The transmissivity of the Floridan aquifer in the Sulphur Springs area is for the most part high, but variable. Stewart and others (1978) reported a transmissivity of 1.3×10^{5} ft^2/d and a storage coefficient of 3.4×10^{-4} for the Temple Terrace area. Ryder and others (1980) derived a transmissivity of 6×10^{5} ft^2/d from model calibration of a well field that included the northeastern part of the Sulphur Springs area. The leakage coefficient ranges from 2×10^{-4} to 8×10^{-3} (ft/d)/ft. Hutchinson and others (1981) derived a transmissivity of 2×10^{5} ft^2/d from a two-dimensional model that included part of the area along the Hillsborough River.

A hydraulic conductivity of 1.9×10^{4} ft/d was obtained for a cavernous area north of Sulphur Springs using the results of two dye tests. It appears that most ground-water flow in this area is in the upper 100 to 200 feet of the Floridan aquifer. Because of the highly developed cavity system, estimated transmissivity for the Floridan aquifer is on the order of 2×10^{6} ft^2/d. The storage coefficient is estimated to be 1×10^{-3}.

The transmissivity of the Floridan aquifer in the northwestern part is 7.3×10^{4} ft^2/d, the storage coefficient is 5×10^{-4} (Stewart, 1968), and the leakage coefficient is 2.0×10^{-4} (ft/d)/ft. In an area 2-1/2 miles east of the northeastern part of the study area, Stewart (1977) reported a transmissivity of 1.3×10^{6} ft^2/d and a storage coefficient of 2×10^{-4} from test pumping a large-diameter sinkhole about three-fourths of a mile south of the Hillsborough River.

Based on the above studies completed in or near the Sulphur Springs area, transmissivity ranges from 7.3×10^{4} ft^2/d in the northwestern part to 1.3×10^{6} ft^2/d in the northeastern part and to 2×10^{6} ft^2/d north of Sulphur Springs. The transmissivity is generally highest near the Hillsborough River. Values obtained for transmissivity, leakage coefficient, and hydraulic conductivity indicate that the Floridan aquifer is highly productive in the study area.

WATER LEVELS

Water levels of the surficial aquifer and the potentiometric surface of the Floridan aquifer for May 1981 are shown by figures 12 and 13. Water levels in the surficial aquifer ranged from 20 feet above sea level in the southern part to 60 feet above sea level in the Temple Terrace area (fig. 12). High water levels in the southeastern part of the area are due largely to the low hydraulic conductivity of the greenish-gray clayey sands of the Hawthorn Formation. The material has a low permeability and restricts vertical movement of water from the surficial aquifer to the Floridan aquifer. Water levels in the surficial aquifer throughout the area ranged from 5 to 45 feet above the potentiometric surface. The highest water levels occur in topographically high areas, and the lowest water levels occur in topographically low areas. An area of low water levels, indicated by the 20- and 25-foot contours near Interstate 275, extends south of Fowler Avenue to the Hillsborough River and includes several well-developed and prominent sinkholes north of Sulphur Springs.

During May 1981, water levels in the surficial aquifer below Tampa Dam were less than 20 feet above sea level near the Hillsborough River and probably were less than a foot above sea level where the aquifer discharged into the river. In the tidal reach below the dam, the stage of the Hillsborough River ranged from less than 2 feet below sea level to less than 3 feet above sea level. Water levels in the surficial aquifer above the dam were less than 25 feet above sea level near the river and were less than 16 feet above sea level at the river. The stage of the Tampa reservoir was 16 feet above sea level. Thus, the surficial aquifer in the area is a source of ground-water discharge to the river, both upstream and downstream from the Tampa Dam.

In May 1981, the potentiometric surface of the Floridan aquifer ranged from 10 feet above sea level in the southern part of the area to 45 feet above sea level in the northern part. Figure 13 shows the general direction of ground-water movement by flow lines drawn normal to the contour lines. Ground-water movement is southerly from a potentiometric high in the northwestern part. In the southern part, most ground-water flow lines tend to converge towards Sulphur Springs and the Hillsborough River.

During May 1981, the potentiometric surface along the Hillsborough River channel below Tampa Dam was about 10 feet above the stage of the river. The head difference between the river and the Floridan aquifer indicates an upward pressure gradient along this part of the channel and represents potential discharge of water from the Floridan aquifer to the river. However, a test hole drilled in the riverbed in 1961, about half a mile southwest of Sulphur Springs, penetrated a green, sandy clay from 8 to 18 feet below sea level. This material forms the confining bed that overlies parts of the Floridan aquifer in the southeastern part of the area and, if unbreached, would restrict upward movement of Floridan aquifer water. Above the dam, the potentiometric surface of the Floridan aquifer under the reservoir area was 3 to 6 feet lower than the stage of the reservoir. Under this condition and assuming an absence of a confining layer, a potential exists for the reservoir to recharge the Floridan aquifer. Conversely, if the reservoir stage declines below the potentiometric surface, then the aquifer has the potential to discharge to the reservoir. The Floridan aquifer in the study area is recharged by leakage from the surficial aquifer and through sinkholes in internally drained areas that are directly and indirectly connected with the Floridan aquifer.

Based on the May 1981 potentiometric map, a ground-water gradient of about 15 feet in 1.8 miles (30- to 15-foot contours, fig. 13) exists west of Interstate 275 between Fletcher Avenue and Busch Boulevard. Immediately south, the gradient decreases to 5 feet in 1.5 miles, or a reduction of about 60 percent. The decrease in gradient is due (1) to an increase in transmissivity of the Floridan aquifer in the southern part of the area, and (2) to a change from an area of lateral or downward ground-water flow in the northern part of the area to one of upward ground-water discharge at Sulphur Springs and the Hillsborough River.

FLOODS

The west-central part of the Sulphur Springs area between Fowler Avenue and Busch Boulevard and west of Florida Avenue has flooded on numerous occasions during the past 25 years. Pride (1962) delineated the September 1960 flood areas along the Hillsborough River; Murphy and others (1982) prepared a report that delineated areas that were flooded during August-October 1979; and the city of Tampa Public Works Department (D.J. Terp, Chief Engineer, written commun., 1981) prepared maps that show areas flooded during floods occurring between September 1957 and September 1979. The 1960 and 1979 flood areas are shown in figure 1. These dates were selected to show flooding that occurred along the Hillsborough River and in the Fowler Avenue-Busch Boulevard area west of Florida Avenue.

WATER USE

In 1980, the city of Tampa pumped an average of 48.5 Mgal/d from the Hillsborough River Reservoir above the Tampa Dam (Duerr and Trommer, 1981). An additional 5 Mgal/d was pumped from Sulphur Springs in October, and 11.5 Mgal/d was pumped in November. The city also pumped 15.2 Mgal/d from its Morris Bridge well field located about 9 miles northeast of Sulphur Springs and about 1 mile east of the northeast corner of the study area. Sulphur Springs is used as a source of supplemental water supply during periods of low flow in the river and when water demands are high. The water from the spring is carried by pipeline and discharged into the Tampa Reservoir near the dam.

Water use in the area in 1980 (Duerr and Trommer, 1981) included the following:

Ground water	*Quantity pumped (Mgal/d)*
Public water supplies:	
City of Tampa (Sulphur Springs)	1.38
City of Temple Terrace	2.13
Florida Citrus Water Company (Carrollwood area)	.77
University of South Florida	.40
Industrial and commercial	1.50
Irrigation	1.00
Air conditioning	.02
Total ground water	7.20
Surface water	
Public water supply:	
City of Tampa (Hillsborough River)	48.5
Total surface water	48.5

SPRINGS

One large spring, Sulphur Springs, and two small springs, Lowry Park Spring and Temple Terrace Spring, are near the Hillsborough River (fig. 1). Sulphur Springs is about a quarter of a mile east of Interstate 275; its discharge ranged from 22 to 39 Mgal/d during 1980. Lowry Park Spring (discharge less than 10 gal/min) is on the west side of the river about two-thirds of a mile west of Interstate 275. Temple Terrace Spring, on the north side of the Hillsborough River in Temple Terrace, discharges about 75 gal/min. This spring was the original water supply for the city of Temple Terrace, but its use as a source of water was discontinued in the early 1940's.

Sulphur Springs is about 300 feet north of the Hillsborough River (fig. 1). The spring pool is used for swimming and is about 30 feet deep. The swimming area consists of a 90-foot circular pool with concrete retaining walls. The pool level is controlled by two fixed-crest weirs and a hand-operated gate. The average discharge based on records for 21 years (1960 through 1980) was 27.1 Mgal/d. The extremes in discharge during the 21 years were 91.4 Mgal/d in 1945 and 2.5 Mgal/d in 1971. The monthly mean discharge of the spring into the Hillsborough River for 1961-80 and the monthly mean diversion to Tampa Reservoir are shown in figure 14.

The discharge of Sulphur Springs is related to the elevation of the potentiometric surface of the Floridan aquifer. A linear relation between spring discharges and water levels at well 66, 1.5 miles northwest of the springs (fig. 1), has an average multiple correlation coefficient of 0.90 and an average standard error of estimate of 53 percent. Analyses of spring discharge and stages of Tampa Reservoir do not show any significant relation.

Rosenau and others (1977) stated that water-quality data collected at Sulphur Springs from 1946 to 1972 showed a gradual deterioration in quality. During the 26-year period, specific conductance increased from 260 to 1,240 micromhos per centimeter (μmho/cm); dissolved solids concentrations increased from 480 to 680 milligrams per liter (mg/L); sulfate concentrations increased from 60 to 100 mg/L; and chloride concentrations increased from 160 to 230 mg/L. Menke and others (1961) stated that a hydraulic connection may exist between the spring and other aquifers at depths greater than that penetrated by existing wells in the area. The source of the mineralized water in the spring probably originates in the deep zones of the Floridan aquifer at depths below the bottoms of existing wells in the area.

A pump was installed in Sulphur Springs in May 1964 to provide Tampa with a supplemental water supply of about 20 Mgal/d during periods when the stage of the Hillsborough River is low and water demands are high.

According to Menke and others (1961), concentrations of dissolved materials in Sulphur Springs fluctuate with the stage and discharge of the spring. Specific conductance and chloride and dissolved solids concentrations showed increases during periods when the water level in the pool was lowered. Plots of discharges and concentrations of selected constituents for the period 1946-80 are shown in figure 15. Specific conductance had the largest change with increased discharge of the spring; chloride and sulfate concentrations had the smallest changes with increased discharge. The pool level in Sulphur Springs is controlled by a hand-operated gate on the west side of the pool. If the spring pool is artificially lowered, discharge of the spring is increased for any given potentiometric head, and the quality of the water differs from that during like discharges at high or normal pool levels. The scattering of points showing chloride and sulfate concentrations and specific conductance in figure 15 is due to sampling of the spring when the pool level was artificially lowered below normal operating level. The data illustrate that the chemical quality of water in Sulphur Springs is related to the head of water maintained in the spring pool.

TOURIST CLUB WELL

A plot of chloride concentrations versus specific conductance of water from an unused Floridan aquifer well about 440 feet southeast of Sulphur Springs and 140 feet north of the Hillsborough River is shown in figure 16. The well is 318 feet deep and is cased to 80 feet, or about 60 feet into the upper part of the Floridan aquifer. A linear regression equation of chloride concentrations as a function of specific conductance, determined for the well, is as follows: chloride (mg/L) = $-336 + 0.334 \times$ specific conductance (μmho/cm). The correlation coefficient is 0.97.

Specific conductance and chloride concentrations of water in the well have increased steadily since about 1971. During the period 1959-81, chloride concentrations ranged from 200 to 4,800 mg/L (fig. 17). During the same period, specific conductance ranged from 1,000 to 15,500 μmho/cm. The high values of specific conductance and chloride concentrations indicate that mineralized water occurs below 80 feet (bottom of well casing) and, in all probability, at a depth greater than several hundred feet. Menke and others (1961) indicated that highly mineralized water in the area is derived from below the Ocala Limestone and is related to connate water in older rocks that has not been flushed by freshwater.

A plot of the potentiometric head in the Tourist Club well and the discharge of Sulphur Springs for the period 1963-81 is shown in figure 18. The data are included to show the relation between the discharge of the spring to corresponding changes in potentiometric head in the well. Data for the Tourist Club well were used because minimum pool levels were not available for Sulphur Springs. For spring discharges of less than 45 ft^3/s, the potentiometric head in the well ranged from 7.8 to 10.7 feet above sea level; for discharges greater than 45 ft^3/s, the potentiometric head ranged from 7.2 to 12.0 feet above sea level. The plotted points in figure 20 indicate that the potentiometric head at the well approached equilibrium during periods when spring discharge was less than about 45 ft^3/s. Large increases in spring discharge occurred during maximum opening of the gate. The scattering of points in figure 18 resulted from periodic and erratic opening of the gate to flush the spring pool.

SINKHOLES

Sinkholes are common surface features in the karst area of Sulphur Springs. The Floridan aquifer in the area consists of limestone and dolomite, rocks that are susceptible to slow dissolution by acidic water that moves through pore spaces, fractures, and other openings in the rocks. The enlarged openings develop a network of conduits or cavities through which increasingly large volumes of sediments are transported by the water (Sinclair, 1981). As the limestone and dolomite continue to dissolve, the overlying material begins to subside and eventually collapses into the rock openings. A decline in water levels in the area removes part of the support of the overlying material causing it to lose competence and collapse. This results in the development of a depression or opening at land surface. Water moves by gravity into the depression. These openings or depressions, commonly referred to as sinkholes, are avenues by which surface water may move rapidly into the Floridan aquifer.

Numerous sinkholes have developed in the Sulphur Springs area. Most are located between Fletcher Avenue and the Hillsborough River (fig. 1) in the southwestern part of the area. The sinkholes generally average less than 15 feet in diameter and range in depth from about 10 to 15 feet. The most active area of sinkhole development is a 1-mile-wide strip along both sides of Interstate 275 that extends from the Hillsborough River northward about 4 miles.

Curiosity Sink

Curiosity Sink is 2.2 miles north-northwest of Sulphur Springs (fig. 1) and is the terminus of Curiosity Creek. The sink is reported to be about 25 feet deep and 40 feet in diameter. The overall sink area is about 500 feet in length and 100 feet in width. The Curiosity Sink area is internally drained, and under normal conditions, water that discharges into the sink area flows downward to the Floridan aquifer. However, overflow from the sink area occurs on the west side when water levels exceed an elevation of 29 feet above sea level.

The depth of the southern part of the Curiosity Sink area was sounded in 1980, shortly after it was cleaned and deepened by the city of Tampa. Depths averaged 6 to 8 feet below the water surface in the northern part, 4 feet in the central part, and 12 feet in the southern part. A pumping station with an 18-inch discharge pipe was installed in the southern part of the sink area in 1980 to reduce flooding. During high-water levels in the sink, water is pumped into a shallow basin east of the sink and is then discharged into the Hillsborough River by a pipeline. Water levels in the sink area averaged about 19 feet above sea level during nonpumping periods and 17 feet during periods of pumping at an average rate of about 5,000 gal/min. Based on a pumping rate of 5,000 gal/min and a drawdown of 2 feet in the sink, the specific capacity of the sink is about 2,500 gal/min per foot of drawdown.

Blue Sinks

Blue Sinks refers to an area of numerous small sinks 1,000 to 1,800 feet south of Curiosity Sink. A cluster of five of the more prominent sinkholes is shown in figure 1. The area has no surface streams and is drained entirely by sinkholes. A low area on the west side of the sink cluster near the 25-foot land-surface contour appears to be the former streambed of Curiosity Creek (fig. 1).

The site was visited several times by the senior author in 1963-64; at that time, the sinks were 20 to 30 feet deep, and water was observed to be flowing at the bottoms of two of the sinkholes. The sinkholes have since been filled with refuse and in 1981 were less than 6 feet deep and dry.

Orchid Street Sink

Orchid Street Sink (also known as Linebaugh Sink), which is about 6,600 feet north of Sulphur Springs (fig. 1), receives runoff from a residential area. The sink is 60 feet long, 50 feet wide, and bottoms at 24 feet below a general land surface of 26 feet above sea level. When the sink was sounded in March 1981, the water level in a 20-foot circular pool on the south side was 13 feet above sea level. The deepest sounding was 11 feet.

Poinsettia Street Sink

Poinsettia Street Sink (Trinity Springs), which is about 1,100 feet north of Orchid Street Sink (fig. 1), receives urban runoff from a residential area. The sink is 75 feet long, 50 feet wide, and bottoms at about 35 feet below a general land surface of 28 feet above sea level. A 30-foot circular pool of water on the west side of the sink was sounded in March 1981 and found to have a maximum depth of 20 feet when the water level in the sink was about 13 feet above sea level.

Tenth Street Sink

Tenth Street Sink is 1,900 feet north-northeast of Sulphur Springs and about 700 feet east of Nebraska Avenue (fig. 1). The sink is 25 feet in diameter and 27 feet deep below a general land surface of about 10 feet above sea level. Land-surface elevation is the lowest observed at a sink in the area. The sink was sounded in March 1981 when its water level was about 5 feet above sea level.

Greco Sink

Greco sink is in the southeastern part of Temple Terrace, about half a mile west of the Hillsborough River (fig. 1). The sink is 110 feet in diameter and bottoms at 32 feet below a general land surface of 45 feet above sea level. The deepest hole sounded was 18 feet below the water level in the sink, or 7 feet above sea level. Quality of a water sample collected at the bottom of the hole suggests a hydraulic connection between the sinkhole and the Floridan aquifer (Stewart and others, 1978).

Hillsborough River Sinks

A profile of the Hillsborough River from Tampa Dam to Fletcher Avenue (Goetz and others, 1978) shows several holes in the bed of the river about 0.7 to 6.9 miles upstream from the dam (fig. 1). The holes range in depth from about 5 to 18 feet below the riverbed and bottom at elevations that range from 6 feet above sea level to 12 feet below sea level. The bottom of a hole 0.7 mile upstream from Tampa Dam is about 6 feet below the riverbed. The deepest hole is 4.4 miles upstream of Tampa Dam or about 0.3 mile east of 56th Street. The hole is 18 feet below the riverbed and bottoms at about 1 foot below sea level.

A deep hole (locally known as Hannah's Swirl) is in a sharp bend of the river about a mile downstream from Tampa Dam and about 0.8 mile southeast of Sulphur Springs (fig. 1). Although the hole may be due to scouring of the river bottom, local residents report the hole to be about 20 feet deeper than the river bed.

A seismic reflection survey of the Hillsborough River in 1981 did not indicate any unreported sinkholes in the river in the Sulphur Springs area (R.M. Wolansky, U.S. Geological Survey, oral commun., 1981).

DYE TESTS

In January and March 1958, the city of Tampa injected fluorescein dye into Curiosity Sink and Blue Sink 5 (fig. 1), about 2 miles north of Sulphur Springs, to determine the rate and direction of ground-water movement. For the January test, 8 pounds of dye were injected into Curiosity Sink, and for the March test, 3.5 pounds of dye were injected into Blue Sink 5. Blue Sink 5 is 1,800 feet south-southeast of Curiosity Sink. During the tests, dye followed a general course toward Sulphur Springs, corresponding to the regional flow patterns shown in figure 13, but its course from Blue Sink 5 to Orchid and Poinsettia Street Sinks was altered somewhat by local structural controls in the aquifer system (Menke and others, 1961). The alteration in course probably was due to an extensive and well-developed cavity system that connects Sulphur Springs with several sinkholes as much as 2 miles north of Sulphur Springs. The time observed for dye to arrive at Sulphur Springs, Poinsettia Street Sink, and Orchid Street Sink after injection and the rates of ground-water movement are given in table 1. During the Curiosity Sink test, ground-water velocities ranged from 5,100 to 7,600 ft/d: for the Blue Sink 5 test, velocities ranged from 4,200 to 9,?00 ft/d. Dye was not detected in Tenth Street Sink during the tests.

SULPHUR SPRINGS COLIFORM INDICATOR BACTERIA

The Sulphur Springs swimming pool has been closed temporarily in May or June of most years during the past decade because of high bacteria counts. The pool was closed to swimming on May 19, 1981, when the total coliform bacteria count exceeded the accepted contact level of 1,000 colonies per 100 milliliters (col/100 mL) of water. Usually, the pool is closed shortly after the spring is pumped to augment the city's water supply during the high water-demand period in May and June. The usual pumping rate is estimated to be 20 Mgal/d. Coliform bacteria counts of 1,000 col/100 mL or greater may occur throughout the year. Data collected by the city of Tampa Water Department (Ernie Wilder, Technical Services Supervisor, city of Tampa, written commun., 1981) for the period 1974-81 show that the annual period of heaviest concentration of bacteria in Sulphur Springs is January through August, and the lowest concentration is September through December. The lowest bacteria counts in Sulphur Springs for 1974-81 were observed during November, the driest month, and the highest counts were observed during April and May, moderately wet months. The bacteria count of water in Sulphur Springs probably is related to rainfall and the quality of runoff into sinkholes.

Water from Sulphur Springs and the Orchid Street and Tenth Street Sinks to the north (fig. 1) was sampled twice in May 1981 and once in July 1981. The Sulphur Springs pool is about 30 feet deep, and water samples were collected near the top, middle, and bottom of the pool; Orchid Street Sink is about 11 feet deep, and water samples were collected at middepth in the pool; Tenth Street Sink is 22 feet deep, and samples were collected near the top, middle, and bottom of the pool.

The ratio of fecal coliform to fecal streptococci (FC/FS) for samples from Sulphur Springs, Orchid Street Sink, and Tenth Street Sink are listed below.

Date (1981)	FC/FS at Sulphur Springs	Orchid Street Sink	Tenth Street Sink	Remarks
May 26	17:1-33:1	29:1	0.9:1-1.6:1	After dry period.
May 28	10:1-22:1	2.8:1	3.5:1-5.4:1	After heavy rain.
July 23	1:1	14:1	0.2:1-6:1	After moderate wet period.

Ratios of FC/FS higher than 4:1 are good indicators that pollution is derived from domestic wastes, which are largely composed of man's body wastes, laundry wastes, and food refuse (Geldreich, 1966). Wet and dry conditions at Orchid Street and Tenth Street Sinks were probably the same as that observed at Sulphur Springs.

Ground-water velocities north of Sulphur Springs range from approximately 4,000 to 9,000 ft/d. These high velocities probably are adequate for most bacteria to survive the 28 to 40 hours required to travel approximately 1 to 2 miles from the sinkholes to Sulphur Springs.

A 36-inch sewer line parallels the Hillsborough River from Sulphur Springs westward. Major sewer junctions are about 200 and 500 feet north of Sulphur Springs. The junctions are reported to have been installed at depths of about 2.0 and 2.5 feet above sea level, well below the water table of the surficial aquifer (fig. 12). The top of rock in the area is about 10 feet below sea level (fig. 9), or about 12 feet below the sewer lines. Data were not available to determine if the sewer line leaks. However, it would be expected that the bacteria count in the spring pool would not vary appreciably if the major source of bacteria was the sanitary sewer.

ESTIMATED RUNOFF LOADS

Orchid Street and Poinsettia Street Sinks are used as retention basins for urban runoff from areas around the sinks. Estimated loads of selected constituents that drain into the sinkholes were computed using average base flow and storm-runoff concentrations and runoff volumes based on data collected at nine urban watersheds in the Tampa Bay area (F. Giovannelli and M.A. Lopez, written commun., 1981).

Orchid Street Sink receives drainage from a 77-acre residential area through a 3-foot diameter concrete pipe on the eastern side, a 4-foot diameter concrete pipe on the northern side, and a 1-foot diameter aluminum corrugated pipe on the western side. The sink, when visited in March 1981, contained scattered refuse in the bottom. Estimated loads of selected constituents that drained into the sinkhole in 1979 are listed in table 2.

Poinsettia Street Sink receives drainage from a 64-acre residential area through a 4-foot diameter concrete pipe on the eastern side. Estimated loads of selected constituents that drained into the sink in 1979 are listed in table 2.

SUMMARY AND CONCLUSIONS

The Sulphur Springs area is highly urbanized in the southern part and largely rural in the northwestern part. The University of South Florida, part of the city of Tampa, and all of the city of Temple Terrace are in the area.

Curiosity Sink is in a flood-prone area near the northwestern limit of the city of Tampa; it has flooded on numerous occasions. Much of the Curiosity Sink area drains through sinkholes to the Floridan aquifer. Most sinkholes are located between Fletcher Avenue and the Hillsborough River in the southern part of the study area. The city of Tampa uses Orchid Street and Poinsettia Street Sinks as retention basins for storm runoff.

The surficial aquifer is the principal source of recharge to the Floridan aquifer, but recharge also occurs through sinkholes and through the Tampa Dam Reservoir on the Hillsborough River.

The transmissivity of the Floridan aquifer in the Sulphur Springs area is high, but variable, and ranges from 7.3×10^4 ft^2/d in the northwestern part to 1.3×10^6 ft^2/d in the northeastern and southeastern parts. The transmissivity is generally highest near the Hillsborough River. The leakage coefficient ranges from 2×10^{-4} to 8×10^{-6} (ft/d)/ft.

In 1980, Tampa pumped an average of 48.5 Mgal/d from the Hillsborough River. Total ground-water pumpage was 7.2 Mgal/d, of which 4.68 Mgal/d was for public supplies, 1.5 Mgal/d was for industrial and commercial use, 1 Mgal/d was for irrigation, and 0.02 Mgal/d was for air conditioning.

A fairly extensive and well-developed cavity system occurs in the Floridan aquifer in the Temple Terrace area and the area north of Sulphur Springs between the Hillsborough River and Fowler Avenue. Ground-water velocities of 1 to 2 miles per day were determined from two dye tests conducted in the Hillsborough River-Fowler Avenue area. Sulphur Springs is a supplemental water-supply source for the city of Tampa and a public recreation area. The spring pool has been temporarily closed to swimming in the spring of most years because coliform bacteria counts exceeded the contact limit of 1,000 col/100 mL. Bacteria counts greater than 1,000 col/100 mL occur most months.

Although the source of the coliform bacteria entering Sulphur Springs was not fully established, indications are that sinkholes north of the spring are the principal sources. The high ratio of fecal coliform and fecal streptococci for Sulphur Springs and two sinkholes north of the spring indicate that the high bacteria count is due to domestic waste. The exceptionally high ground-water velocities obtained for the area probably are adequate for most bacteria to survive the 1- to 2-day underground traveltime needed to reach Sulphur Springs.

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Table 1.—*Results of fluorescein dye tests, Sulphur Springs area*

Dye injection site	Dye detection site	Distance from injection site (ft)	Time of arrival (h)	Velocity (ft/h)	Velocity (ft/d)
Curiosity Sink (January 1958)	Poinsettia Sink	5,400	25.4	210	5,100
	Orchid Sink	6,300	27.9	230	5,400
	Tenth Street Sink[1]	11,100	—	—	—
	Sulphur Springs	12,700	40.0	320	7,600
Blue Sink 5 (March 1958)	Poinsettia Sink	4,500	25.5	180	4,200
	Orchid Sink	5,000	23.9	210	5,000
	Tenth Street Sink[1]	9,600	—	—	—
	Sulphur Springs	10,000	28.1	380	9,200

[1]Dye not detected in sinkhole.

Table 2.—*Estimated load of selected constituents discharged into Orchid Street and Poinsettia Street Sinks in 1979*

Constituent	Load: Pounds, Orchid[1] Street Sink	Load: Pounds, Poinsettia[2] Street Sink	Load: Pounds per acre, Orchid[1] Street Sink	Load: Pounds per acre, Poinsettia[2] Street Sink
Biochemical oxygen demand	3,200	2,200	42	34
Chemical oxygen demand	6,900	1,200	90	19
Nitrogen, total	1,300	1,100	17	17
Nitrogen, organic	390	120	5.1	1.9
Phosphorus, total	80	26	1.0	.4
Lead, total	17	2	.2	.03

[1]Drainage area 77 acres.
[2]Drainage area 66 acres.

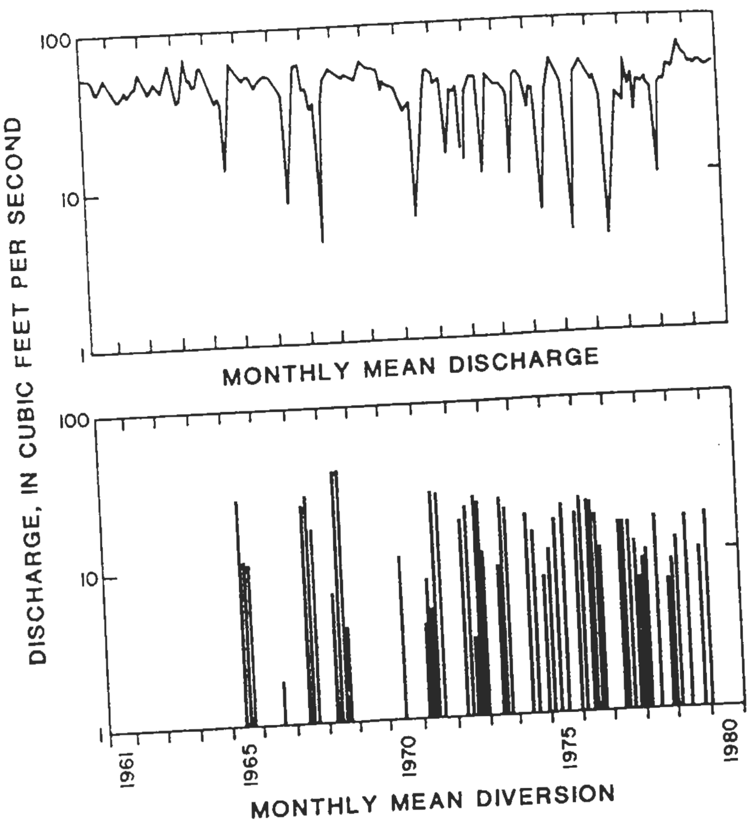
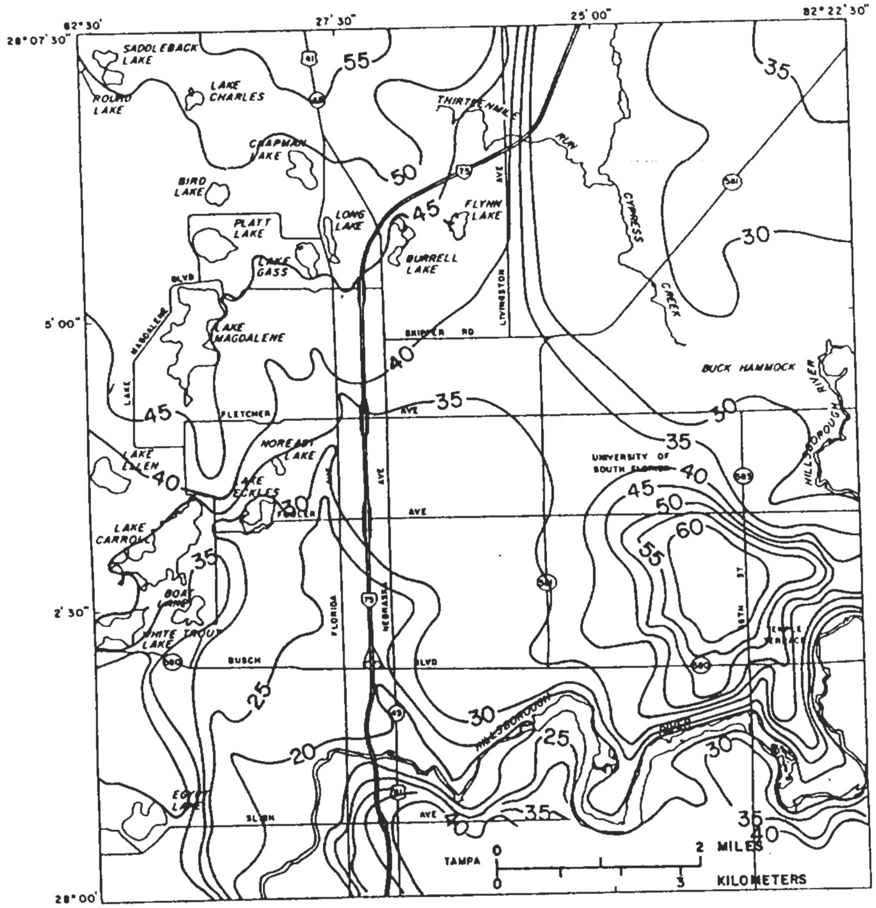


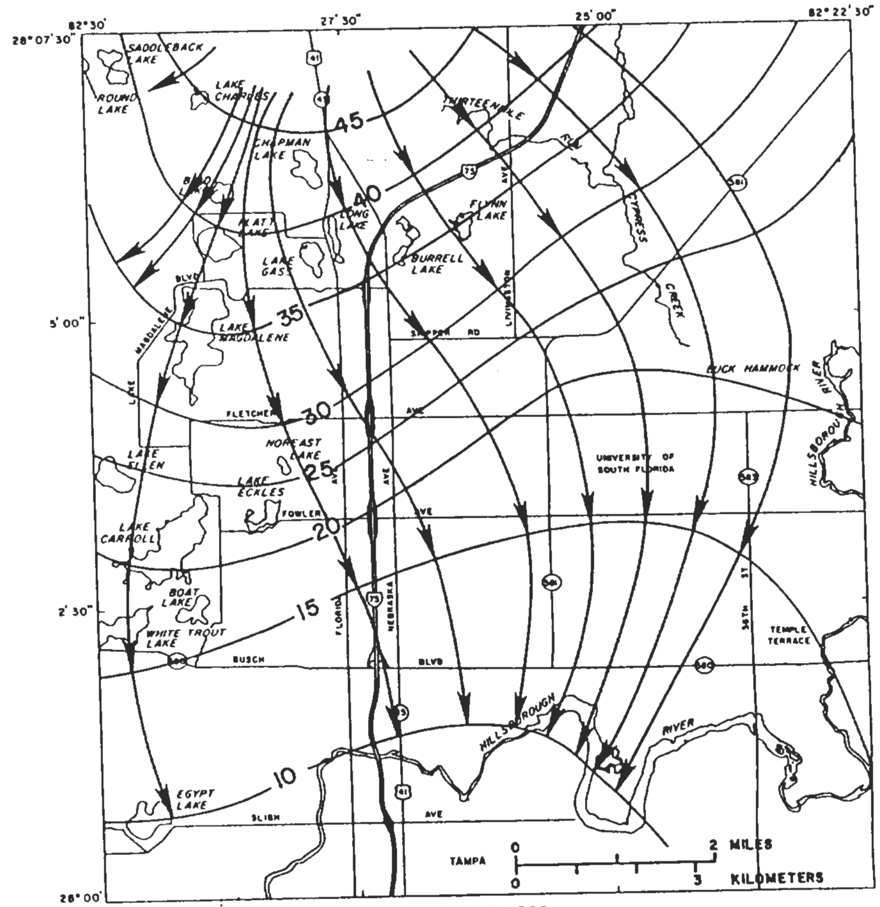
Figure 14.—Monthly mean discharge and monthly mean diversion of Sulphur Springs, 1961-80.



EXPLANATION

——40—— WATER-TABLE CONTOUR—Shows altitude of water table in surficial aquifer, May 1981. Contour interval 5 feet. National Geodetic Vertical Datum of 1929.

Figure 12.—Generalized configuration of water table in the surficial aquifer, May 1981 (modified from Yobbi and Woodham, 1981).

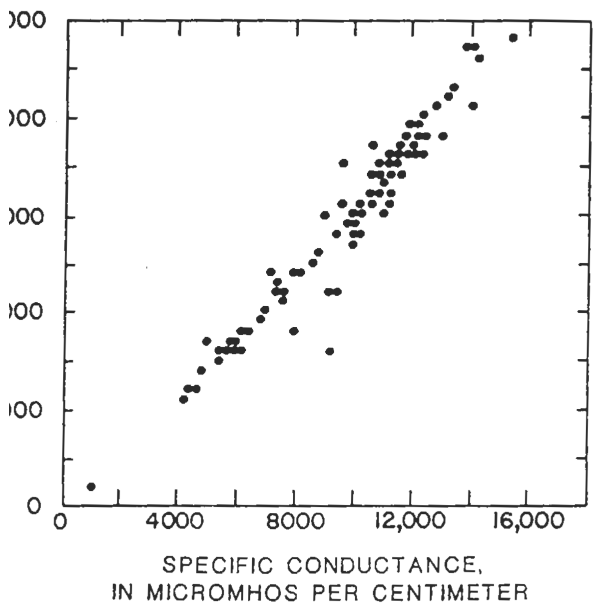


EXPLANATION

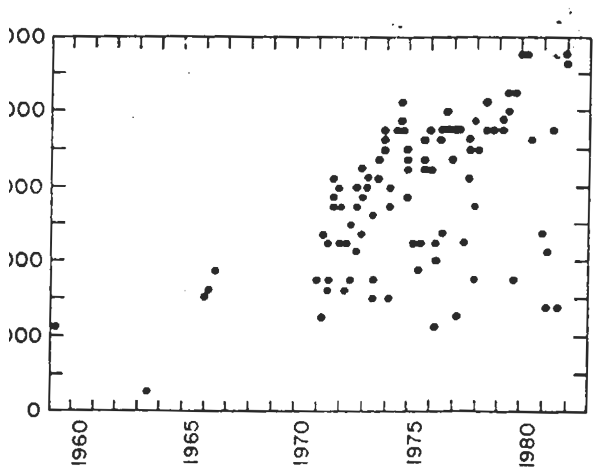
——10—— POTENTIOMETRIC CONTOUR—Shows altitude at which water level would have stood in tightly cased wells, May 1981. Contour interval 10 feet. National Geodetic Vertical Datum of 1929.

Ground-water flow.

Figure 13.—Potentiometric surface of the Floridan aquifer, May 1981 (modified from Yobbi and others, 1981).



16.—Relation of chloride concentration to specific conductance of water from the Tourist Club well, 1946-80.



.—Chloride concentration of water from the Tourist Club well, 1959-81.

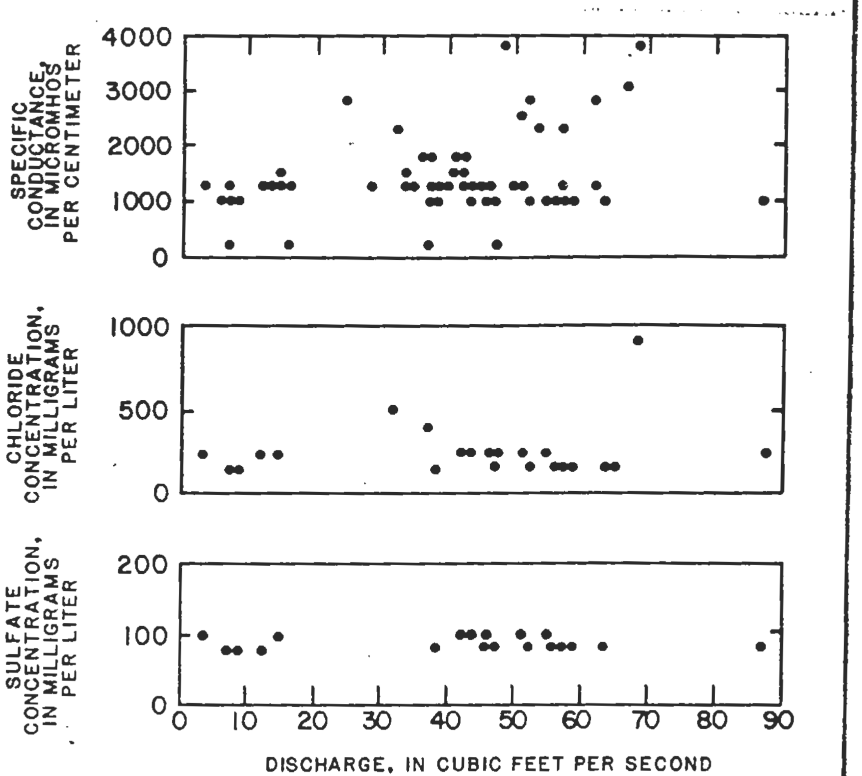


Figure 15.—Relation of specific conductance (top), chloride concentration (middle), and sulfate concentration (bottom) to discharge of Sulphur Springs, 1946-80.

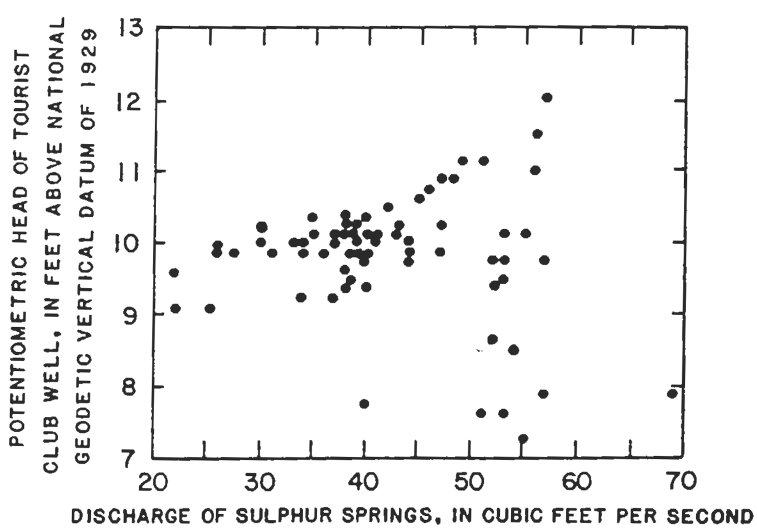
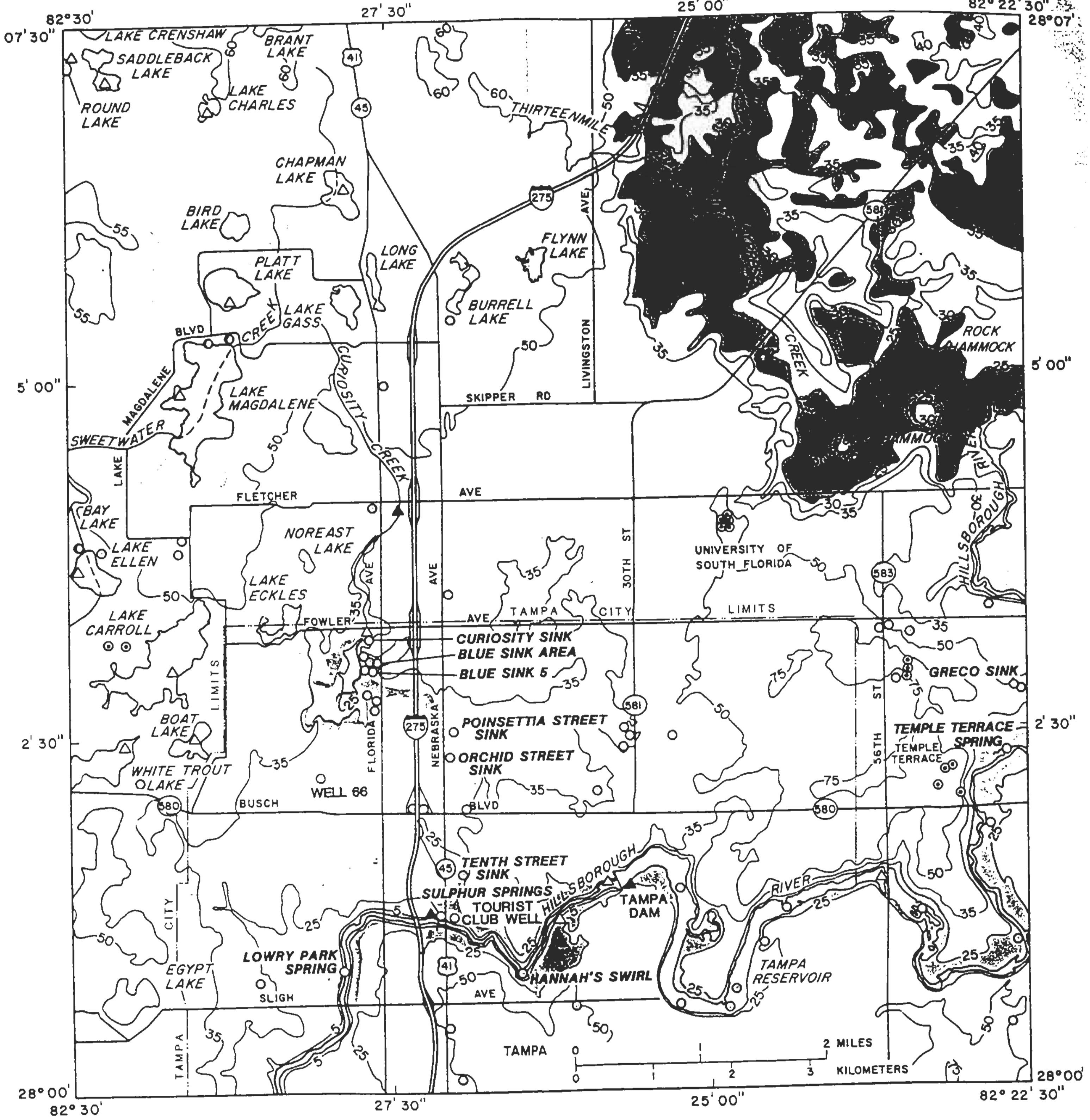


Figure 18.—Relation of potentiometric head in the Tourist Club well to the discharge of Sulphur Springs, 1963-81.



EXPLANATION

—— 5 —— LAND-SURFACE CONTOUR—Shows altitude of land surface. Contour interval varies. National Geodetic Vertical Datum of 1929.

△ Staff gage

▲ Continuous-record gaging station

⊙ Public water-supply well

○ Observation well

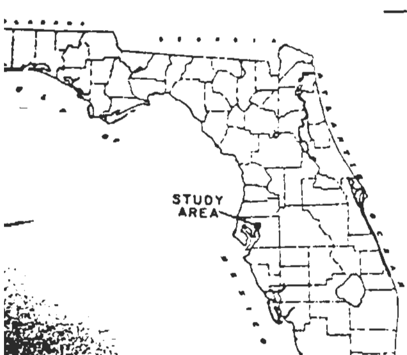
⊙ Sinkhole

Swamp

Area flooded in 19

Area flooded in 19

Open water



APPENDIX L

SULPHUR SPRINGS DYE TRACE 1987

CITY OF TAMPA STORMWATER MANAGEMENT DIVISION - BURWELL

Sulphur Springs Dye Trace - 1987

City of Tampa
Dept. of Public Works
Stormwater Management Division

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From the Tampa Recreation Department, I'd like to thank Mr. Mike Grant for his assistance throughout the test. Thanks also to the City of Tampa Department of Sanitary Sewers for the use of their fluorometer and lab for the analysis; particularly Mr. Dave Carpenter and Mr. Roger Johansson. I'd also like to thank my supervisor, Ms. Theresa B. Meyer for her assistance as well as the time to perform the study. A special thanks to Mr. Joe Stewart for his interest and assistance.

Michael J. Burwell
Stormwater Planner
May 21, 1987

SULPHUR SPRINGS DYE TRACE - 1987

BACKGROUND

In 1958 a dye trace was performed on the karst area in North Tampa, south of Curiosity Creek, to determine the possibility of interconnections between the sinkhole system at the end of Curiosity Creek and Sulphur Springs. The subsurface flow in this region is extremely important in that it provides the only positive drainage for approximately 4700 acres. Stormwater from this area is directed into lakes, sinkholes and retention areas with no positive surface outfalls, and is discharged at various points along the Hillsborough River. Four known springs on the north bank of the river, as well as various "clear zones" (areas where aquifer water dilutes river water where the river has cut through the water bearing strata), are known to discharge this water.

Since this area has undergone significant land use changes in the time period since the first test, and changes have occurred in most of the sinkholes, it was determined that it would be beneficial to re-examine the flow characteristics to determine what, if any, changes may have occurred in the intervening years. Sulphur Springs, the main discharge point for this subsurface flow, is now perceived to be bacteriologically contaminated and this study also explores the possibility that untreated stormwater runoff may be a significant contributor to this contamination.

METHODOLOGY

In the original study, dye was introduced at Curiosity Sink and its appearance noted at 11 downstream locations. A second test involved Blue Sink and the same downstream locations. For the 1987 test, the dye was again placed at Curiosity Sink with the addition of a second dye source at Orchid Sink. This second source utilized a different type of dye in an attempt to quantify the contribution of this sink to the flow at Sulphur Springs. The Orchid Sink with its large urbanized contributing basin and lack of stormwater treatment facilities is suspected of contributing a major share of the pollutants found at Sulphur Springs. Supplemental water quality data is being collected at both sites to further define this relationship.

TIMING

It was initially felt that it would be beneficial to duplicate the hydrologic conditions found during the first dye trace. Upon investigation it was found that a storm occurred on the second day of the test which would have made duplication almost impossible. The antecedent conditions, on the other hand, should have been fairly easy to replicate.

This turned out to be a false hope; after a significant rainfall, we waited overnight as in the original study only to find that Orchid Sink had drained before the dye could be introduced. After two false starts with insufficient rainfall, the dye was placed at Orchid Sink on February 16 at 0830 and Curiosity Sink at 0900 (H+O). Rainfall during the test and the period immediately preceding it is shown in Figure 1. Rainfall data was collected at the Seneca Pump House rain gage south of Curiosity Sink at the northwest corner at Seneca and Florida Avenues. This gage is a Belfort recording type and is well situated in the basin (see Figure 2).

DOSAGE

In the original test eight pounds of florescein dye were dissolved and introduced into Curiosity Sink. For this test we utilized an equivalent amount of liquid concentrate, due to convenience. Fluorescein dye has an average dilution of 2%. Therefore, the original 8 pounds would be equivalent to about 10 gallons of the 10% liquid concentrate which was used. Due to its availability, Rhodamine WT (red) was used at Curiosity Sink and 5 gallons of fluorescein dye (yellow-green) was introduced at Orchid Sink.

SAMPLING

Prior to sink dosage, samples were taken to establish blanks for the following locations: (Figure 2)

1. Curiosity Sink - The terminus of Curiosity Creek, reportedly had a spring at the north and siphon near the south end. Twenty four hundred acres drains to this point. A temporary pump station has been installed to handle excess flow.

2. Orchid Avenue Sink - This sinkhole located at Linebaugh and Nebraska Avenues drains about 130 acres. The sink is regularly overwhelmed, and runoff floods the area for short periods of time. However, this sink does drain rapidly and remains dry most of the time.

3. Jasmine/Poinsettia (Trinity Springs) - A former "swimming hole". Basin size is roughly 63 acres, mostly residential. this sink remains wet and the water quality appears to be much better than most of the sinks in the area.

4. 10th Street Sink - A small sink located in a residential neighborhood. Considerable debris has accumulated but the majority of the drainage basin has been diverted into nearby storm sewers.

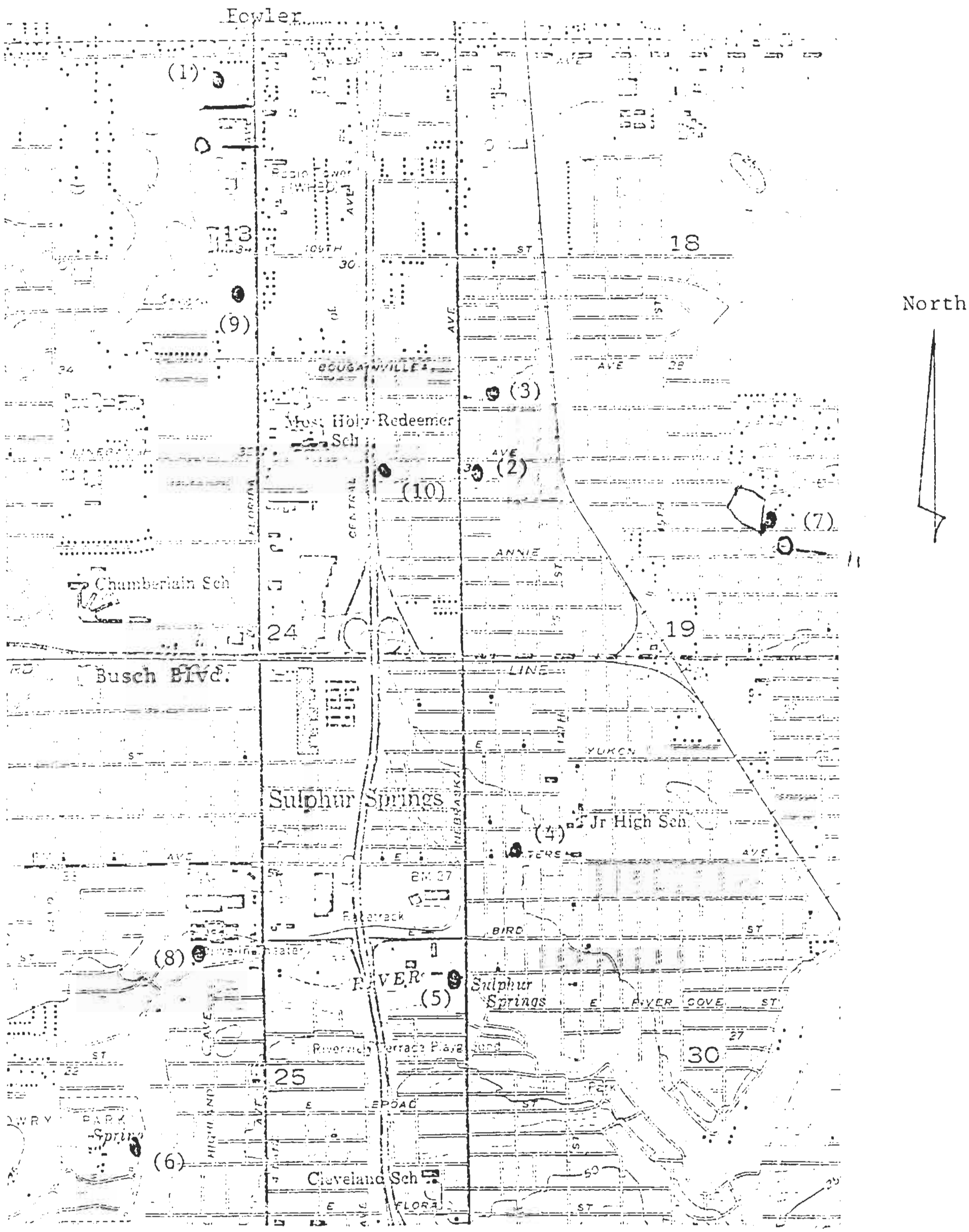

FIGURE 2 - SAMPLING LOCATIONS

1. Curiosity Sink
2. Orchid Ave. Sink
3. Jasmine/Poinsettia
4. 10th St. Sink
5. Sulphur Springs
6. Lowry Park Springs
7. Sink east of Elmer-98th
8. Water Dept. Spring
9. Seneca Pump Station
10. 705 E. Linebaugh
11. Frog Pond (Annie & Mary)
12. Blue Sink

5. Sulphur Springs - A City of Tampa Recreation Department swimming pool and park area, in use since 1800's. Subject periodic closures due to perceived bacteriological contamination. Normal flow averages 43 CFS.

6. Lowry Park Spring - A small ornamental spring at Lowry Park. High sulphur smell.

7. Water Department Spring - A small spring formerly used as a supplemental source of drinking water for the area.

8. Seneca Pumping Station (100' west of Florida Ave.) - A former sink excavated into a detention basin.

9. Well at 705 E. Linebaugh - A well found to be contaminated by bacteria. Proximity to to Orchid Sink suspicious, so connection was explored.

Many of the test sites from the original program were no longer available for sampling. Blue Sink and the cluster of sinkholes surrounding it south of Curiosity Sink had been filled and no longer contained standing water. "Frog Pond" at Annie St. and Mary Ave. has been excavated into a retention pond, as has the "pond west of Henderson Field at 30th Street". It is unknown if dye was found at the latter location during the original study, but the interconnection of the former to the sink system has been proven. The sink east of the Sanitary Sewers Pumping Station (east of Elmer - 98th) was not sampled for safety reasons; the sides are crumbling and have been covered with debris. The well at 705 E. Linebaugh was added to test a connection between it and Orchid Sink since the well had proven to be contaminated in the past.

Sampling was to consist of hourly grab samples taken until dye appeared at Sulphur Springs, with samples taken at various intervals at all other locations for a period of 72 hours. After the initial set of samples were taken at the time of dosage, six hours elapsed before the next set. After H+18 (18 hours after dye application) hourly samples were taken at Sulphur Springs. This proved to be fortuitous since the dye from Orchid showed up at H+21. These hourly samples continued until H+79 when bihourly sampling began. This was continued for only a short time when the red dye from Curiosity Sink still had not appeared. After H+87 sampling became sporadic; first four-a-day, then twice daily.

Samples were collected in 4 oz. bottles provided by the USGS. Paper labels with coded numbers were affixed with control maintained by a log sheet recording sample number, location, time and sampler. Space was available on the log sheet for pertinent notes concerning conditions at the sample site and the samples were stored in a dark area until analysis took place.

ANALYSIS

Since two fluorometers were available, the fluorescein and rhodamine filters could be placed on separate machines and the samples analyzed for both dyes at the same time. Normally, a comparison would have to be made with the two dyes in order to eliminate false readings. However, since the rhodamine dye never appeared at Sulphur Springs, this was not done. After some problems were encountered with the scales on the fluorescein-adapted fluorometer, Turner Designs, the manufacturer, was contacted and they recommended that actual quantities of dye not be ascertained but that we only test for "units of fluorescence." Unfortunately, quantification of the flow from Orchid Sink was impossible to determine, but travel time and relative concentration could still be calculated.

THE TEST

On Monday, February 16, at 0830 after a .25" rainfall, the fluorescein dye was placed in the runoff accumulated in Orchid Sink. The rhodamine dye was placed at Curiosity Creek at 0900. At 0930 an additional .26" of rain fell which increased the amount of runoff in Orchid Sink and raised the stage at Curiosity Creek .15'. Figure 1 illustrates the change in stage at Curiosity Creek and the rainfall at Seneca Pumphouse. By H+9 the dye and runoff were, for the most part, gone from Orchid Sink. A few puddles did, however, remain for over a day before they too disappeared into the bottom of the sink.

Samples from Sulphur Springs indicated no dye at that site until H+21, but by 0800 of 2/17/87 (H+23) the fluorescein dye was plainly visible at the site. Figure 3 is a graph showing this change in fluorescence at Sulphur Springs. Maximum concentration was reached at H+26 and fell sharply thereafter. Dye was visible throughout the day at this site turning the discharge a bright green. No other sampling sites indicated either fluorescein or rhodamine at any time during the test. After 72 hours, sampling was curtailed, and continued sporadically until March 11, 24 days after the dye was placed. At no time did Sulphur Springs indicate the presence of rhodamine dye.

On March 6-7, the area received approximately 2.6" of rain which raised the stage at Curiosity Sink 3.1 ft. before the pump at that site was started. The pump lowered the stage to 24.4 and it was decided to conduct one further test of this system.

In 1979-82, knowing that Sulphur Springs was connected to Curiosity Creek, the Department of Public Works effectively lowered the stage at Curiosity Sink by opening the gates at Sulphur Springs, thereby increasing the difference in head. On March 9, 1987, with the pumps off and the stage at 22.3± this was attempted once more. The stage at Sulphur Springs was dropped from 7.5 to 2.17 msl, increasing the potential fall from Curiosity by 5.33 ft. or 32%. After 48 hours the stage at Curiosity had continued to rise to 24.45 where it stabilized.

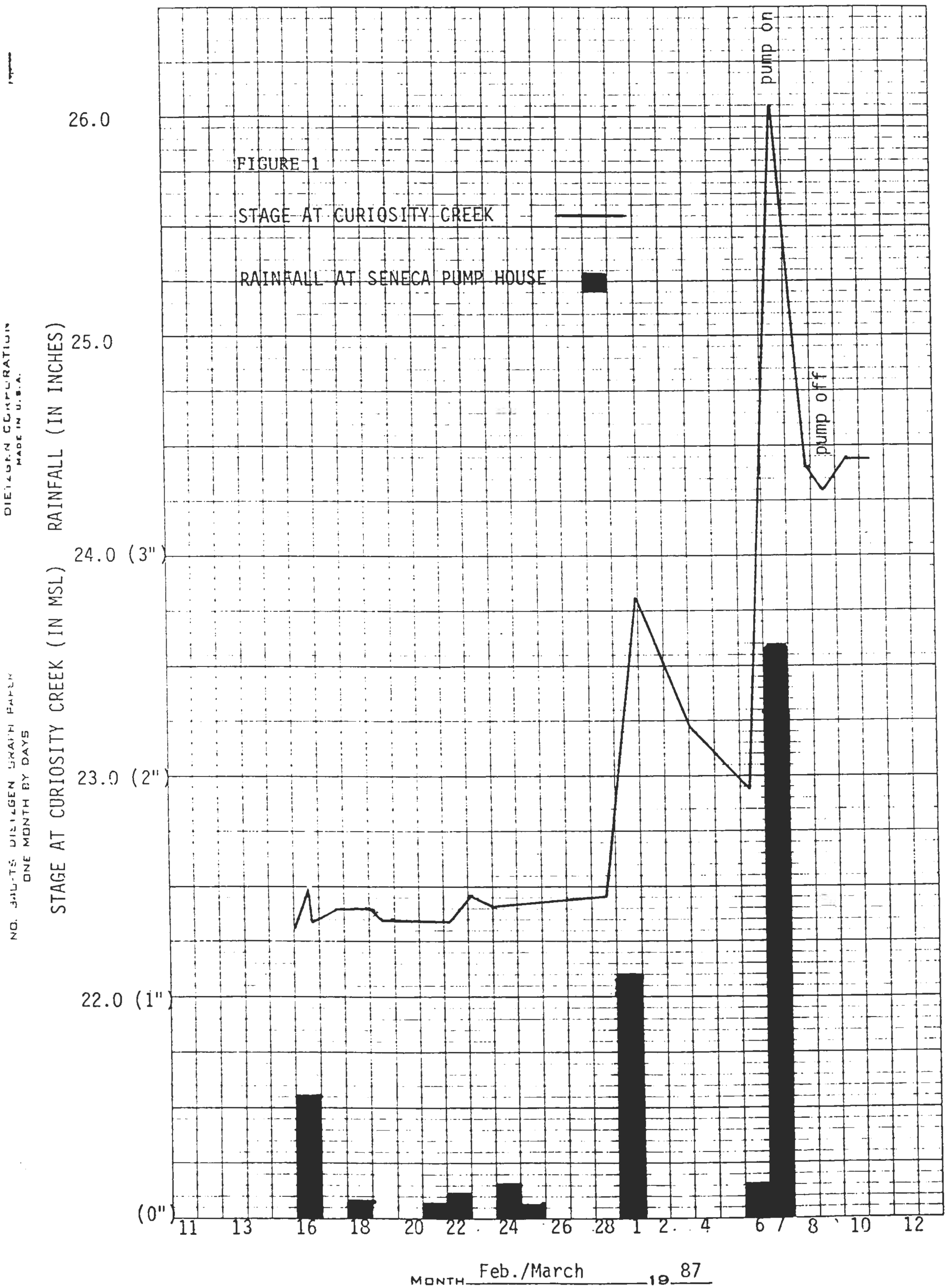

FIGURE 1
STAGE AT CURIOSITY CREEK
RAINFALL AT SENECA PUMP HOUSE
pump on
pump off
26.0
25.0
24.0 (3")
23.0 (2")
22.0 (1")
(0")
STAGE AT CURIOSITY CREEK (IN MSL) RAINFALL (IN INCHES)
11
13
16
18
20
22
24
26
28
1
2
4
6
7
8
10
12
MONTH Feb./March 19 87
NO. 340-T5 DIETZGEN GRAPH PAPER ONE MONTH BY DAYS
DIETZGEN CORPORATION MADE IN U.S.A.

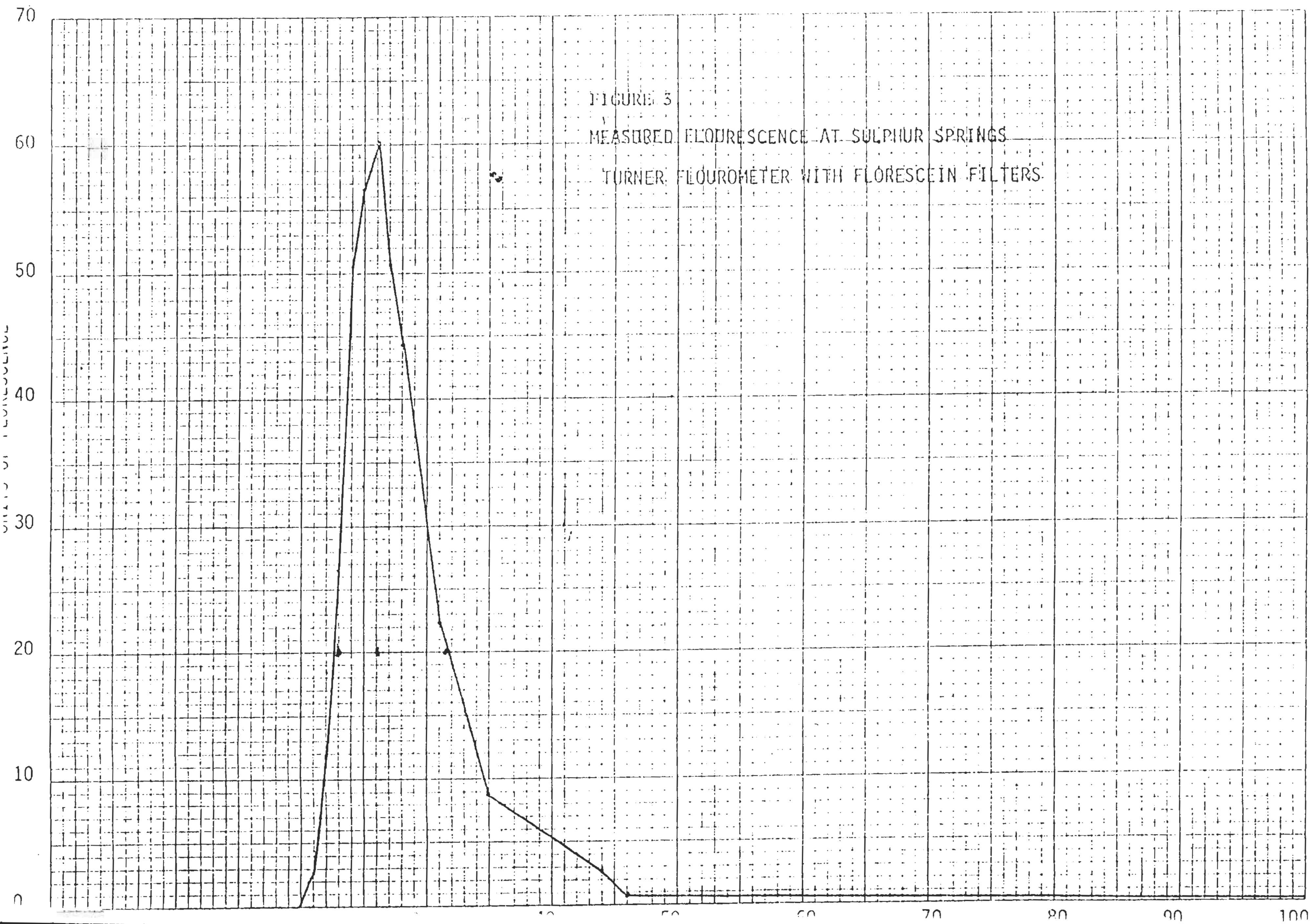
FIGURE 3
MEASURED FLOURESCENCE AT SULPHUR SPRINGS
TURNER FLOUROMETER WITH FLORESCEIN FILTERS
70
60
50
40
30
20
10
0
70
80
90

This test was of course complicated by the accumulated runoff in Curiosity Creek itself, which may have masked any drop in stage. However, samples taken at Sulphur Springs during this period still showed no trace of the rhodamine dye which was present on March 7 while the pumps were running and which, if it had entered the aquifer, should have been accelerated towards Sulphur Springs. On the morning of March 11, the gates were closed at the Springs and the stage allowed to return to 7.5' msl.

On March 2, we received a complaint from Mr. Vernon Dutton of 11511 Ravine, on the west side of Curiosity Creek, that his well water had turned pink. This water was tested and found to have about 100 ppb rhodamine dye in addition to being bacteriologically contaminated, indicating a connection to the sink. This was the only site to indicate the presence of the dye and could have been caused by several factors, such as bleeding from the sink into the surficial aquifer, thence into his well. Mr. Dutton was informed of the bacteriological contamination and was put in contact with the Tampa Water Department for an alternate source of water. It is not known if this occurred during the tests in the 1950's since the dye was gone from the point of application within hours during the original tests. By contrast, in this test, the sink stayed red from February 17 until March 7 when the dye was removed with the stormwater pump.

CONCLUSIONS

This test proved the connection between Orchid Sink and Sulphur Springs which had been surmised but not proven. Earlier tests had proven a connection between Curiosity (and Blue Sink) to Orchid and Curiosity (and Blue Sink) to Sulphur Springs, but since the travel times between Curiosity (and Blue Sink) and the other two were similar (27.9 vs 40 hrs. and 23.9 vs 28.1 hrs.) a direct connection could not be proven. This test proves the connection and indicates a travel time of 21 hours with a peak concentration after 26 hours for the hydrologic conditions under which the test was performed. This may be of use in determining a management plan for the Sulphur Springs Pool, perhaps indicating a time period during which contact should be curtailed.

This test also indicates that Curiosity Sink is no longer connected to Sulphur Springs or any of the other sampled sinks in the same manner as the earlier tests. No sink water with dye appeared in the 24 days in which samples were taken (compared to the 40 hour travel time found in 1958). Recent construction of a sanitary sewer lift station on Country Club Boulevard dumped tons of clay into the sink during excavation and dewatering and may have sealed what connections remained. This effectively eliminates the sink as a useful receptical for stormwater and indicates that pumping will have to be continued and perhaps accelerated in order to avoid flooding of the area. Earlier studies have shown that the sink was capable of accepting 60 cfs at flood stage. This capacity has been lost and until a retention basin (F100-c) is constructed the only outflow will be through the temporary pump station which has a capacity of only 16.73 cfs.

Several questions still remain about this system which could be answered with more study. It has been found that even without a proven, positive outfall, the stage at Curiosity tends to stabilize at about 22.0 msl. Whether this is due to a connection to the Floridan Aquifer or is only a response to the surficial aquifer surrounding it needs to be established. Residence times at Jasmine/Poinsettia and 10th Street sinks need to be established. These two sinks, despite the runoff which enters them, have fairly clear water and the possibility that they may be spring-siphons should be explored.

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APPENDIX M

MICROORGANISMS IN URBAN SPRINGS AND SINKHOLES 1987

DR. NOSS U.S.F.

MICROORGANISMS IN URBAN SPRINGS AND SINKHOLES

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EXECUTIVE SUMMARY

Water from Curiosity, Jasmine/Poinsettia, Orchid and Tenth Street sinks and Sulphur Springs pool was sampled and analyzed for total and fecal coliforms, Escherichia coli, fecal streptococci and enterococci. Samples were collected from late September to mid-December. Orchid sink had the highest level of microbial contamination followed by Jasmine, Curiosity and Tenth Street sinks and Sulphur Springs pool.

Total and fecal coliforms were measured by two methods. Both membrane filtration and multiple tube fermentation procedures gave similar results, with the filtration data usually yielding slightly higher but not significantly different geometric mean values.

Dye studies performed by the City of Tampa in 1987 demonstrated that Curiosity sink was not supplying water to Sulphur Springs pool. Orchid sink was shown to provide water to the Sulphur Springs pool. The travel time from Orchid sink to Sulphur Springs pool was about 26 hours, which does not allow for sufficient die-off of microorganisms entering underground channels at these sinks. Therefore, polluted waters entering Jasmine and Orchid sinks are likely to contaminate down-gradient water bodies.

It is recommended that the hydraulic residence time and further tests of the microbial quality of Jasmine sink be determined. Also, the hydraulic residence time of water in the Tenth Street sink and connections to the Sulphur Springs pool should be determined. Lastly, studies on the quality of water in Sulphur Springs pool should be performed relative to the yield of the spring.

INTRODUCTION

The Sulphur Springs area is located in the north-central part of the City of Tampa. It consists of one large spring, two smaller springs and numerous sinkholes (Figure 1). The large spring is located about one quarter of a mile east of Interstate 275 and 300 feet north of the Hillsborough River. The spring provides supplemental water supply to the City of Tampa during periods of low flow in the river, when water demands are high. The water from the spring is carried by pipeline and discharged into the Tampa reservoir near the dam. The spring has also been used for community recreation projects, but has been closed due to the presence of high concentrations of coliform bacteria.

Sinkholes are common in the areas of Sulphur Springs, with most located between Fletcher Avenue and the Hillsborough River. Curiosity sink is located 2.2 miles northwest of Sulphur Springs pool. Orchid Street sink is just over one mile north of Sulphur Springs pool and receives urban runoff from the nearby residential area. Jasmine/ Poinsettia Street sink, located 1,100 feet north of Orchid sink, also receives urban runoff. Tenth Street sink is 2,100 feet north of Sulphur Springs pool and just east of Nebraska Avenue.

Water quality data collected at Sulphur Springs pool from 1946 to 1972 showed a gradual deterioration of this resource (Rosenau et. al., 1977). Water quality parameters measured included specific conductance, dissolved solids, sulfate and chloride. Recent monitoring of the microbial quality of Sulphur Springs water has provided information concerning bacterial contamination. The greatest bacterial loads in Sulphur Springs pool were observed at the beginning of the wet season

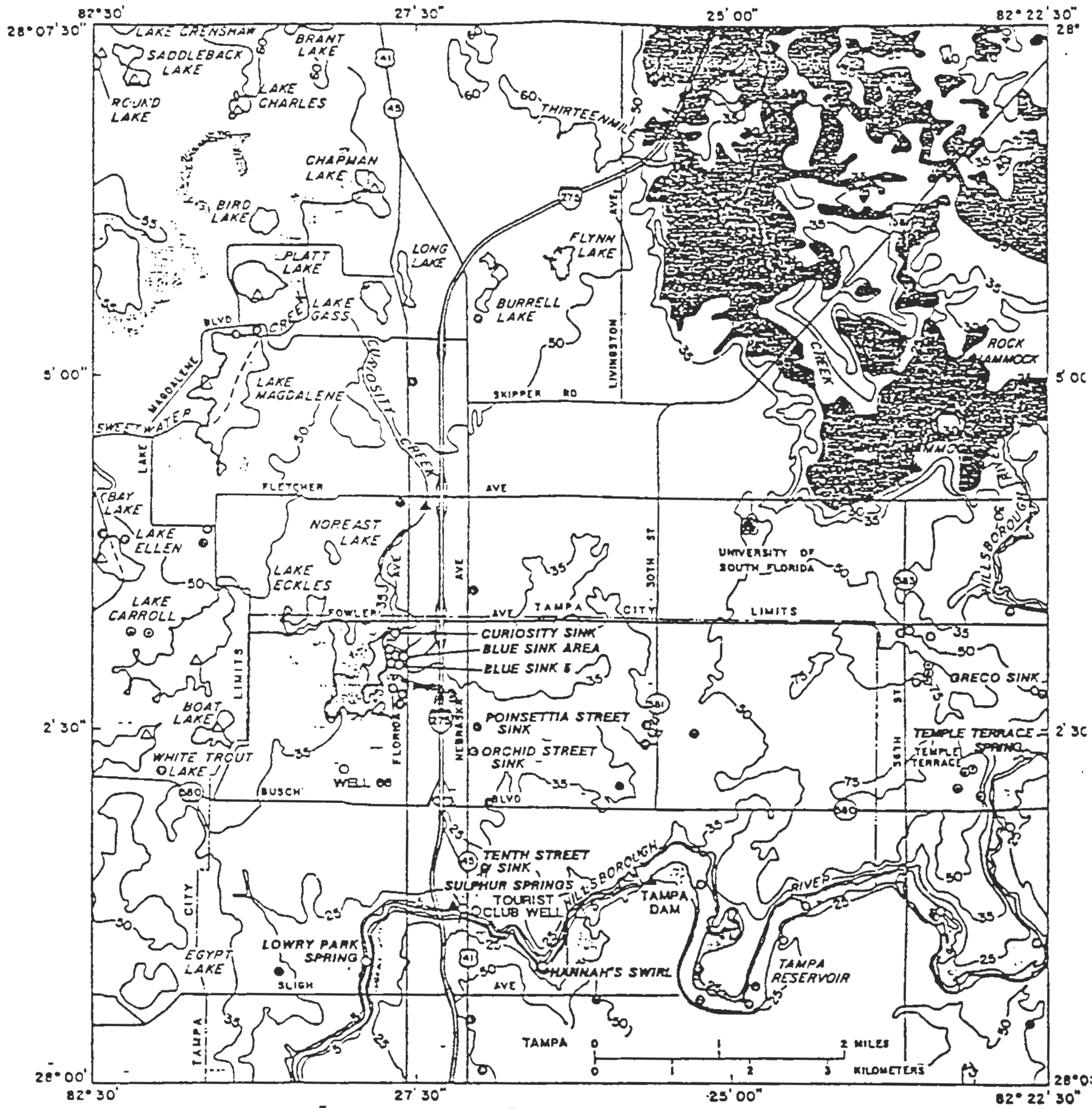

Figure 1. Sulphur Springs and surrounding hydrologic features

in early summer. Due to this bacterial pollution, the recreational facilities at Sulphur Springs have been closed to the public.

The closing of the swimming pool at Sulphur Springs resulted in public pressures to find the source of the bacterial contamination and to correct the situation. Suggested sources of the pollution were urban storm water runoff which drains into existing sinks in the Sulphur Springs area, or underground flow of water from a shallow aquifer which is polluted with human wastes. Therefore, this research was undertaken to evaluate existing data, and to collect information on microbial populations in nearby sinks and Sulphur Springs pool.

RESEARCH OBJECTIVES

The purpose of this study was to test for levels of indicator bacteria in sinkholes. The data collected were then used to ascertain whether these microbes were likely to contribute to the contamination of Sulphur Springs pool.

MATERIALS AND METHODS

Water samples were received from the City of Tampa, Department of Public Works. Five locations were sampled: Sulphur Springs Pool, Tenth Street Sinkhole, Orchid Sinkhole, Jasmine/Poinsettia Sinkhole and Curiosity Sinkhole. Upon receipt of the samples, each sample was diluted with phosphate buffered saline, then inoculated and incubated on appropriate culture media. Samples were processed within six hours of collection.

Total Coliforms

Total coliform levels were determined by two methods. The first method used the membrane filtration technique after which the filter membranes were soaked in lactose broth for two hours at 37°C and placed on les-endo agar plates for 24 hours at 37°C. Green positive colonies were counted on plates containing between 3 and 80 colonies.

The second procedure used the multiple tube method of microbial enumeration. Lactose broth tubes were incubated for 24 and 48 hours at 37°C, and were monitored for gas production. Positive tubes were inoculated into a brilliant green lactose bile tubes (BGLB). The tubes were incubated at 37°C for 48 hours and checked for gas production. Bacterial levels were determined from most probable number (MPN) tables. Both procedures were performed as described in Standard Methods (1985).

Fecal Coliforms

Fecal coliform levels were also determined by two methods. The first method used the membrane filtration technique after which the filter membranes were placed on mFC agar plates. The plates were incubated at 44.5°C for 24 hours. Blue colonies were counted on plates containing between 3 and 80 colonies.

The second procedure used the multiple tube method of microbial enumeration. Inoculum from positive lactose fermentation tubes were transferred to EC broth. The tubes were incubated at 44.5°C for 24 hours, then checked for gas production. Fecal coliform levels were determined from MPN tables. Both procedures were preformed as described in Standard Methods (1985).

Other Indicator Bacterial Tests

Escherichia coli levels were determined by the membrane filtration technique in which filters were placed onto mTEC agar and incubated at 44.5°C for 24 hours. Filters with colonies were transferred to Christiansen's urease agar for 20 minutes and incubated at 45°C. Colonies which turned yellow-brown were counted on plates containing between 3 and 80 colonies. The procedure was performed as described in "Test Methods for Escherichia coli and Enterococci in Water by the Membrane Filtration Procedure" (EPA, 1985).

Enterococci levels were determined by the membrane filtration technique. The filters were placed onto mE agar and incubated at 41°C for 48 hours. Filters with colonies were transferred to E1A agar for 20 minutes and incubated at 41°C. Colonies which turned yellow-brown with a black precipitate were counted on plates containing between 3 and 80 colonies. The procedure was performed as described in "Test Methods for Escherichia coli and Enterococci in Water by the Membrane Filtration Procedure," (EPA, 1985).

Fecal streptococci were enumerated by plating sample dilutions on KF streptococcus agar. The plates were incubated at 37°C for 48 hours according to the methods described in Standard Methods (1985).

RESULTS

Rainfall

Rainfall data from the Seneca monitoring station in the Sulphur Springs area was supplied by the City of Tampa. Figure 2 shows the frequency and magnitude of storm events over the microbial sampling period. Five storm events are shown during the sampling period where more than ½ inch of rain fell in the course of one day. Samples were collected on three of the days when storm events occurred. The samples, however, were not collected with consideration given to travel times from sinkholes to Sulphur Springs pool. Overall, the samples mostly reflect normal background flow conditions as collection was initiated at the start of each day.

The effect of rainfall on microbial titers in sampled surface water is shown in Figure 3. Fecal coliform levels found in Jasmine sink and Sulphur Springs pool are shown in relation to rainfall events. The levels of fecal coliforms in Jasmine sink were fairly constant over the study period while levels in Sulphur Springs pool were highly variable. Because no attempt was made to coordinate collection of multiple sample with rainfall events, no conclusions were drawn relevant to the direct input or dilation of sinkhole bacterial loads on the microbial populations measured in Sulphur Springs pool. However, both sample locations demonstrate little fluctuation in microbial levels with storm events.

Microbial Determinations

The geometric mean values of microbial determinations of water samples from north Tampa sinks and Sulphur Springs pool are shown in Table 1. All data are expressed as the number of bacteria per 100 ml of water. Orchid sink consistently had the highest level of all indicator microorganisms measured. Jasmine sink was the second most contaminated sinkhole followed by Curiosity sink, Tenth Street sink and Sulphur Springs pool.

Samples were processed in duplicate for total and fecal coliforms. Both membrane filtration and multiple tube fermentation

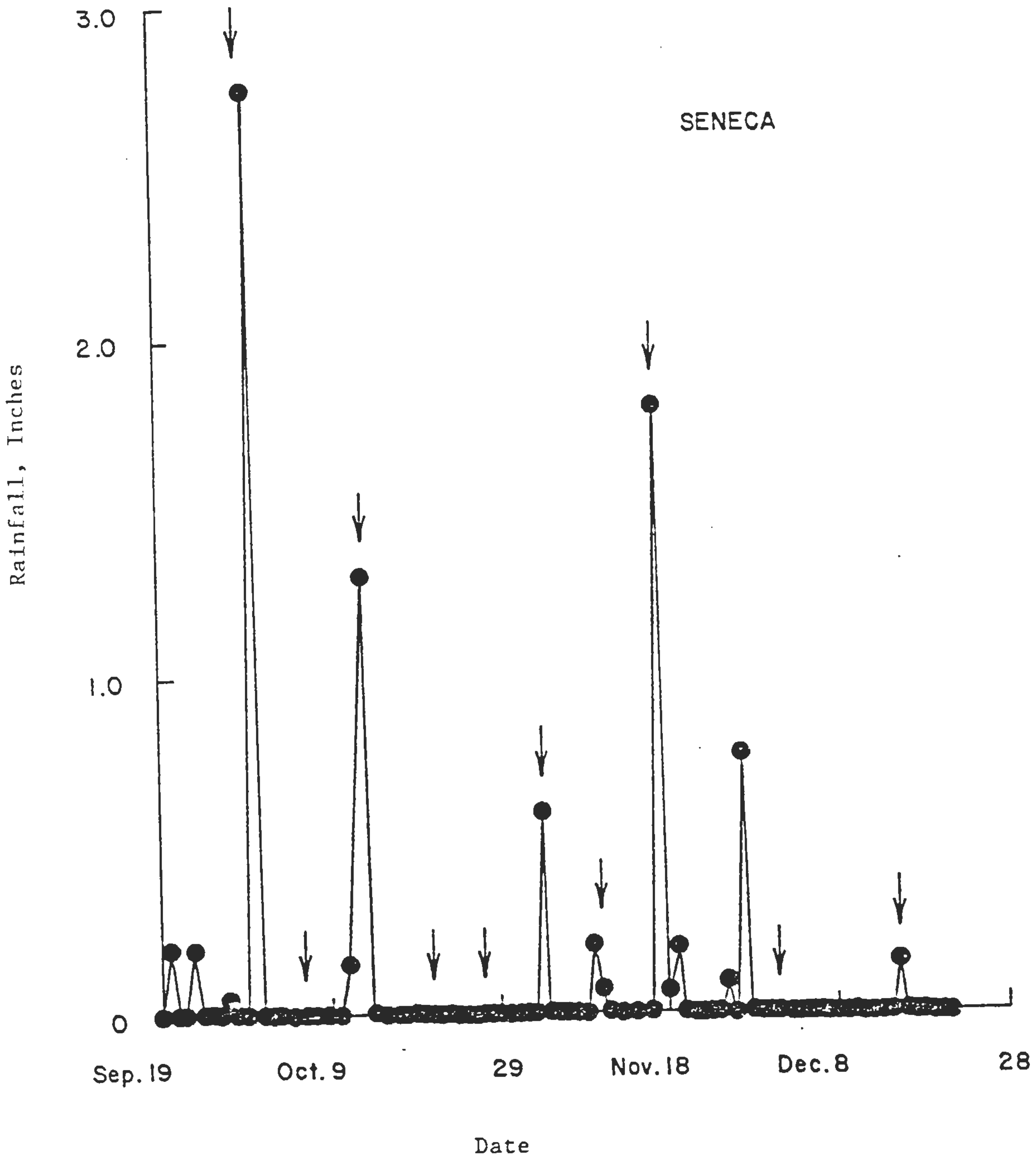

Figure 2. Rainfall at Seneca station in the Sulphur Springs drainage area

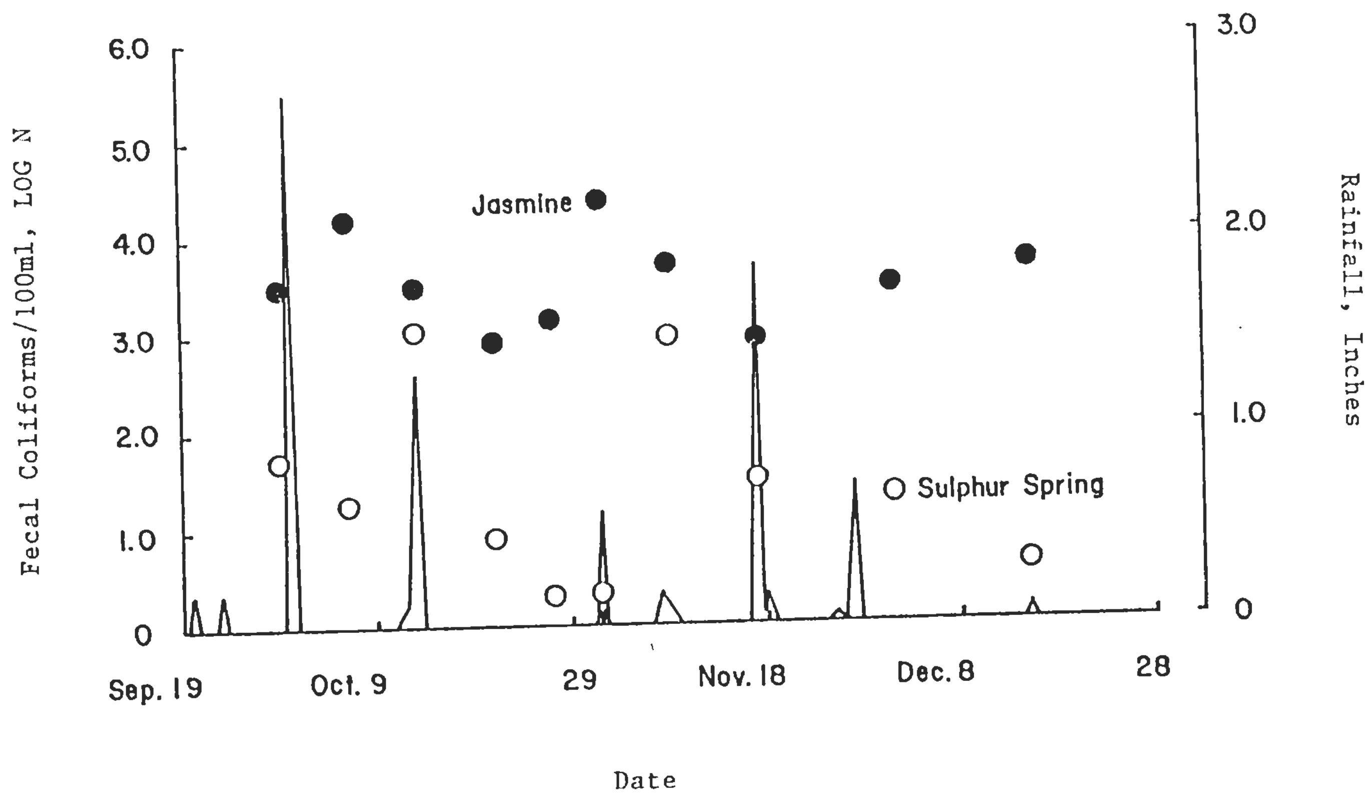

Figure 3. Fecal coliforms at Jasmine Sink and Sulphur Springs Pool are shown relative to rainfall.

TABLE 1
Geometric Mean Values of Microbial Determinations of Surface Water Samples in Tampa, Florida

Bacterial Number/100 ml

Location	Total Coliforms	Fecal Coliforms	*Escherichia coli*	Fecal Streptococci	Enterococci
Curiosity Sink	1.4×10^3	3.2×10^2	2.6×10^2	$<4.3 \times 10^1$	$<1.5 \times 10^2$
Jasmine Sink	6.9×10^3	3.4×10^3	1.5×10^3	$<2.6 \times 10^2$	9.8×10^2
Orchid Sink	2.5×10^4	1.1×10^4	9.8×10^3	$<2.0 \times 10^3$	6.8×10^3
Tenth Street Sink	1.3×10^3	1.8×10^2	1.6×10^2	$<6.8 \times 10^1$	2.6×10^2
Sulphur Springs	8.1×10^1	2.4×10^1	$<2.6 \times 10^1$	$<1.6 \times 10^1$	$<1.5 \times 10^1$

procedures were used. Each method gave similar results with the filtration data generally yielding slightly higher but not significantly different geometric mean values.

Curiosity Sink

Plate 1 shows Curiosity sink which lies at the end of Curiosity Creek. The sink normally discharges water downward to the Floridian aquifer. In 1961, Menke et al. reported that about 30 percent of the Sulphur Springs effluent was derived from Curiosity and Blue sinks. Recent dye tracer studies performed by the City of Tampa show that this underground flow no longer exists (Burwell, 1987).

The levels of total coliforms, fecal coliforms and E. coli in Curiosity sink are shown in Figure 4. In each panel of the figure, a solid line depicts the geometric mean value of an indicator organism for the 3-month sampling period, while the dashed line represents the bacterial standard required for Class III recreational waters according to DER 17-3.121, or EPA guidelines. In each case, total and fecal coliforms and E. coli slightly exceed these standards, implying that these waters would contribute to the deterioration of down-gradient water supplies.

Jasmine Sink

Plate 2 shows Jasmine/Poinsettia sinkhole with waterfowl barely visible in the underbrush. This sink receives urban runoff (Plate 3) and water from an aquifer which boils to the surface maintaining a clear zone in the duckweed and surface debris.

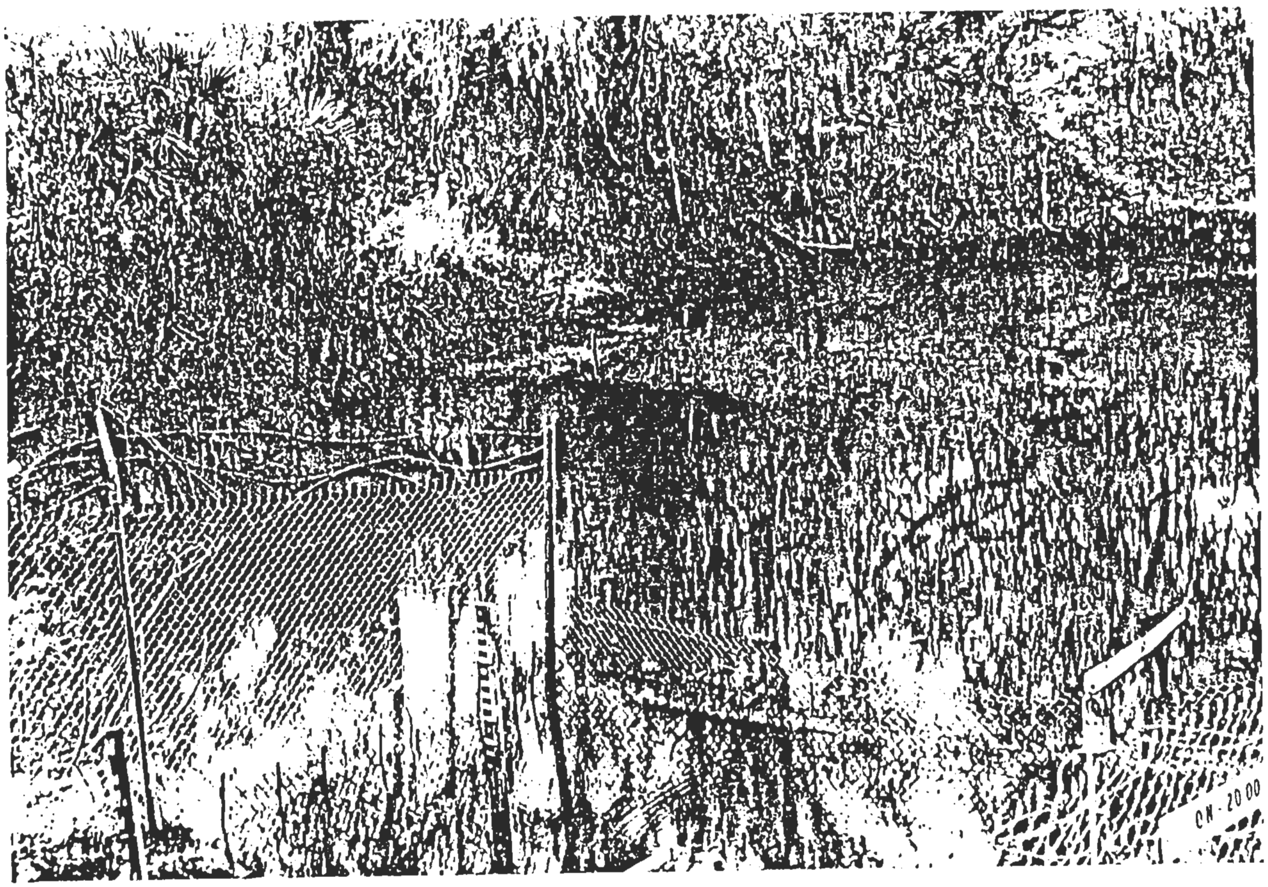

Plate 1. Curiosity Sink

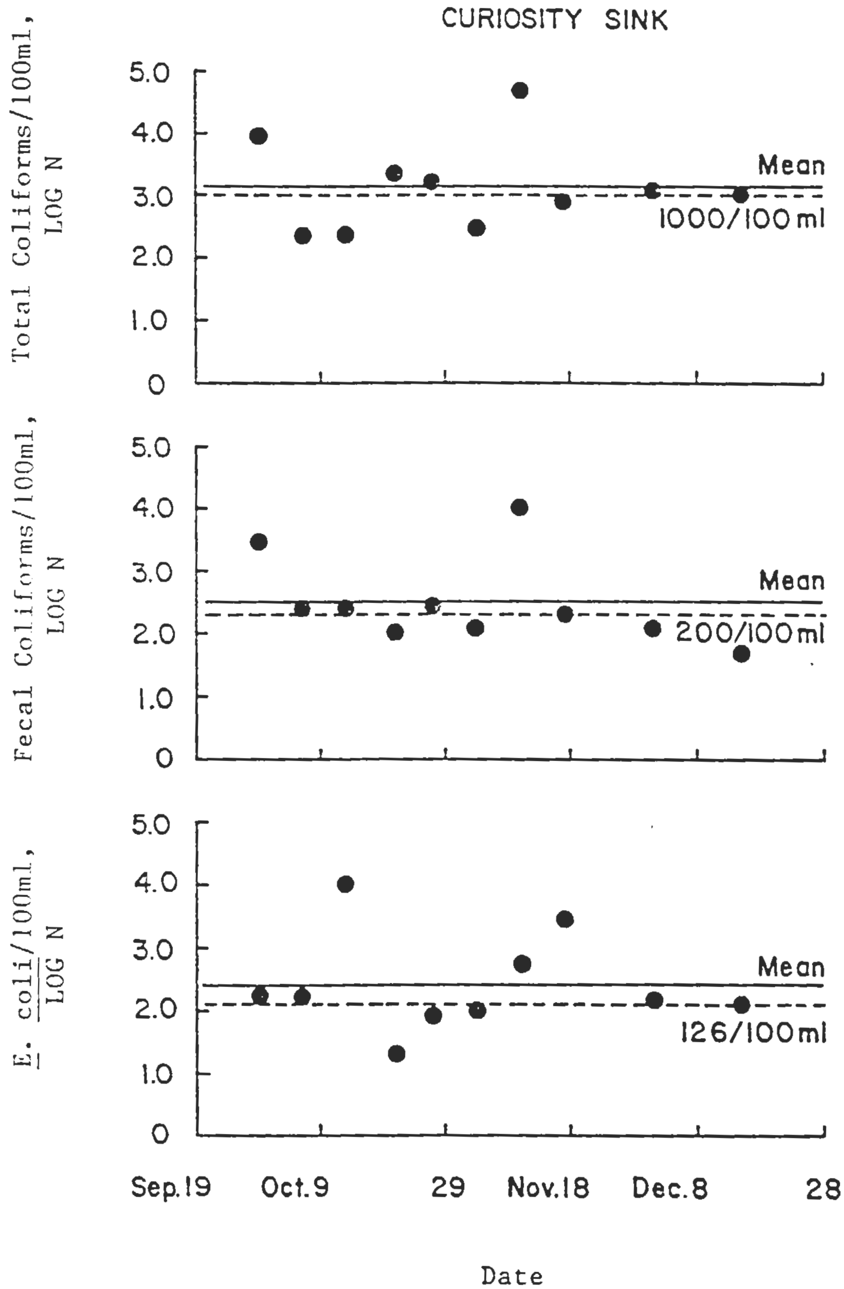

Figure 4. Total coliforms (Top), fecal coliforms (Middle) and E. coli (Bottom) are plotted relative to the sample date. Geometric mean values and corresponding water quality standard values are indicated

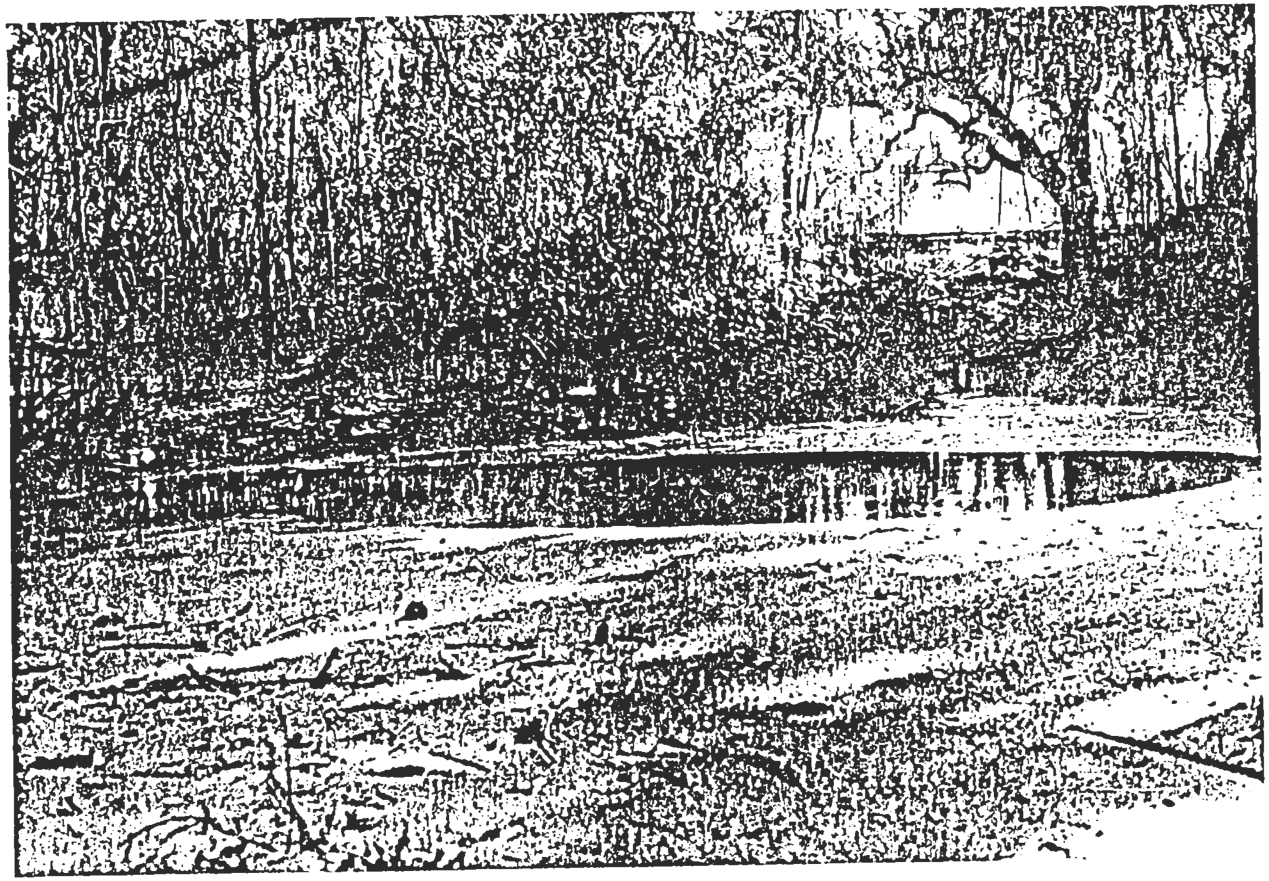

Plate 2. Jasmine Sink

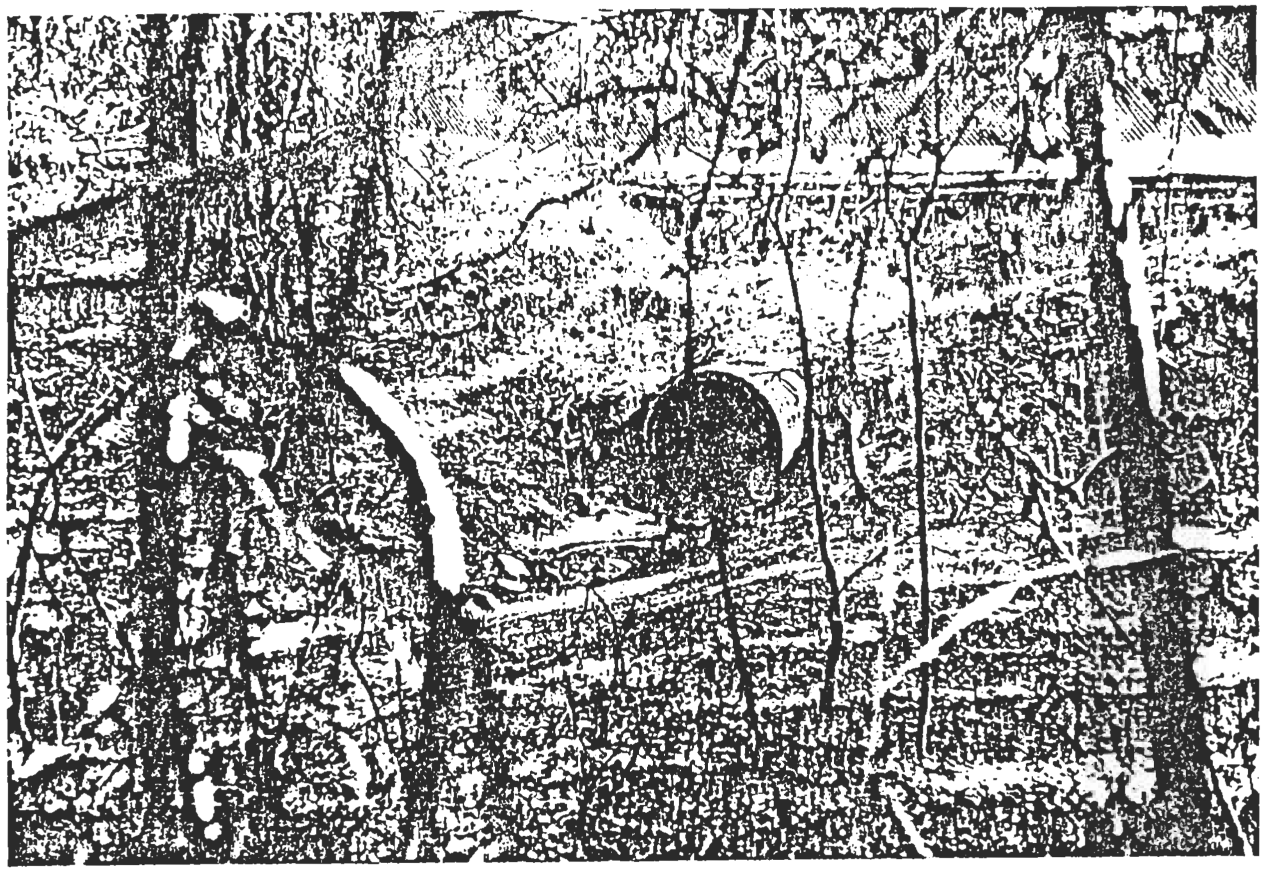

Plate 3. Storm drain in Jasmine Sink

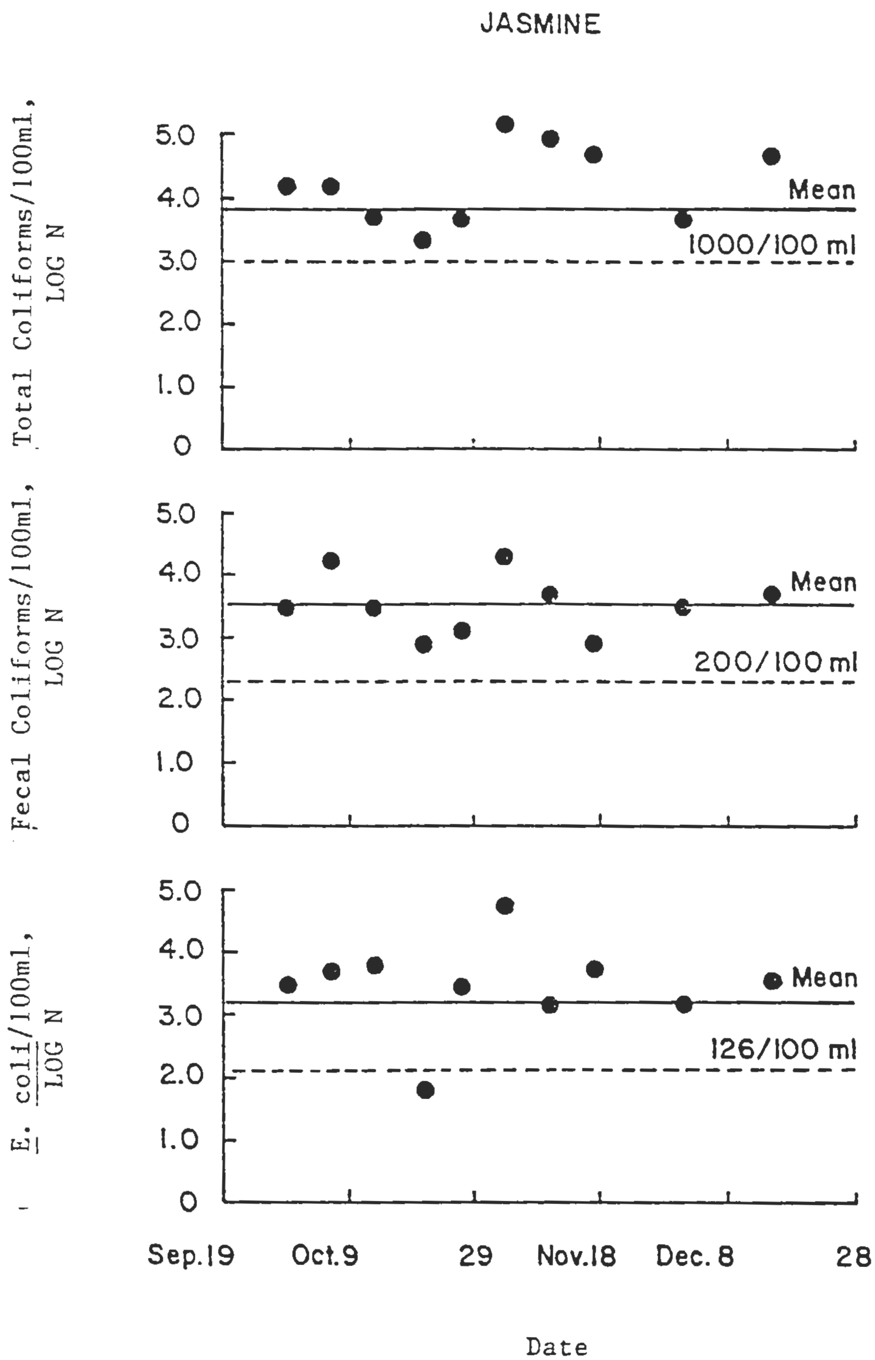

Figure 5. Total coliforms (Top), fecal coliforms (Middle) and E. coli (Bottom) are plotted relative to the sample date. Geometric mean values and corresponding water quality standard value are indicated

Levels of indicator bacteria in Jasmine sink exceeded those observed in Curiosity sink. The geometric mean value for each organism exceeded recreational water bacterial standards by a factor of 10 (Figure 5). The water in Jasmine sink was of poor microbial quality, capable of degrading down-gradient water supplies.

Orchid Sink

Orchid sink is shown in Plate 4 during a dry period in December. Orchid sink receives storm water (Plate 5), leaving relatively fresh pools of storm water which were sampled during this study. In a recent dye study (Burwell, 1987), underground flow from Orchid sink was demonstrated to travel to Sulphur Springs pool in less than 30 hours.

The water sampled in Orchid sink was heavily contaminated as shown in Figure 6. This is not unexpected as urban runoff served as the source of the water samples.

Tenth Street Sink

Tenth Street sink is a small sinkhole, with a diameter of approximately 25 feet, which receives no storm water runoff (Plate 6) from constructed drainage systems. The sink is at least 20 feet deep and appears to be fairly stagnant. From recent dye studies, the Tenth Street sink and Sulphur Springs pool were shown to be hydraulically related, but not necessarily interconnected in terms of flow from the sink to Sulphur Springs pool.

The levels of indicator bacteria in Tenth Street sink are shown in Figure 7. These bacterial numbers indicate that microbial contamination still exists where no street drains directly empty into the sinkhole.

Plate 4. Orchid Sink

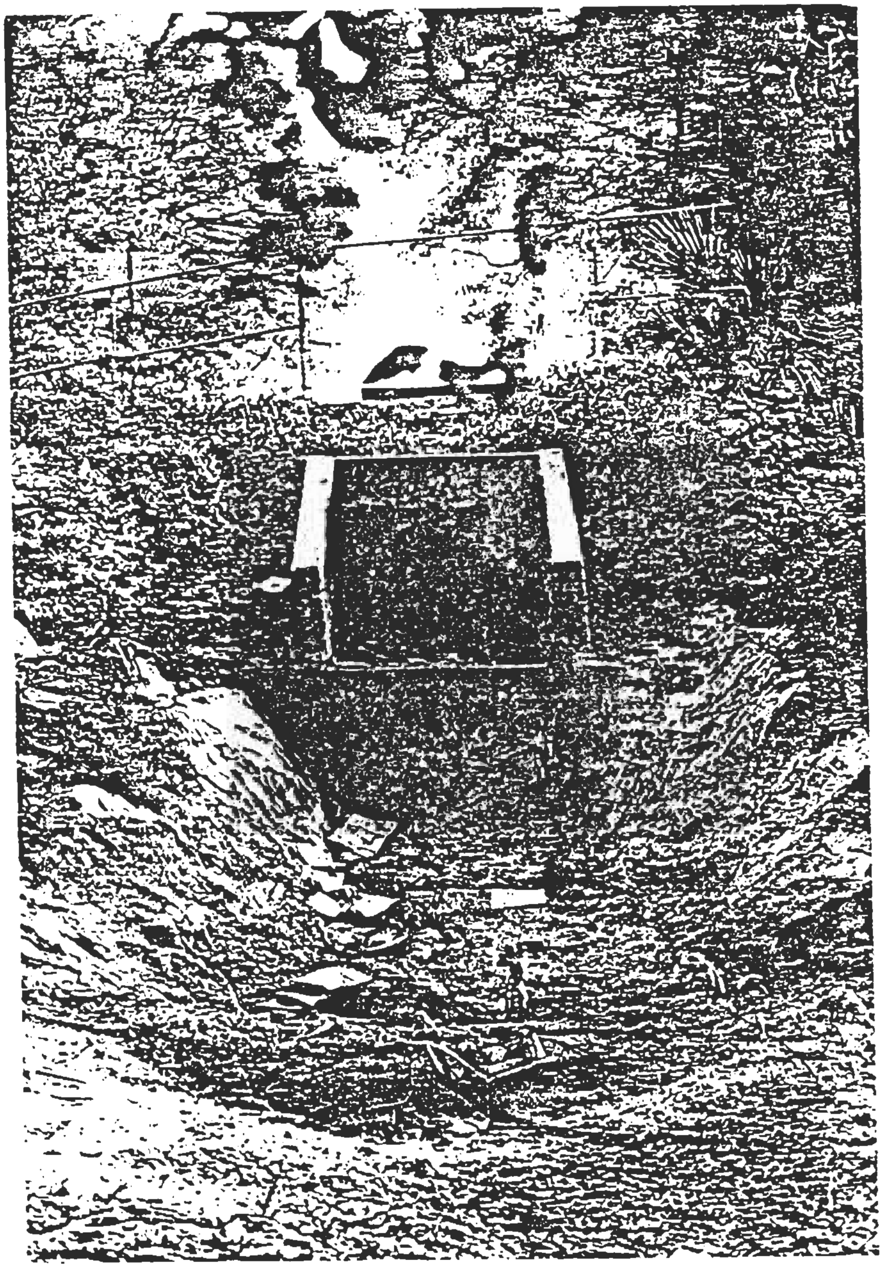

Plate 5. Storm drain in Orchid Sink

ORCHID SINK

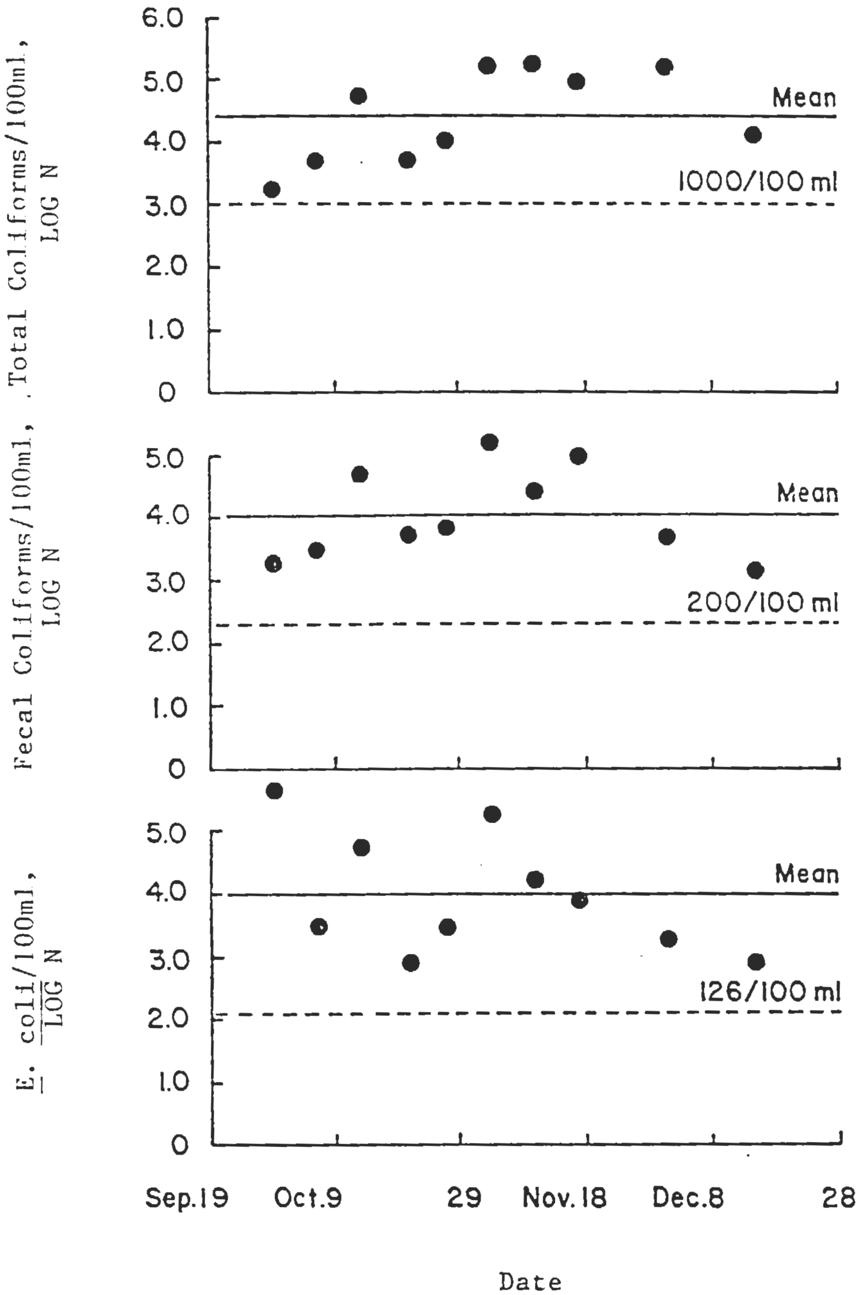

Figure 6. Total coliforms (Top), fecal coliforms (Middle) and _E. coli_ (Bottom) are plotted relative to the sample date. Geometric mean values and corresponding water quality standard values are indicated

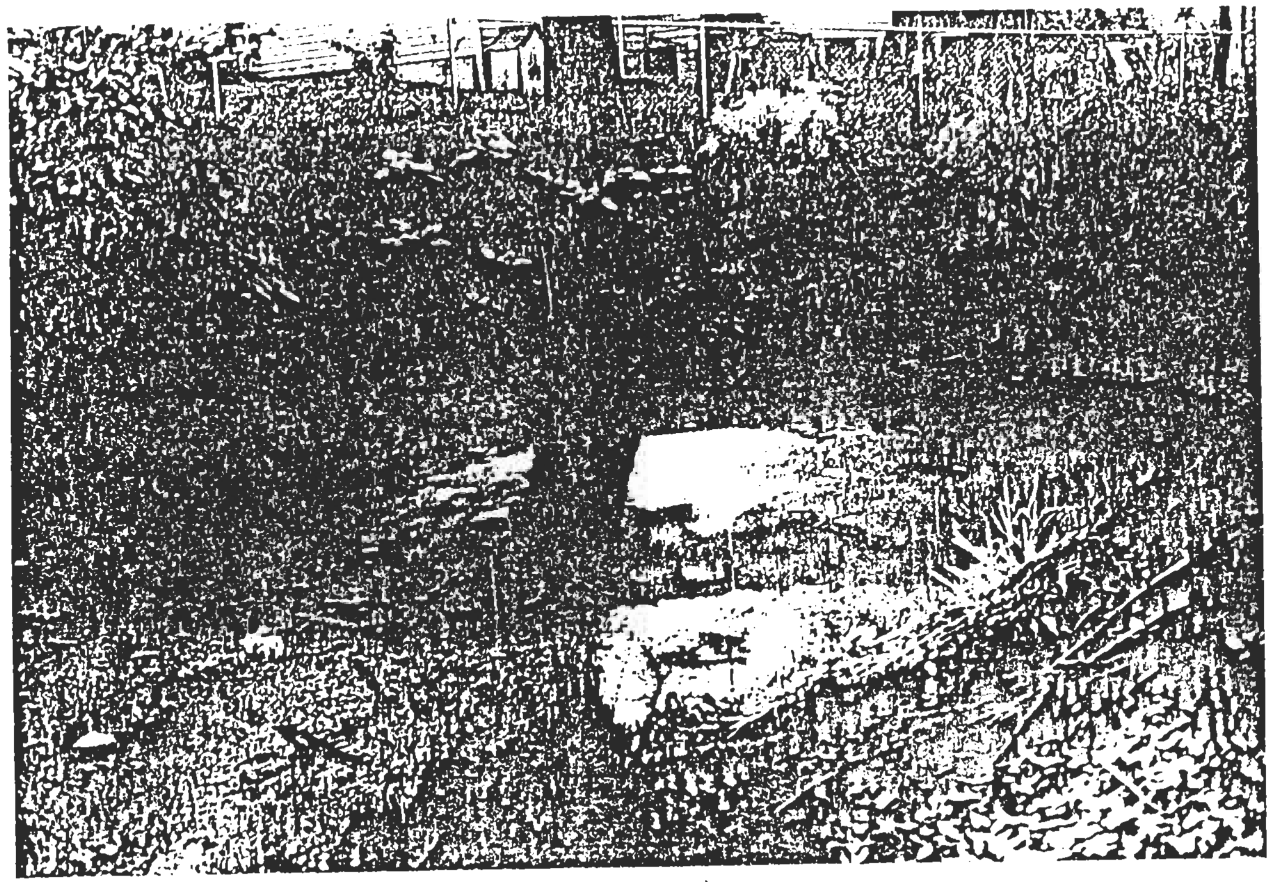

Plate 6. Tenth Street Sink

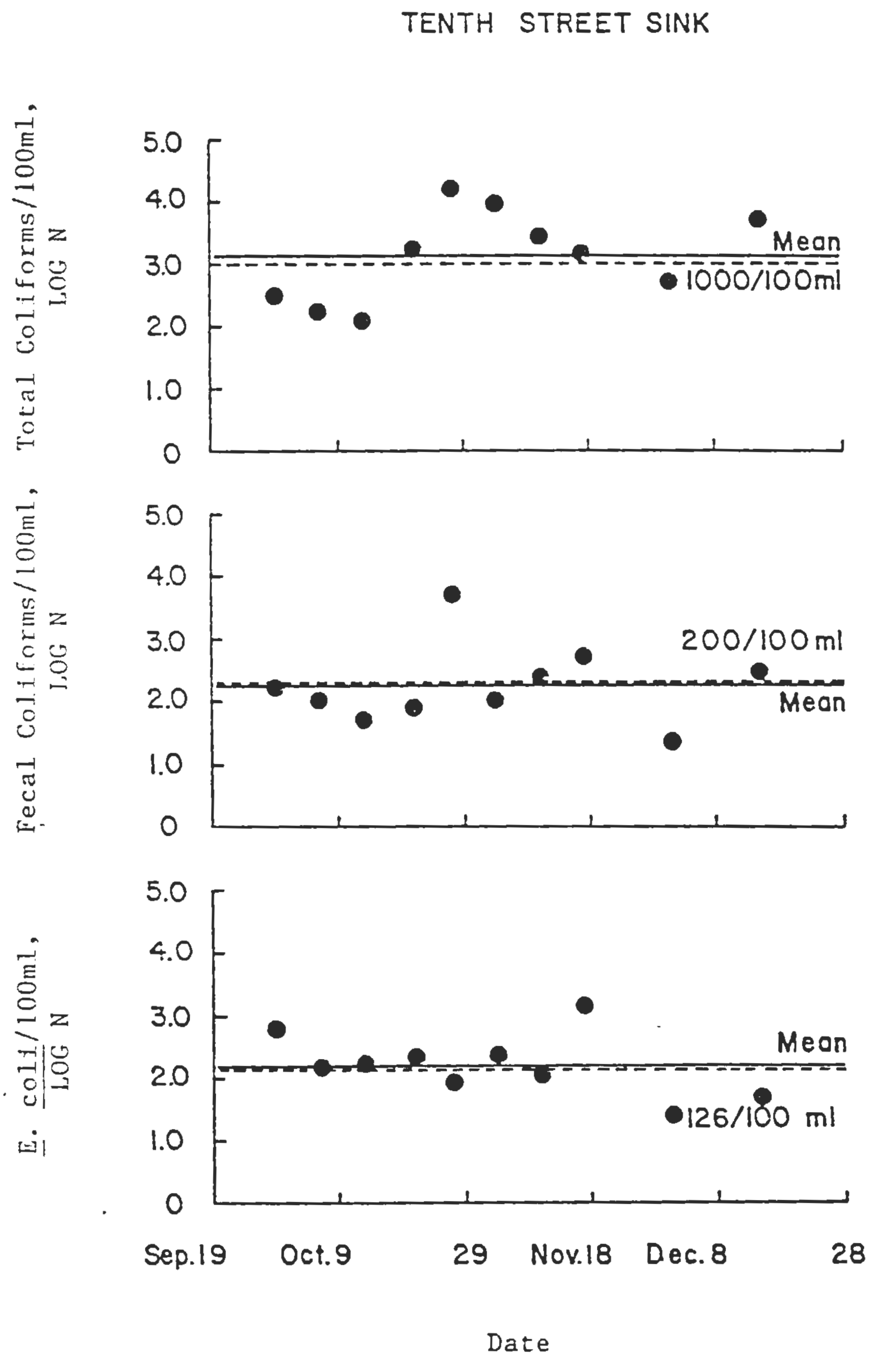

Figure 7. Total coliforms (Top), fecal coliforms (Middle) and E. coli (Bottom) are plotted relative to the sample date. Geometric mean values and corresponding water quality standard values are indicated

Plate 7. Sulphur Springs Pool

However, the Tenth Street sink had the lowest level of bacterial contamination of any of the sinks sampled.

Sulphur Springs

The Sulphur Springs pool (Plate 7) was closed to the public during the summer of 1986, because of high levels of bacterial pollution. During the study period, microbial contamination had decreased, as demonstrated by geometric mean values which were less than the various indicator microorganism standards (Figure 8).

Other Bacterial Populations

Many samples did not yield fecal streptococci (Appendix 1). Data from those samples which did yield fecal streptococci and fecal coliforms are shown in Figure 9. The ratio of fecal coliform to fecal streptococci (FC/FS) which is greater than 4 is indicative of human fecal contamination (Geldreich, 1970). Stewart and Mills (1984) reported that FC/FS ratios, in July 1981 were much greater than 4:1 for Orchid sink and Sulphur Springs pool, but less than 4:1 for Tenth Street sink. The data in Figure 9 shows similar findings to those reported by Stewart and Mills (1984).

The data in Figure 9 and that presented in Figures 10 and 11 show that the indicator bacterial populations in Curiosity and Tenth Street sinks differ from Jasmine and Orchid sinks and Sulphur Springs pool. *E. coli* and Enterococci titers were expected to increase proportionately with increasing levels of fecal coliforms shown in Figures 10 and 11, respectively. This proportional relationship was observed in Jasmine and Orchid sinks and Sulphur Springs pool, but not in Curiosity and Tenth Street sinks. Explanations which could account for this

SULPHUR SPRING

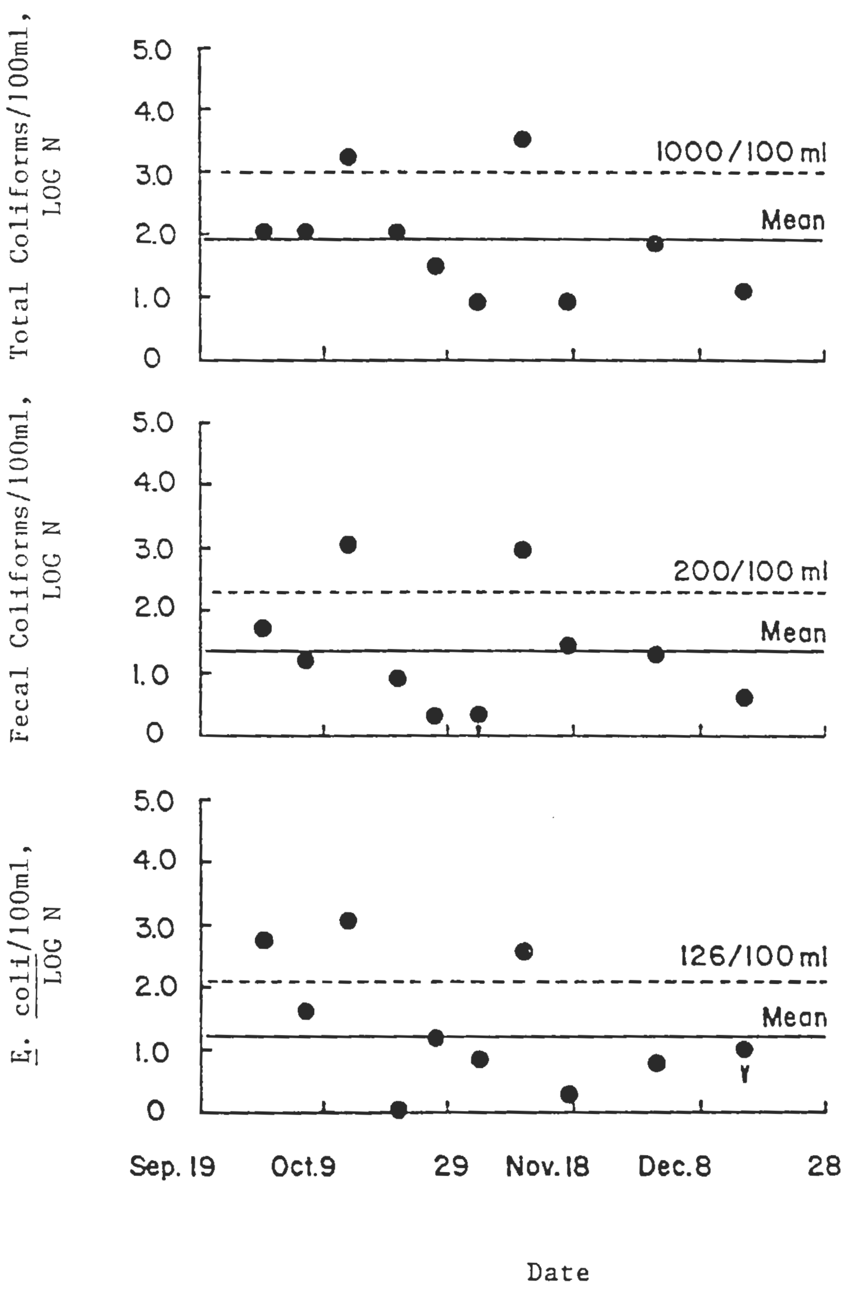

Figure 8. Total coliforms (Top), Fecal coliforms (Middle) and E. coli (Bottom) are plotted relative to the sample date. Geometric mean values and corresponding water quality standard values are indicated

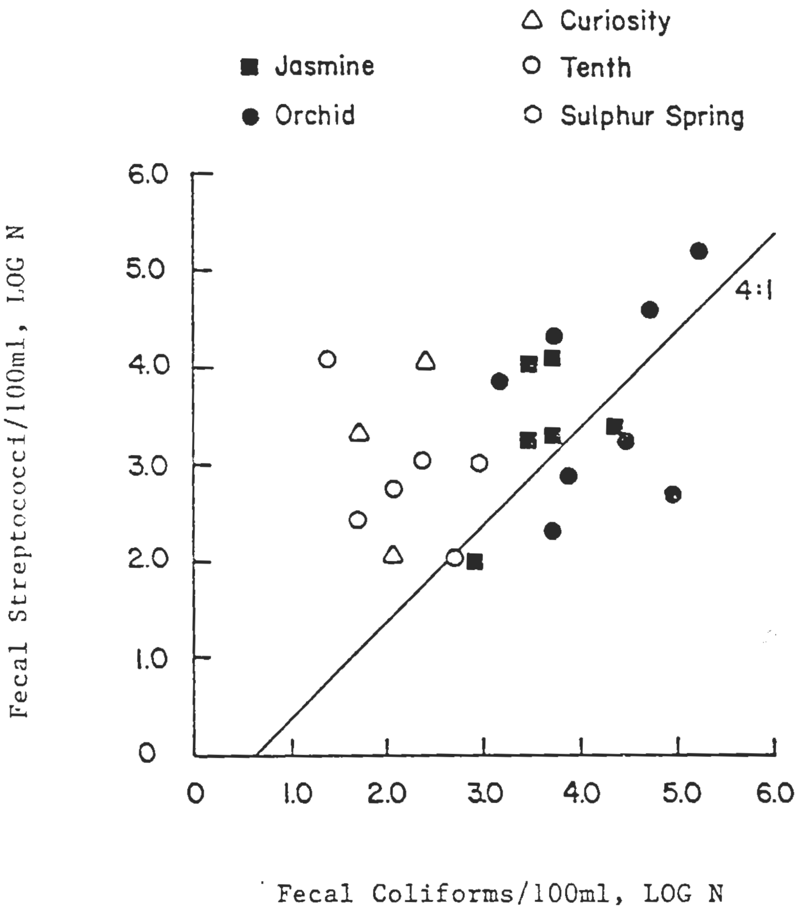

Figure 9. Fecal streptococci are plotted as a function of fecal coliform concentration. This FC/FS ratio of 4:1 is indicated by the solid line. Values greater than 4 are indicative of human fecal contamination (Geldreich, 1970)

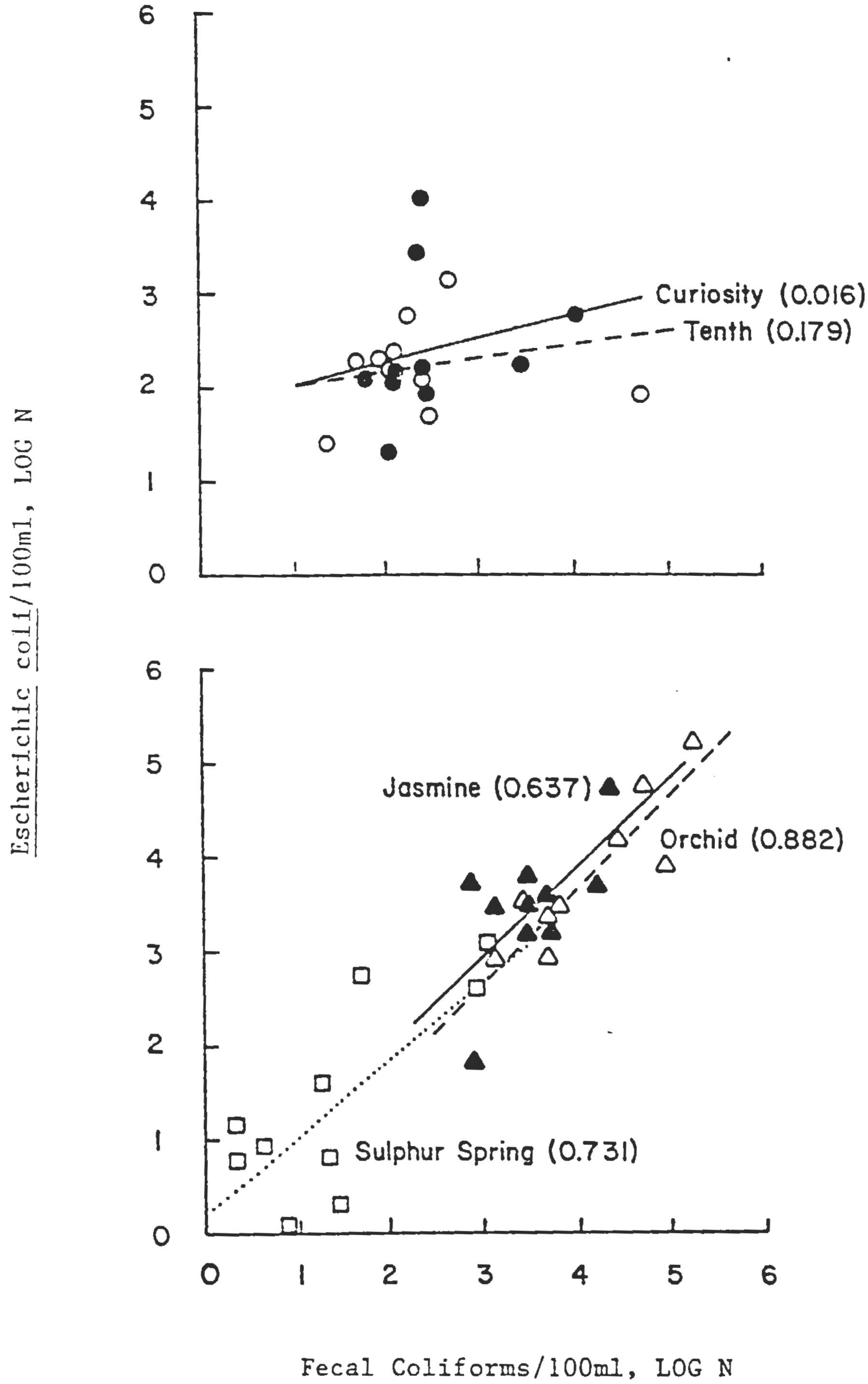

Figure 10. *E. coli* concentrations are plotted as a function of fecal coliform concentrations. The numbers in parentheses are correlation coefficients for the regression lines.

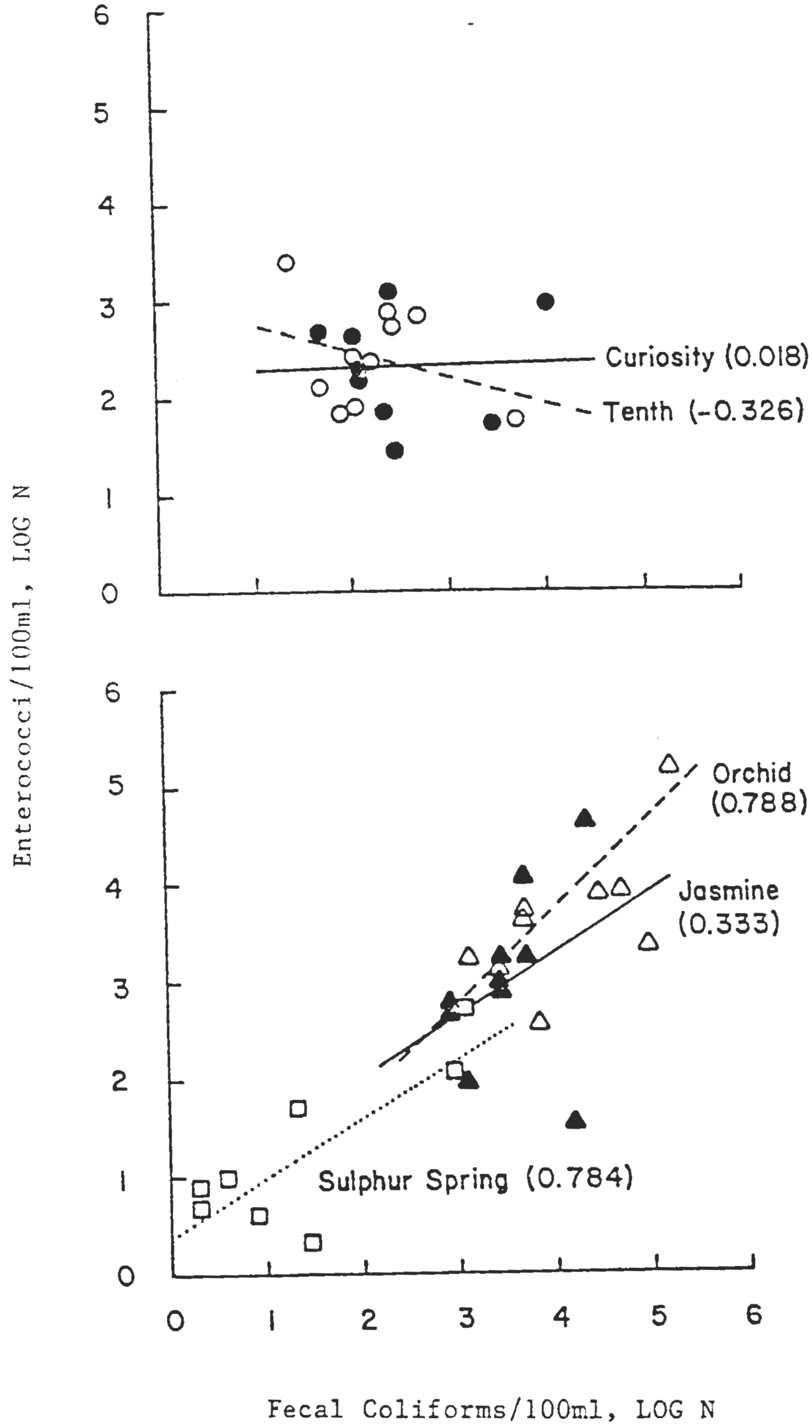

Figure 11. Enterococci concentrations are plotted as a function of fecal coliform concentrations. The numbers in parentheses are correlation coefficients for the regression lines.

difference include unequal die-off of bacterial indicators and non-human sources of contamination. Variable die-off could be a major factor in water bodies such as Tenth Street sink if long hydraulic residence times prevail.

DISCUSSION

Sulphur Springs pool has been closed because bacterial contaminants have periodically exceeded the standards for Class III recreational waters. In this study, all bacterial indicators were favorably compared to each other at the Sulphur Springs location, indicating that all test procedures sufficiently detected the bacterial pollution. This was also true for Jasmine and Orchid sinks but not for Curiosity and Tenth Street sinks where E. coli and enterococci titers were not proportional to fecal coliform levels.

McFetters et al. (1974) and Feachem (1974) reported that fecal coliforms do not survive as long as fecal streptococci and enterococci in fresh water sources. It is possible that the bacterial pollution affecting Curiosity and Tenth Street sinks is older than that sampled at other locations. Information in support of this hypothesis include the large size of Curiosity sink and the absence of storm drains entering the Tenth Street sink. Each situation could lead to long residence times in the respective sinks, thereby affecting the distribution of surviving bacterial species.

Dye studies performed by City of Tampa in 1987 demonstrated that Curiosity sink was not supplying water to Sulphur Springs pool. The same study implied that the Tenth Street sink and Sulphur Springs were hydraulically related, but may not necessarily have the same water passing through both water bodies. These data which suggest that Curiosity and Tenth Street sink water does not pass into the Sulphur Springs pool are supported by the data presented in Figures 9-11.

Orchid sink was shown to provide water to the Sulphur Springs pool during recent dye tests (Burwell, 1987). The data presented herein fit the suggested model of underground flow indicated by the dye tests. The travel time from Orchid sink to Sulphur Springs pool was about 26 hours, such that bacterial pollution from human wastes or urban runoff from the Orchid sink area would be diluted but would not greatly change in character before emerging at the Sulphur Springs pool.

The level of bacterial contamination in Jasmine sink was relatively constant on wet and dry days during the study period. These consistently high numbers could be due to contamination by a source of human waste, or due to sampling or mixing anomalies within the sinkhole. It was not within the scope of this study to investigate sources of microbial contamination. The bacterial loads measured in these sinkholes could have been derived from wastewater conveyance systems, urban runoff and animal sources, to indicate only some possibilities. Therefore, it is suggested that the water quality of Jasmine sink and the hydraulic residence time within the sink should be further evaluated.

RECOMMENDATIONS

1. High bacterial titers were found in Jasmine sink, at the sample location used during this study. The microbiological quality of water and the hydraulic residence time in Jasmine sink should be further evaluated. Such information would help to determine whether other sources of waste are affecting water quality as well as urban runoff.

2. The residence time of water in the Tenth Street sink needs to be determined. At the same time as the dye is being diluted in the sink, monitoring for the emergence of the dye at the Sulphur Springs pool would indicate whether water flows from the sink to the pool.

3. It has been suggested that the height of the overflow water at Sulphur Springs pool be raised to reduce flow and decrease bacterial pollution. In contrast to this possible solution, Menke _et al_. (1961) reported that dissolved materials increased in Sulphur Springs water as the stage was lowered. This means that as the spring yield was increased the chemical quality of water decreased due to intermixing of water from aquifers at greater depths. The 1957 test relating stage to chemical quality should be repeated, with an evaluation of microbial quality and organic content as well.

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CURIOSITY SINK

	TOTAL COLIFORMS/100 ml		FECAL COLIFORMS/100 ml			FECAL STREPTOCOCCI/100 ml	
Date	BGLB	Endo Agar	EC Broth	mFc	mTec	KF	mE
9/29	9.0×10^3	-	3.0×10^3	2.6×10^4	1.7×10^2	<10	5.0×10^1
10/6	2.4×10^2	-	2.4×10^2	7.5×10^2	1.6×10^2	<10	<10
10/13	2.4×10^2	-	2.4×10^2	9.1×10^3	1.1×10^4	1.1×10^4	1.3×10^3
10/20	2.2×10^3	9.1×10^2	1.1×10^2	4.7×10^2	2.0×10^1	1.0×10^2	4.3×10^2
10/27	1.6×10^3	4.6×10^1	2.8×10^2	2.2×10^2	8.3×10^1	<10	2.7×10^1
11/3	3.0×10^2	1.4×10^2	1.3×10^2	2.5×10^2	1.0×10^2	<10	1.5×10^2
11/10	5.0×10^4	3.1×10^4	1.1×10^4	6.4×10^2	5.8×10^2	<10	9.7×10^2
11/17	8.0×10^2	1.4×10^4	2.2×10^2	6.0×10^1	2.8×10^3	<10	7.0×10^1
12/1	1.3×10^3	2.5×10^3	1.3×10^2	1.2×10^2	1.5×10^2	<10	2.2×10^2
12/15	1.1×10^3	4.4×10^3	5.0×10^2	1.2×10^2	1.2×10^2	2.0×10^3	5.0×10^2

JASMINE SINK

	TOTAL COLIFORMS/100 ml		FECAL COLIFORMS/100 ml			FECAL STREPTOCOCCI/100 ml	
Date	BGLB	Endo Agar	EC Broth	mFc	mTec	KF	mE
9/29	1.6×10^4	-	3.0×10^3	7.1×10^3	3.0×10^3	<10	7.3×10^2
10/6	1.6×10^4	-	1.6×10^4	6.2×10^3	5.1×10^3	<10	3.0×10^1
10/13	5.0×10^3	-	3.0×10^3	7.1×10^3	6.3×10^3	1.8×10^3	8.6×10^2
10/20	2.3×10^3	5.9×10^3	8.0×10^2	8.8×10^2	6.5×10^1	1.0×10^2	4.4×10^2
10/27	5.0×10^3	4.2×10^3	1.3×10^3	1.8×10^3	3.0×10^3	<10	9.0×10^1
11/3	1.6×10^5	2.9×10^5	2.2×10^4	4.4×10^4	5.4×10^4	2.5×10^3	4.5×10^4
11/10	9.0×10^4	1.9×10^5	5.0×10^4	3.6×10^3	1.5×10^3	2.0×10^3	1.8×10^3
11/17	5.0×10^4	2.2×10^6	8.0×10^2	1.0×10^3	5.2×10^3	<10	6.0×10^2
12/1	5.0×10^3	3.2×10^3	3.0×10^3	2.2×10^3	1.5×10^3	1.1×10^4	1.9×10^3
12/15	5.0×10^4	1.0×10^4	5.0×10^3	3.8×10^3	3.7×10^3	1.3×10^4	1.1×10^4

ORCHID SINK

Date	TOTAL COLIFORMS/100 ml		FECAL COLIFORMS/100 ml			FECAL STREPTOCOCCI/100 ml	
	BGLB	Endo Agar	EC Broth	mFc	mTec	KF	mE
9/29	1.6×10^3	-	ND	2.1×10^6	6.2×10^5	6.0×10^2	5.7×10^3
10/6	5.0×10^3	-	3.0×10^3	7.1×10^3	3.1×10^3	<10	1.4×10^3
10/13	5.0×10^4	-	5.0×10^4	6.5×10^4	5.8×10^4	4.1×10^4	8.5×10^3
10/20	5.0×10^3	7.7×10^4	5.0×10^3	7.0×10^3	7.8×10^2	2.0×10^2	5.4×10^3
10/27	1.1×10^4	5.6×10^3	7.0×10^3	1.7×10^3	2.7×10^3	6.0×10^2	3.5×10^2
11/3	1.6×10^5	9.2×10^5	1.6×10^5	2.9×10^5	1.8×10^5	1.7×10^5	1.6×10^5
11/10	1.6×10^5	1.0×10^6	2.8×10^4	9.3×10^3	1.6×10^4	3.3×10^3	7.8×10^4
11/17	9.0×10^4	9.0×10^5	9.0×10^4	2.5×10^4	8.0×10^3	5.0×10^2	2.3×10^4
12/1	1.6×10^5	3.2×10^6	5.0×10^3	1.1×10^3	1.8×10^3	2.0×10^4	3.5×10^3
12/15	1.3×10^4	2.1×10^4	1.4×10^3	5.5×10^2	8.0×10^2	7.0×10^3	1.7×10^3

TENTH STREET SINK

	TOTAL COLIFORMS/100 ml		FECAL COLIFORMS/100 ml			FECAL STREPTOCOCCI/100 ml	
Date	BCLB	Endo Agar	EC Broth	mFc	mTec	KF	mE
9/29	3.0×10^2	-	1.7×10^2	7.0×10^1	6.2×10^2	<10	2.4×10^2
10/6	1.7×10^2	-	1.1×10^2	2.0×10^2	1.4×10^2	<10	8.0×10^1
10/13	1.3×10^2	-	5.0×10^1	1.1×10^2	1.7×10^2	3.0×10^2	1.3×10^2
10/20	1.7×10^3	2.5×10^2	8.0×10^1	7.2×10^1	2.1×10^2	<10	6.6×10^1
10/27	1.6×10^4	7.3×10^4	5.0×10^3	7.0×10^1	8.4×10^1	1.0×10^0	5.6×10^1
11/3	9.0×10^3	2.9×10^2	1.1×10^2	1.0×10^2	2.3×10^2	6.0×10^2	2.2×10^2
11/10	2.8×10^3	5.8×10^4	2.4×10^2	1.2×10^2	1.2×10^2	1.0×10^3	8.1×10^2
11/17	1.4×10^3	8.0×10^3	5.0×10^2	6.0×10^2	1.4×10^3	1.0×10^2	7.0×10^2
12/1	5.0×10^2	5.3×10^2	2.2×10^1	1.2×10^1	2.5×10^1	1.1×10^4	2.5×10^3
12/15	5.0×10^3	2.5×10^2	3.0×10^2	4.5×10^1	4.9×10^1	<10	5.4×10^2

SULPHUR SPRINGS

	TOTAL COLIFORMS/100 ml		FECAL COLIFORMS/100 ml			FECAL STREPTOCOCCI/100 ml	
Date	BGLB	Endo Agar	EC Broth	mFc	mTec	KF	mE
9/29	1.1×10^{2}	-	5.0×10^{1}	8.7×10^{2}	5.8×10^{2}	<10	<10
10/6	1.1×10^{2}	-	1.7×10^{1}	4.0×10^{1}	4.0×10^{1}	<10	<10
10/13	1.7×10^{3}	-	1.1×10^{3}	1.4×10^{3}	1.2×10^{3}	<10	5.1×10^{2}
10/20	1.1×10^{2}	2.5×10^{1}	8.0×10^{0}	8.0×10^{0}	1.0×10^{0}	<10	4.0×10^{0}
10/27	3.0×10^{1}	2.5×10^{1}	2.0×10^{0}	1.5×10^{1}	1.5×10^{1}	<10	5.0×10^{0}
11/3	8.0×10^{0}	2.0×10^{1}	2.0×10^{0}	2.0×10^{0}	6.5×10^{0}	<10	8.0×10^{0}
11/10	3.0×10^{3}	1.2×10^{4}	9.0×10^{2}	4.4×10^{2}	3.7×10^{2}	1.0×10^{3}	1.1×10^{2}
11/17	8.0×10^{1}	<100	3.0×10^{1}	1.0×10^{1}	2.0×10^{0}	<10	2.0×10^{0}
12/1	7.0×10^{1}	1.4×10^{2}	2.1×10^{1}	4.0×10^{0}	6.0×10^{0}	<10	5.0×10^{1}
12/15	1.3×10^{1}	2.0×10^{1}	4.0×10^{0}	1.0×10^{0}	<10	<10	9.5×10^{0}

APPENDIX N

HILLSBOROUGH COUNTY ENVIRONMENTAL PROTECTION COMMISSION
ANALYSIS OF STORMWATER AND BACTERIA PATTERNS, CARDINALE
1988

C. B.

COMMISSION
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PAM IORIO
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MEMORANDUM

Date January 19, 1988

To Sulphur Springs File

From Tom Cardinale T.C.

Subject: Evaluation of Health Department Data

The bacterial contamination at the Sulphur Springs pool has been suspected of being directly related to rainfall. The enclosed seventeen years of data collected only from the upper pool from June 1971 through September 1987 was evaluated two ways, in order to determine any correlation between bacteria and rainfall.

An important consideration that needs to be kept in mind is the fact that rain falling one to two days prior to sample collection may have an impact on the sample. This is so because dye studies in 1958 and 1987 indicate connections among various sinkholes and Sulphur Springs, with travel times for rainfall varying from approximately three to more than 40 hours.

Table 1 is an attempt to average the rainfall for three (3) different periods of time when the bacterial count exceeded the 1000 MPN safe swimming criteria used by the Health Department. When the bacterial count was less than 1000 MPN the rainfall was also averaged.

For example, rain falling the same day a sample was collected averaged 0.09 inches when the bacterial count was less than 1000 MPN.

TABLE 1

AVERAGE RAINFALL (INCHES)

MPN Bacteria	Sampled Day	24-Hours Prior	48-Hours Prior
>1000	.37	.53	.57
<1000	.09	.09	.11

The second way to show a correlation uses graphs. Bar graph 1 shows the total coliform counts over the seventeen year period and bar graph 2 shows the total rainfall for the day sampled plus any falling twenty four to forty eight hours prior to sampling.

The next 4 graphs use data only from 1986 through 1987 because the rainfall records all come from the Seneca Avenue location and not the Tampa Airport, which may be too far away from the area of interest. It is also easier to visualize the graphic correlations with less data or with the the data more spread out.

Line graph 1 correlated coliform bacteria and rainfall for the same day.

Line graph 2 correlates coliform bacteria and rainfall that fell approximately 24 hours prior to sampling. This graph suggests that a source approximately 24 hours away is frequently related to the bacterial count.

Line graph 3 also suggests a relationship between bacteria and rain falling 48 hours prior to sampling.

Since any rainfall around a three day period could affect bacterial counts at the pool, line graph 4 was produced.

In conclusion it appears that practically every high bacterial count in the pool is related to rainfall. In addition I suggest that septic tanks and sanitary sewage facilities (lift stations and sanitary sewer piping) which are continuous sources of bacteria are probably <u>not</u> significantly impacting the Sulphur Springs pool.

TC/ph

HEALTH DEPT. TOTAL COLIFORM BACTERIA DATA / RAINFALL DATA

YEAR HD	DATE M-D	SAMPLES #	MPN AVE *1000	RAIN DAY	RAIN -24HR	RAIN -48HR	TotRAIN 3DAYS
71	608	2	0.023	0.06	0.37	0	0.43
	719	2	0.445	0	0	0	0
	809	2	0.73	0	0	0	0
	824	2	1.47	0.42	0	0	0.42
72	412	2	0.019	0	0	0	0
	502	2	0.58	0	0.01	0	0.01
	605	2	0.095	0	0	0	0
	613	2	2.4	0.37	0	0.19	0.56
	619	2	1.65	0.26	3.21	0	3.47
	620	3	1.263	0	0.26	3.21	3.47
	621	3	0.403	0	0	0.26	0.26
	625	3	0.099	0.02	0.02	0.07	0.11
	626	3	0.114	0	0.02	0.02	0.04
72	627	6	0.185	0	0	0.02	0.02
	717	3	0.477	0.01	0.04	0	0.05
	724	3	0.38	0.01	0.9	0.5	1.41
	726	2	0.39	0.01	1.49	0.01	1.51
	801	3	0.051	0.02	0.07	0	0.09
	807	3	1.867	0.04	0	0	0.04
	814	3	0.109	1.02	0	0	1.02
	828	3	0.106	0	2.2	0.05	2.25
	911	3	0.066	0.08	0	0	0.08
	1017	2	0.095	0	0	0	0
73	326	3	2.4	0	3.17	0	3.17
	327	3	0.667	0	0	3.17	3.17
	402	3	2.4	0.55	0.18	0	0.72
	408	3	0.13	0.01	0.46	0	0.47
	409	3	0.147	0	0.01	0.46	0.47
	410	3	0.066	0	0	0.01	0.01
	625	3	0.37	0	0	0.48	0.48
75	512	3	2.4	0.01	0	0.64	0.65
	520	3	0.44	0	0	0	0
	602	3	0.27	0.05	0	0	0.05
	707	3	0.362	0.05	0.04	0	0.09
	819	3	0.476	0	0.08	0.6	0.68
76	511	3	2.4	0	0	0	0
	517	3	2.4	0.86	0	3.86	4.72
	518	3	2.133	0	0.86	0	0.86
	601	3	0.897	0	0	0	0
77	606	3	1.867	0	0	0.44	0.44
	612	3	1.45	0	0	0	0
	613	3	0.313	0	0	0	0
78	515	3	0.156	0	0	0	0
	725	3	0.543	0.51	0	0	0.51
	803	3	0.154	0	0.33	0.82	1.15
	804	3	0.29	0	0	0.33	0.33
79	618	3	0.56	0	0	0	0
	801	3	0.032	0	0	0	0
80	721	3	2.133				
	723	3	1.097				
81	512	3	2.4	0	0	0	0
	809	3	0.227	0	0	0.45	0.45
	810	3	0.858	0	0	0	0

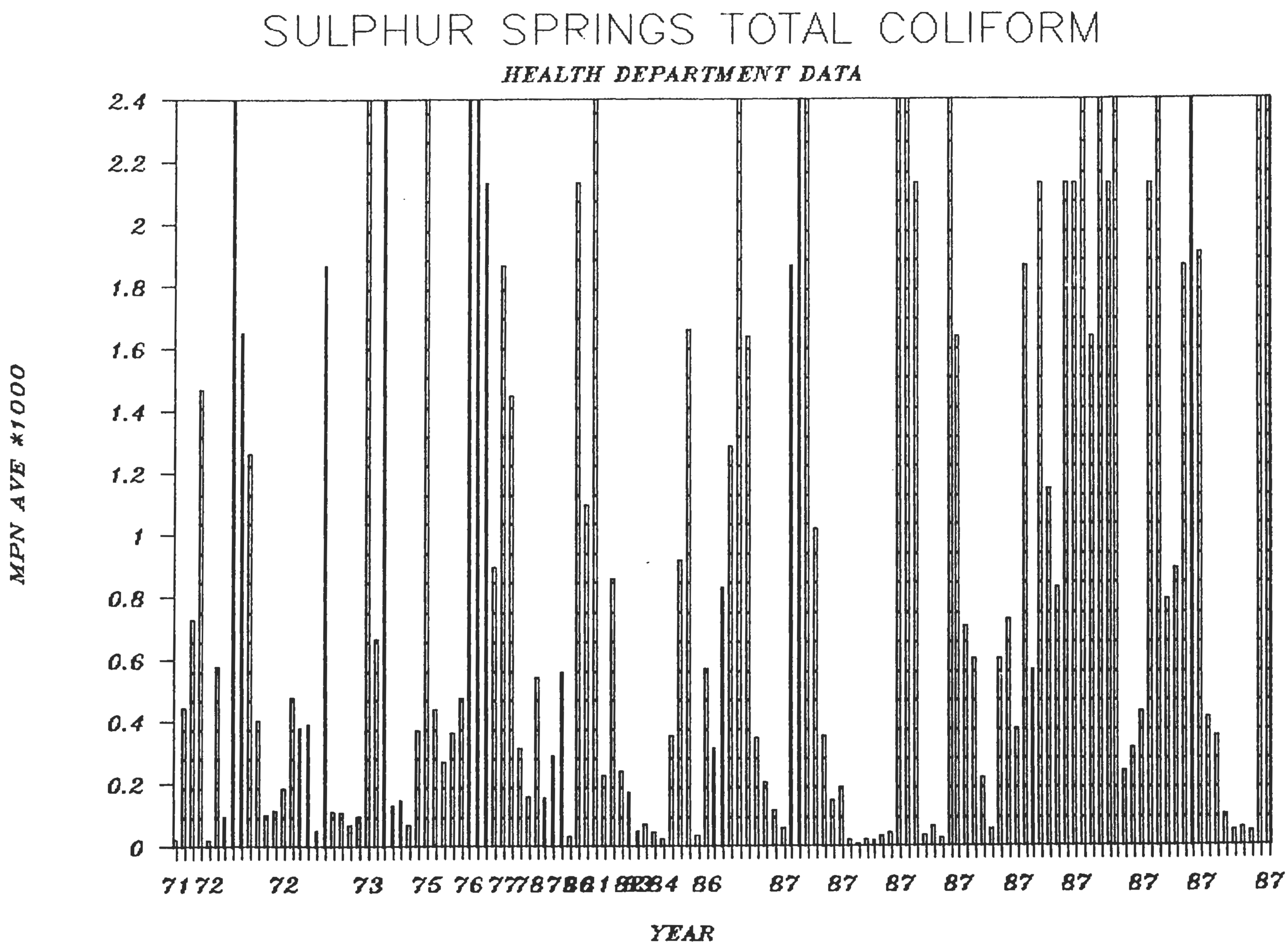
HEALTH DEPT. TOTAL COLIFORM BACTERIA DATA / RAINFALL DATA

	816	1	0.24	0	0	0	0
82	807	1	0.17	0.07	0	0	0.07
83	520	1	0.049	0	0	0	0
	621	1	0.07	0	0.1	0	0.1
	801	1	0.046	0.1			0.1
84	423	1	0.023	0.15	0	0	0.15
	625	1	0.35	0	0	0.35	0.35
	723	1	0.92	0.8	0.17	0.1	1.07
	731	2	1.66	0.25	0.3	1.48	2.03
	827	3	0.035	0	0	0	0
86	106	2	0.57	0	0	0	0
	107	3	0.313	0.25	0	0	0.25
	108	3	0.83	0	0.25	0	0.25
	622	3	1.287	0.8	0.18	0.04	1.02
	623	3	2.4	0.43	0.8	0.18	1.41
	706	3	1.64	0.13	0.4	0	0.53
	707	3	0.347	0.18	0.13	0.4	0.71
	708	3	0.205	0.14	0.18	0.13	0.45
	825	2	0.112	0.37	0	0	0.37
87	320	3	0.056	0	0.28	0.67	0.95
	329	3	1.867	2.25	0	1.17	3.42
	330	3	2.4	2.33	2.25	0	4.58
	331	3	2.4	0.1	2.33	2.25	4.68
	405	3	1.02	0	0	0.14	0.14
	406	3	0.35	0	0	0	0
	407	3	0.147	0	0	0	0
87	412	2	0.187	0	0	0	0
	504	3	0.02	0	0	0	0
	505	3	0.006	0	0	0	0
	506	3	0.02	0	0	0	0
	511	3	0.016	0	0.03	0	0.03
	512	3	0.032	0	0	0.03	0.03
	513	3	0.042	0.22	0	0	0.22
87	518	3	2.4	1.1	0	1.62	2.72
	519	3	2.4	0.15	1.1	0	1.25
	520	3	2.133	0	0.15	1.1	1.25
	601	3	0.035	0	0	0	0
	602	3	0.062	0	0	0	0
	603	3	0.024	0	0	0	0
	608	3	2.4	0	0	0.55	0.55
87	609	3	1.64	0	0	0	0
	610	3	0.707	0	0	0	0
	615	3	0.603	0	0	0.03	0.03
	616	3	0.217	0	0	0	0
	617	3	0.054	0	0	0	0
	622	3	0.603	0	0	0	0
	623	3	0.73	0	0	0	0
87	624	3	0.377	0	0	0	0
	629	3	1.867	0.4	0	0.5	0.9
	630	3	0.567	0.34	0.4	0	0.74
	701	3	2.133	0.6	0.34	0.4	1.34
	706	3	1.147	0	0	0	0
	707	3	0.83	0.95	0	0	0.95
	708	3	2.133	0	0.95	0	0.95
87	713	3	2.133	1.15	0	0	1.15
	714	3	2.4	0	1.15	0	1.15

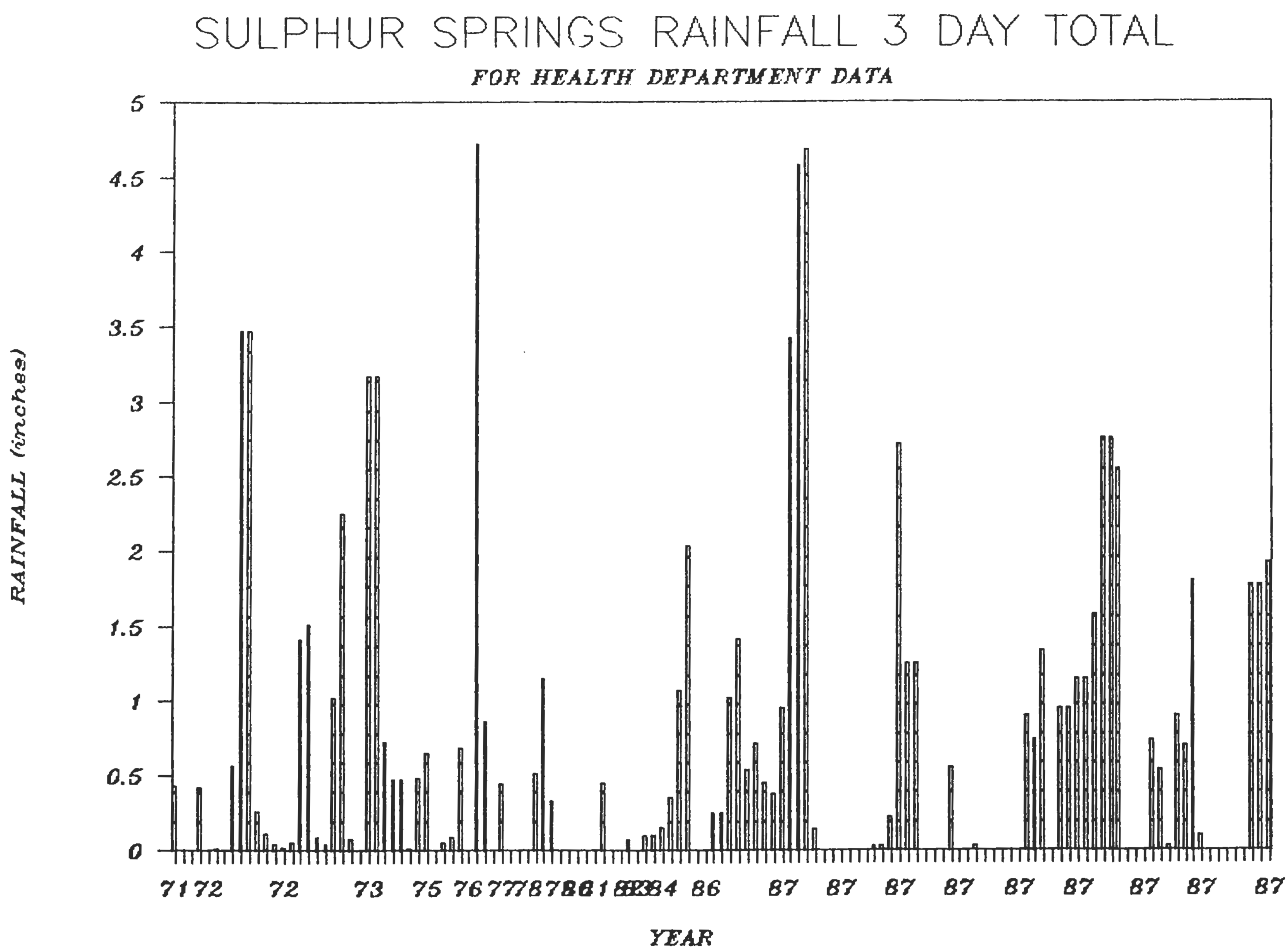
HEALTH DEPT. TOTAL COLIFORM BACTERIA DATA / RAINFALL DATA

	715	3	1.64	0.43	0	1.15	1.58
	720	3	2.4	2.55	0.21	0	2.76
	721	3	2.133	0	2.55	0.21	2.76
	722	3	2.4	0	0	2.55	2.55
	727	3	0.24	0	0	0	0
	728	3	0.313	0	0	0	0
87	729	3	0.43	0	0	0	0
	803	3	2.133	0.03	0.5	0.2	0.73
	804	3	2.4	0	0.03	0.5	0.53
	805	3	0.793	0	0	0.03	0.03
	810	3	0.893	0.7	0	0.2	0.9
	811	3	1.867	0	0.7	0	0.7
	812	3	2.4	1.1	0	0.7	1.8
87	817	3	1.907	0	0	0.1	0.1
	818	3	0.413	0	0	0	0
	819	3	0.35	0	0	0	0
	824	3	0.096	0	0	0	0
	825	3	0.047	0	0	0	0
	826	3	0.056	0	0	0	0
	831	3	0.045	1.77	0	0	1.77
	901	3	2.4	0	1.77	0	1.77
87	902	3	2.4	0.15	0	1.77	1.92

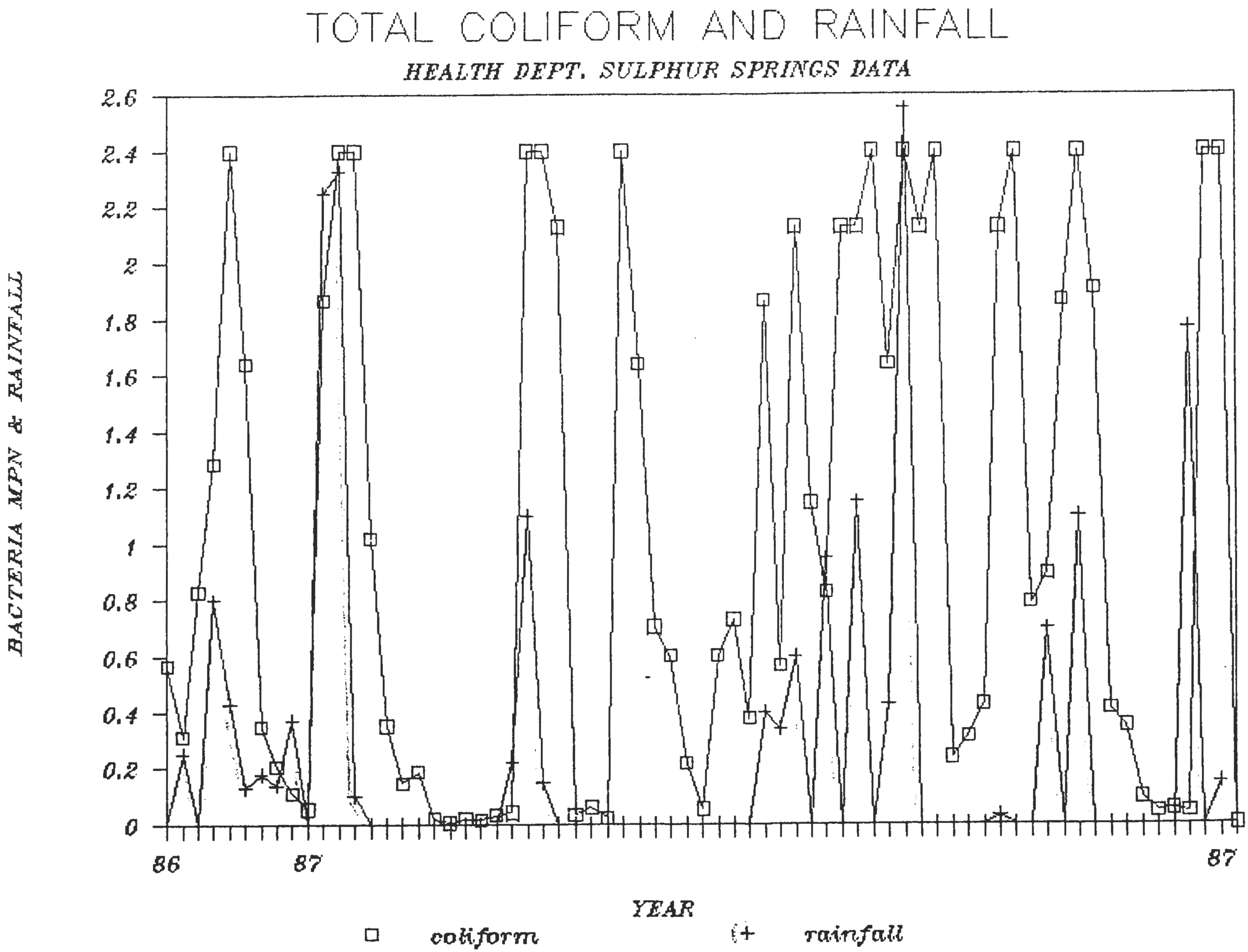
BAR GRAPH 1


SULPHUR SPRINGS TOTAL COLIFORM
HEALTH DEPARTMENT DATA
MPN AVE *1000
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
YEAR

BAR GRAPH 2

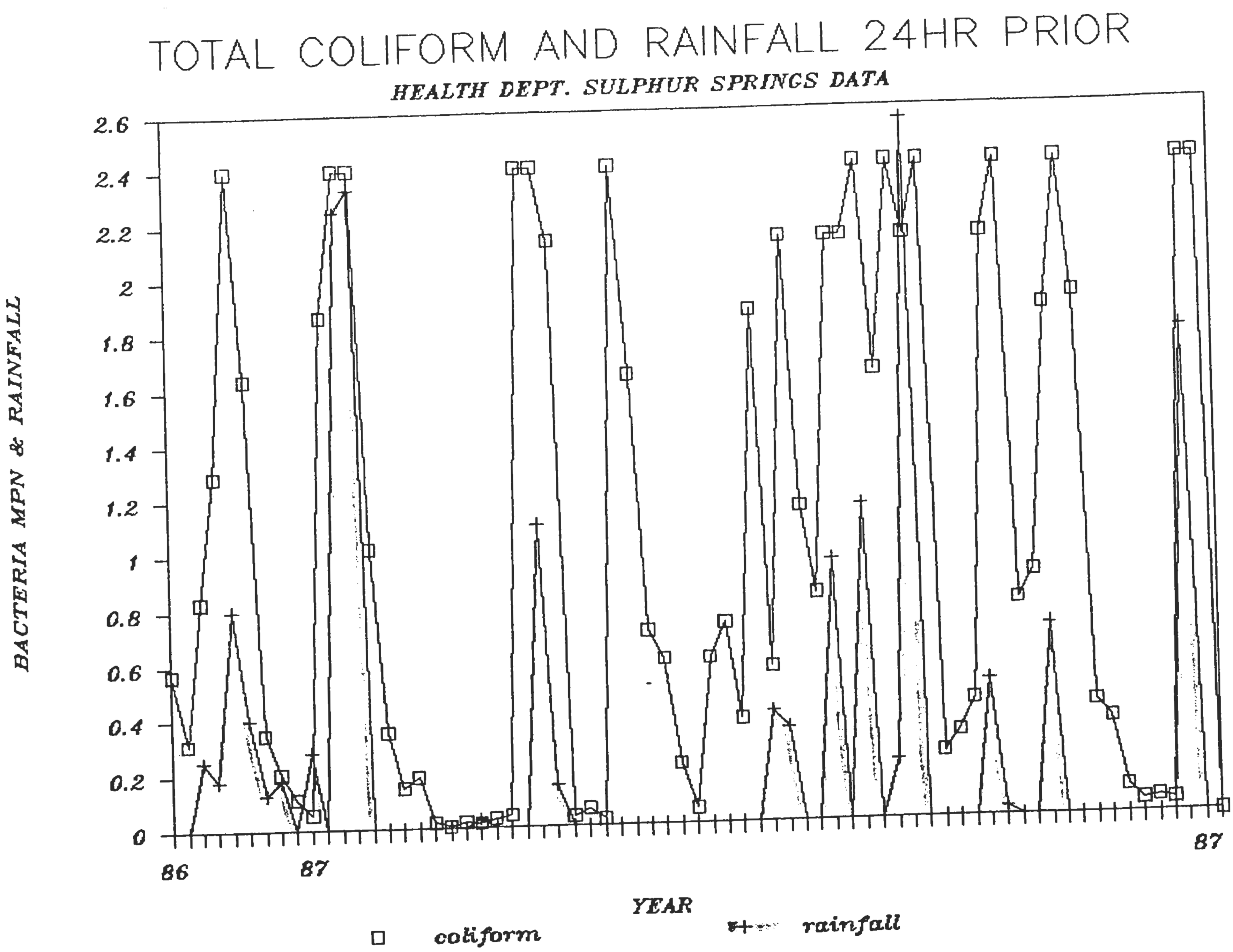

SULPHUR SPRINGS RAINFALL 3 DAY TOTAL
FOR HEALTH DEPARTMENT DATA
RAINFALL (inches)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
YEAR
71
72
73
75
76
86
87

LINE GRAPH 1



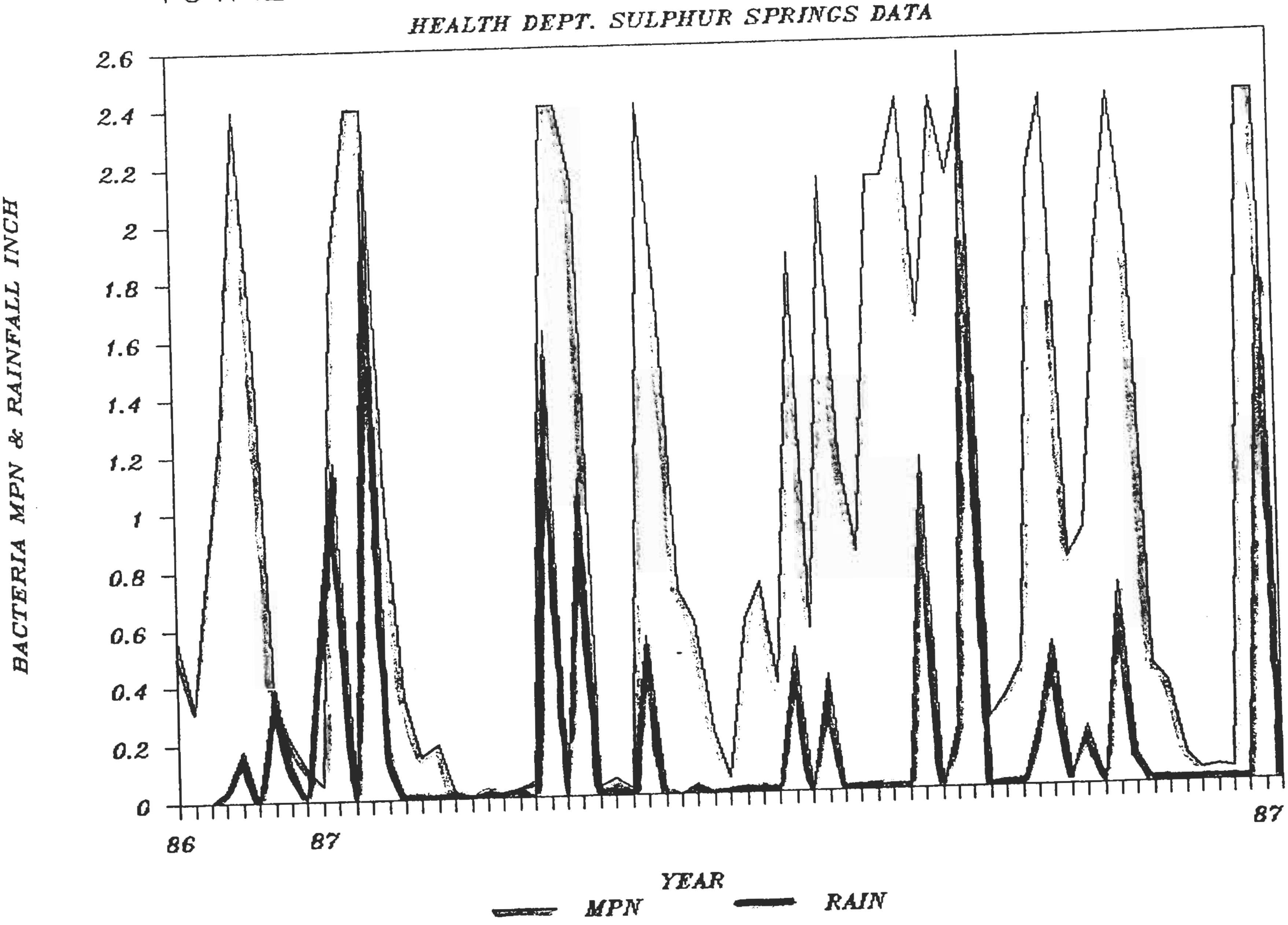
TOTAL COLIFORM AND RAINFALL
HEALTH DEPT. SULPHUR SPRINGS DATA
BACTERIA MPN & RAINFALL
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
86
87
87
YEAR
coliform
rainfall

LINE GRAPH 2


TOTAL COLIFORM AND RAINFALL 24HR PRIOR
HEALTH DEPT. SULPHUR SPRINGS DATA
BACTERIA MPN & RAINFALL
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
86
87
87
YEAR
coliform
rainfall

LINE GRAPH 3

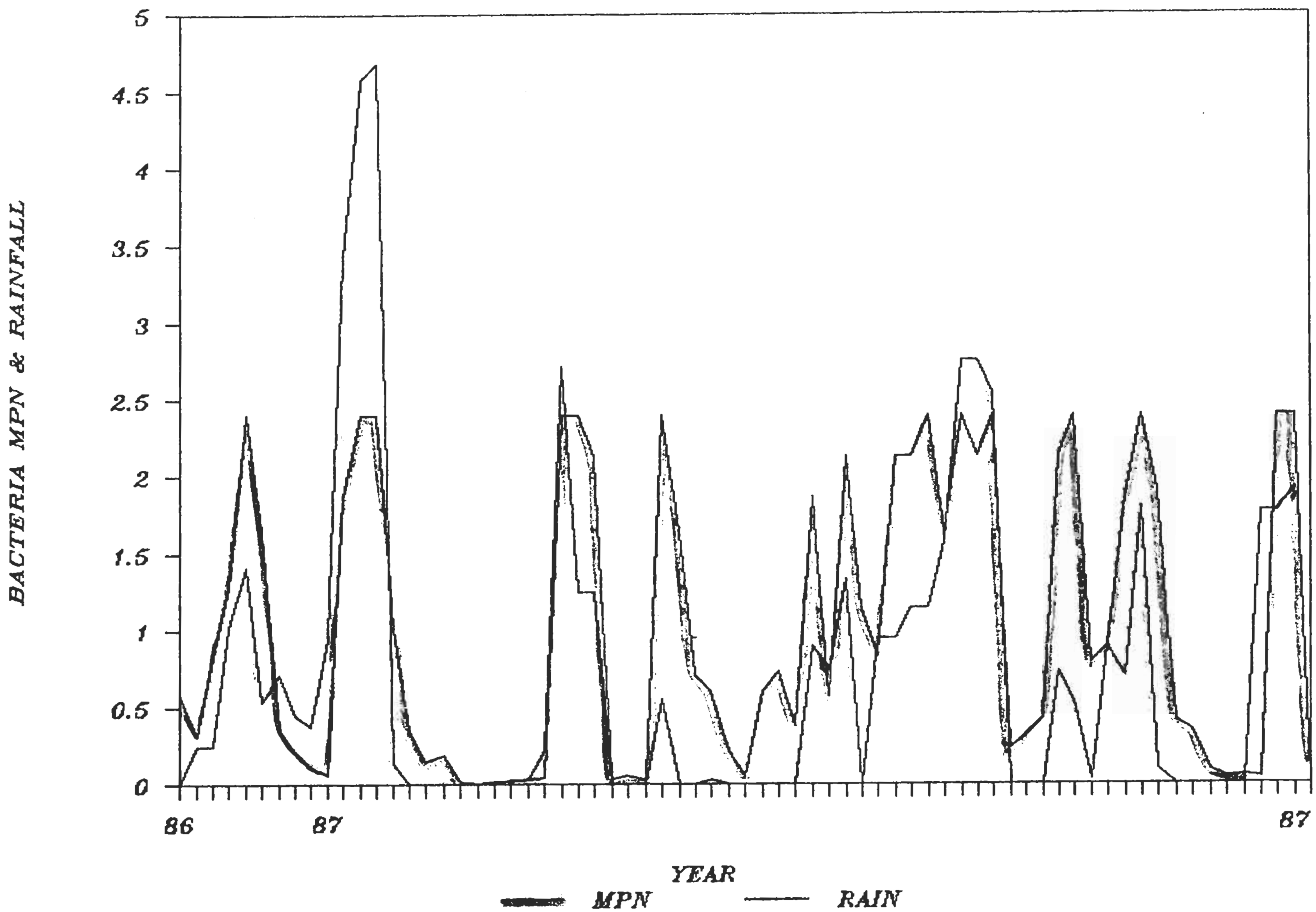
TOTAL COLIFORM AND RAINFALL 48HR PRIOR



LINE GRAPH 4

TOTAL COLIFORM AND RAINFALL 3 DAY TOTAL

HEALTH DEPT. SULPHUR SPRINGS DATA



C. B.

ENVIRONMENTAL PROTECTION COMMISSION
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MEMORANDUM

Date January 19, 1988

To Sulphur Springs File

From Tom Cardinale T.C

Subject: Data Evaluation / Water Department

The enclosed printout is a summary of a portion of the nineteen years of data collected by the City of Tampa Water Department for Sulphur Springs.

Column 1 is the year, Column 2 is the number of total coliform tests performed, column 3 is the number of tests exceeding the safe swimming criteria of 1000 per 100 ml, and the last column is the percent of times the coliform exceeded 1000 per 100 ml.

Bar graph 1 graphically displays the same information. The information appears to indicate that contamination by bacteria at the Sulphur Springs pool gradually worsened, peaking out in 1979 and 1980 followed by a substantial improvement in recent years (86 and 87).

If this trend is true, and not an artifact of sample timing or some other bias, then perhaps something occured between 1982 and 1986 which lowered bacterial contamination. The dumping of tons of clay into Curiosity Sink during the construction of a sanitary sewer lift station may have sealed any direct connection to the aquifer. The sealing has the net effect of filtering bacterial laden stormwater before entering the aquifer.

The City of Tampa Sanitary Sewer Department confirmed by phone that the lift station at Country Club Boulevard and Curiosity Creek went into operation in January 1985 and was probably under construction in 1984.

TC/ph

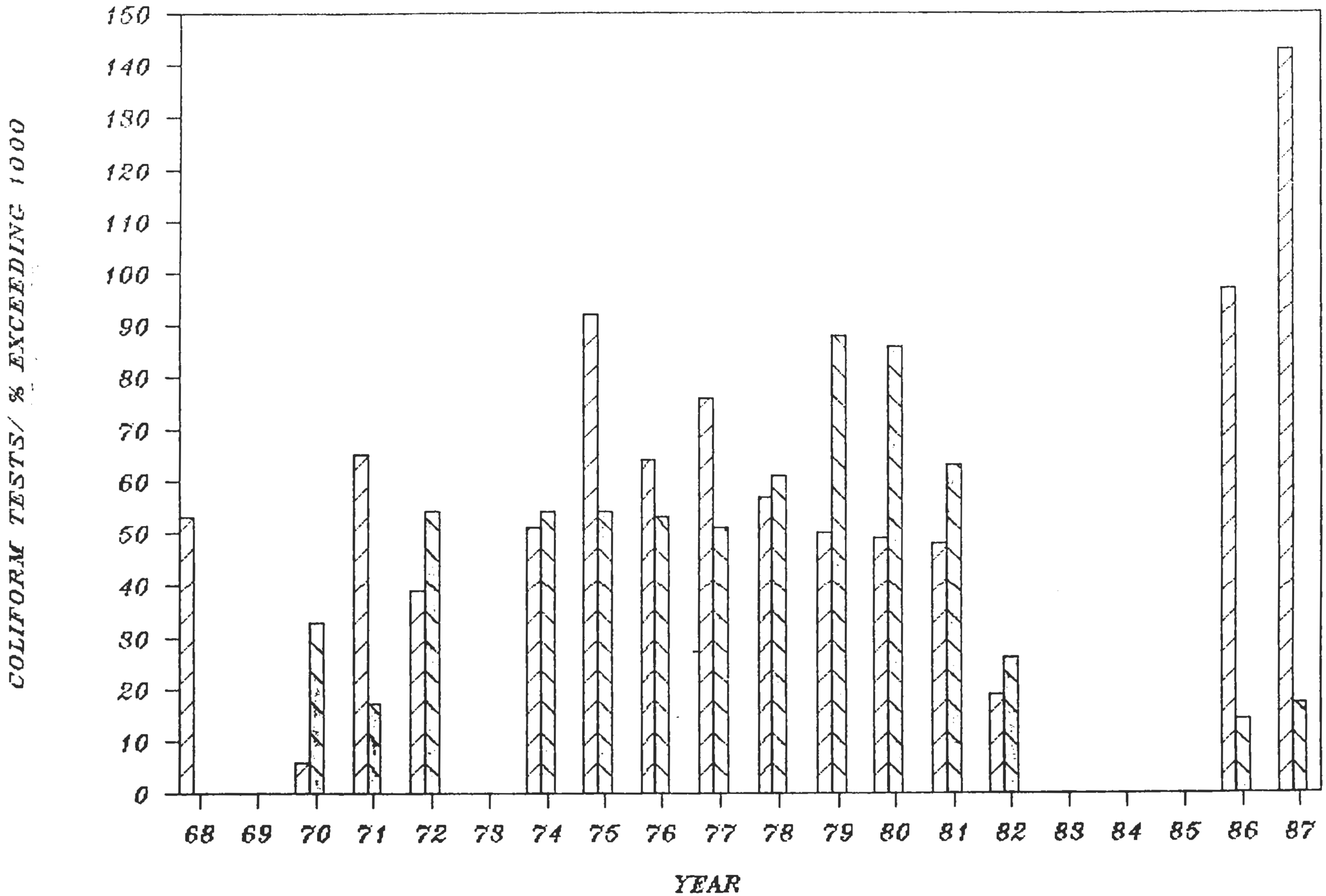
SULPHUR SPRINGS COLIFORM SUMMARY

YEAR C	COLI TEST No.	EXCE COLI No.	EX COLI P percent
68	53	0	0
69			
70	6	2	33
71	65	11	17
72	39	21	54
73			
74	51	23	54
75	92	50	54
76	64	34	53
77	76	39	51
78	57	35	61
79	50	44	88
80	49	42	86
81	48	30	63
82	19	5	26
83			
84			
85			
86	97	14	14
87	143	25	17

BAR GRAPH 1

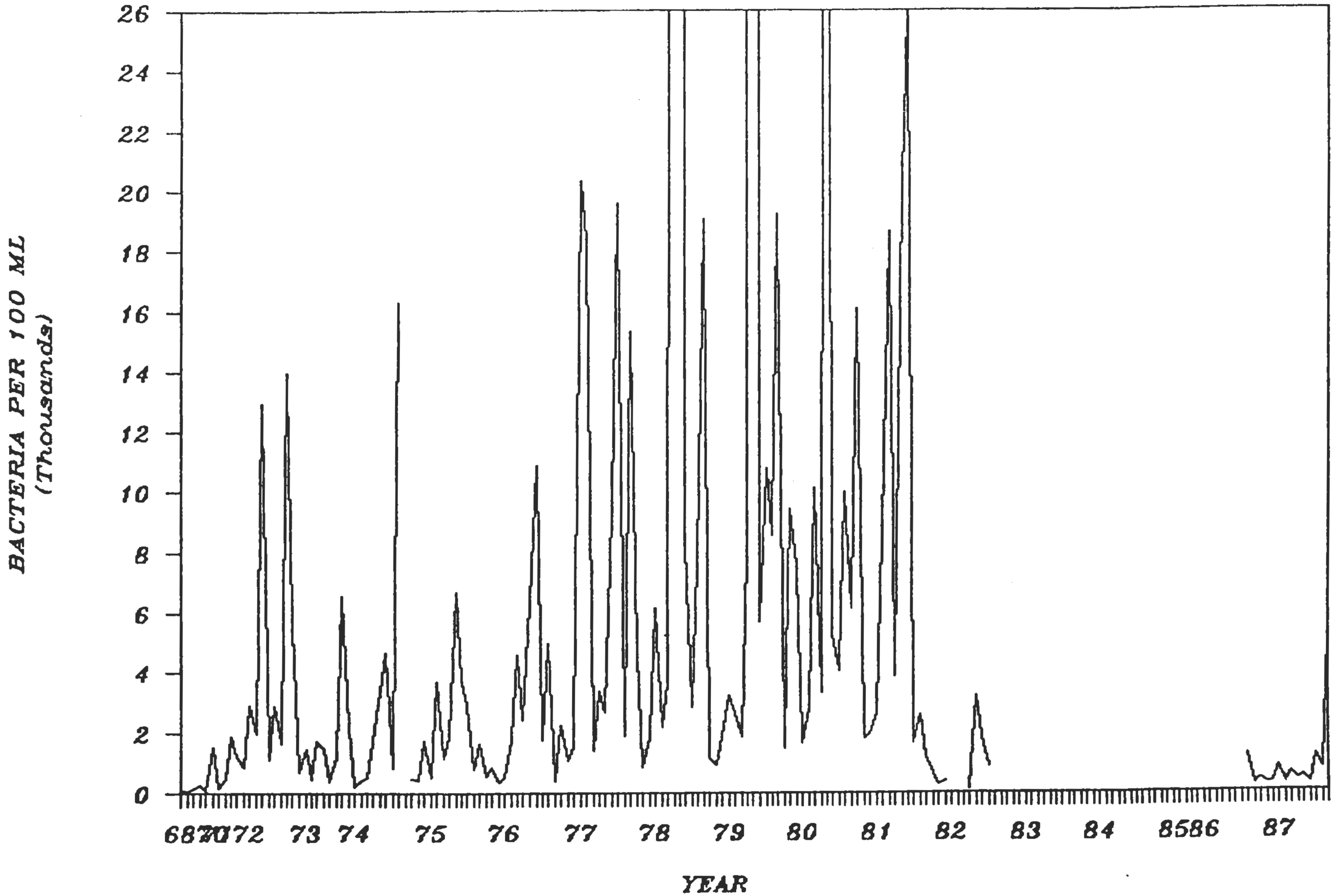
COLIFORM SUMMARY

SULPHUR SPRINGS



SULPHUR SPRINGS COLIFORM BACTERIA

TAMPA WATER DEPT. DATA



ENVIRONMENTAL PROTECTION COMMISSION
HILLSBOROUGH COUNTY

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MEMORANDUM

Date December 30, 1987

To Sulphur Springs File

From Tom Cardinale T.C.

Subject: Tampa Water Department Data Base

The enclosed print out is a summary of water quality data collected by the City of Tampa Water Department starting on February 11, 1968 through the present time for samples of Sulphur Springs pool water (upper pool).

The city started these analysis in conjuction with their use of the spring as a supplemental water supply source (approximately 20 mgd) during dry periods when the Hillsborough River reservoir becomes too low.

Little or no data were collected in 1969 and 1970. Most of the sampling occured when the city was pumping, but some years samples were collected year round whether pumping was occuring or not.

The rainfall data represents the total precipitation for each month measured at the cities Seneca Avenue stormwater detention basin, starting in October 1980 through present.

Rainfall data prior to October 1980 came from the U.S. Weather Service Tampa Airport Gauge. The analysis data in the other columns represent the arithmetic mean for any and all data collected during any monthly period.

All of this data has been placed into the EPC computer network system on a Lotus 123 worksheet under the file name Sulphurs.

TC/ph

SULPHUR SPRINGS

YEAR	COLOR units	ALK ppm	HARD ppm	pH units	COND umhos	COLI per100ml	CL ppm	RAIN inch
68	8	138	282	7.3	1000	90	212	1.5
	7.8	140	281	7.3	970	63	228	1.2
	7.8	138	294	7.3	1036	142	214	0.7
	7	139	287	7.3	976	259	191	2.0
	6.5	139	284	7.5	963	60	192	6.7
70	10	130	272	7.4	957	1515	218	4.1
71	19	134	280	7.2	958	140	230	2.3
	12	140	291	7.3	1007	483	253	1.5
	7.8	141	288	7.3	972	1866	226	3.5
	6.3	144	296	7.3	980	1242	229	2.5
	5.8	144	299	7.3	987	827	238	2.8
72	11.9	140	280	7.3	945	2907	227	0.3
	6.4	143	283	7.3	966	1963	227	1.8
	4.9	144	264	7.2	848	12945	191	5.2
	16.5	137	269	7.3	866	1103	206	6.6
	10.7	141	275	7.3	904	2872	210	9.7
	20.8	141	274	7.3	947	1680	223	1.2
	15.7	142	287	7.3	990	13979	244	3.2
	7.4	145	299	7.3	1009	5592	254	3.5
	6.3	144	297	7.3	1025	704	261	2.1
73	12.7	141	280	7.3	992	1455	241	3.7
	13	141	284	7.2	1000	480	238	2.5
	7.1	141	281	7.4	970	1720	232	4.7
	18.6	138	275	7.3	960	1484	229	9.4
	19.3	137	284	7.3	945	415	227	8.9
	22.2	137	281	7.4	963	1195	230	0.9
	20	135	271	7.4	948	6580	220	2.8
	14	137	276	7.4	980	2150	235	5.5
74	14.3	136	280	7.3	947	227	237	0.1
	16.3	136	282	7.3	920	437	241	0.8
	15.6	137	277	7.4	893	520	216	2.3
	14.4	141	276	7.3	905	1696	233	0.3
	10.6	142	293	7.3	953	3375	251	1.1
	8.4	141	304	7.5	1010	4677	280	13.7
	5.3	146	309	7.2	983	813	302	3.4
	4.5	136	310	7.3	1016	16300	340	4.6
	5	137	310	7.3	1015		300	.
	2.7	137	295	7.2	1010	493	307	0.2
	6	136	277	7.2	884	443	306	0.1
	4.1	139	298	7.2	1021	1739	317	2.
75	3.8	145	305	7.4	1012	528	287	0.9
	4.3	150	295	7.3	1009	3700	275	1.5
	5.3	144	299	7.3	1006	1120	276	1.0
	3	141	307	7.2	1009	1840	253	0.9
	3.7	143	288	7.3	952	6671	244	2.0
	3.6	140	283	7.3	909	3696	226	8.7
	4.5	141	287	7.4	925	2925	222	6.6
	7	138	300	7.3	951	785	247	4.2
	6.3	144	292	7.3	999	1640	235	11.2
	9.2	138	302	7.3	1003	560	281	4.9
	17	134	298	7.4	1058	840	290	0.2
	19.3	134	299	7.3	1025	367	267	0.87
76	16.2	135	299	7.4	1082	528	293	0.4

SULPHUR SPRINGS

	13.4	138	300	7.5	1115	1772	267	0.4
	11.6	140	314	7.4	1188	4578	269	1.6
	10.4	147	315	7.4	1171	2431	298	1.8
	12	144	356	7.3	1286	6333	1745	8.1
	25	136	392	7.2	1425	10883	312	7.2
	24.8	136	313	7.3	1335	1732	1370	4.5
	21.8	137	303	7.4	1033	4973	249	7.0
	16.5	136	307	7.3	973	395	273	6.0
	17.8	135	308	7.3	995	2230	282	1.
	14.5	143	308	7.4	984	1063	309	1.5
	9.5	143	308	7.3	962	1533	296	2.0
77	10.8	144	313	7.3	938	20338	306	2.7
	13.5	135	305	7.3	955	18345	313	2.4
	13.8	136	300	7.2	1038	1445	296	0.7
	13.1	141	305	7.4	987	3360	298	0.8
	8.2	145	293	7.4	915	2658	257	0.7
	5.7	146	291	7.4	901	9293	219	2.6
	6.2	145	290	7.4	903	19597	206	5.3
	6.4	147	295	7.3	985	1910	223	5.9
	24.6	142	304	7.3	1002	15365	246	4.2
	42	139	300	7.3	1029	4664	249	0.4
	25	145	309	7.4	1020	827	270	1.8
	15	148	337	7.4	1176	1849	304	3.
78	17.3	144	493	7.3	2175	6165	675	2.8
	23.2	136	340	7.3	1296	2175	345	5.1
	23.2	139	318	7.3	1146	3660	290	2.4
	24.9	140	316	7.3	1141	176245	294	0.9
	18.3	141	391	7.3	1528	94750	429	[illegible]
	16	142	371	7.3	1416	8350	410	2.0
	19.8	143	327	7.2	1040	2845	290	5.8
	23.3	140	326	7.2	1100	7635	313	5.9
	26.2	138	315	7.2	1072	19060	278	3.0
	19.8	141	310	7.3	1048	1160	268	3.4
	12.6	146	308	7.3	1000	920	263	0.0
	9.2	145	321	7.4	1082	1880	261	3.1
79	8.8	144	361	7.3	1310	3225	358	5.7
	21.5	138	384	7.3	1440	2625	425	2.8
	24.6	138	344	7.3	1220	1840	326	2.4
	29	138	318	7.3	1090	8000	284	0.5
	15.5	140	395	7.3	1559	406960	451	17.6
	18	141	346	7.3	1308	5680	325	2.0
	13.3	148	353	7.2	1275	10787	281	5.9
	9.4	147	380	7.2	1429	8540	395	12.7
	6.3	150	520	7.2	2213	19250	685	13.9
	6.8	147	575	7.2	2250	1475	839	0.1
	11.8	147	578	7.2	2550	9400	829	0.8
	12.3	150	605	7.3	2888	7533	925	1.5
80	12.3	150	531	7.2	2288	1650	731	1.7
	12.3	144	478	7.3	2058	2775	636	2.0
	12.3	146	486	7.2	2243	10125	685	3.0
	15.5	147	501	7.3	2458	3300	689	4.3
	16.4	141	437	7.2	2072	92828	562	3.9
	10.8	146	393	7.2	1686	5275	461	3.8
	11.2	147	399	7.1	1802	4060	466	5.6
	18.3	144	413	7.2	1915	9975	468	7.6
	17.8	143	411	7.2	1826	6125	483	4.0

SULPHUR SPRINGS

	11.6	148	402	7.2	1868	16080	490	0.4
	7	150	357	7.3	1405	1800	350	1.8
	7	150	417	7.2	1787	1933	502	0.
81	7	150	334	7.3	1222	2620	302	0.2
	10	147	433	7.2	1945	8575	544	6.8
	18	145	446	7.2	2008	18633	558	1.6
	11.4	150	359	7.2	1438	3820	351	[illegible]
	7	150	313	7.2	1220	20300	241	1.
	8.5	143	346	7.2	1335	27350	268	15.0
	5.2	151	343	7.2	1544	1640	319	3.7
	7.5	146	395	7.2	2535	2590	595	15.4
	19	146	408	7.2	2091	1193	599	4.9
	21.8	145	361	7.2	1606	633	363	0.
	24.3	150	363	7.2	1475	263	373	[illegible]
	17	155	369	7.2	1538	405	353	4.1
82	15	152	429	7.2	1733		381	2.
	24.8	148	371	7.3	1613		375	1.8
	28.8	151	400	7.3	1638		355	1.
	37.3	151	393	7.3	1620	132	418	[illegible]
	26.5	153	343	7.3	1310	3205	333	10.
	15	156	395	7.3	1775	1834	425	12.2
	8.2	161	437	7.3	2113	858	520	11.7
	10.8	146	417	7.2	2038		505	6.3
	9.3	149	464	7.3	2350		583	7.
	9.3	147	395	7.4	1867		424	2.8
	17.5	145	402	7.3	1850		495	0.
	19	147	399	7.2	1890		458	1.4
83	13	151	364	7.3	1550		393	1.5
	15.3	143	376	7.3	1700		494	8.2
	18	146	398	7.1	1900		428	8.3
	15	149	426	7	2063		543	3.3
	21	145	366	7.1	1663		385	2.
	18.8	146	355	7.2	1588		375	5.
	23.5	147	360	7.2	1638		369	5.0
	20.8	172	373	7.2	1688		398	5.2
	14.6	149	380	7.2	1744		388	2.8
	22.3	148	383	7.1	1775		480	3.1
	20	149	379	7.2	1717		420	2.
	17.6	148	407	7.2	1870		469	6.2
84	18.5	148	384	7.2	1738		419	2.1
	22.5	144	368	7.2	1500		395	4.1
	24	145	361	7.3	1638		383	1.95
	24.8	142	370	7.2	1725		415	2.
	27	145	336	7.2	1200		340	2.8
	26.5	145	322	7.3	1375		320	3.67
	20.8	149	330	7.2	1325		315	10.45
	19	147	348	7.3	1525		368	7.2
	26.4	144	364	7.1	1660		392	1.2
	19.5	148	378	7	1713		408	0.3
	14	150	363	7.1	1625		348	2.73
	10	154	359	7.1	1525		323	0.15
85	8	157	410	7.3	1760		422	1.68
	8.5	154	382	7.3	1750		380	1.88
	8.3	155	379	7.3	1650		356	1.93
	8.5	151	370	7.3	1675		355	0.92
	8	155	370	7.1	1600		335	0.25

SULPHUR SPRINGS

86	22	150	576	7.2	2400		750	2.3
	27.5	146	346	7.5	1500		300	1.
	25	156	344	7.5	1315		300	4.5
	35	153	353	7.4	1445		375	0.9
	30	160	351	7.5	1480		413	2.9
	13	164	389	7.4	1576		440	11.8
		166	438	7.2	2633		712	7.7
	25	150	405	7.2	1827	1234	556	6.1
	22	156	415	7.3	1835	229	421	3.7
	24	157	389	7.4	1759	427	404	2.5
	22	161	397	7.4	1769	269	404	1.4
	22	155	393	7.3	1713	318	616	2.
87	18	167	394	7.3	1766	842	602	2.
	22	152	389	7.3	1655	258	466	1.2
	22	153	457	7.2	2026	643	614	11.7
	20	148	408	7.3	1729	407	487	0.2
	21	149	394	7.3	1497	528	563	3.4
	28	146	378	7.3	1648	276	566	2.8
	23	147	394	7.2	1714	1203	578	10.0
	21	153	403	7.3	1618	763	684	5.
	20	147	404	7.3	1828	5107	617	3.8
								1.4
								3.7

ENVIRONMENTAL PROTECTION COMMISSION
HILLSBOROUGH COUNTY

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MEMORANDUM

Date January 07, 1988

To Sulphur Springs File

From Tom Cardinale T.C.

Subject: HEALTH DEPARTMENT DATA BASE

The enclosed printout is a summary of water quality data collected by the Hillsborough County Health Department starting on June 08, 1971 through September 02, 1987 for samples of Sulphur Springs pool water (upper pool).

The Health Department collected this data in conjunction with their need to varify the quality of the water for swimming. Data only from the upper pool was included in this data printout even though the Health Department also collected more samples (usually three more) downstream of the upper pool.

The Health Department data reflects the total coliform bacteria counts per 100 ml using the multiple-tube fermentation technique and reports data as most probable number (MPN). Most of the samples were collected during the spring and early summer months when swimming at the pool is most desireable.

The rainfall data included in the printout did not come from the Health Department. The City of Tampa Seneca Avenue stormwater detention basin rain gauge data is included in the last three columns starting from October 1980 thorugh September 02, 1987. Rainfall prior to October 1980 came from published meteorological summaries issued by the U.S. Weather Service from data collected at the Tampa International Airport.

The column labled Rain Inch is the rainfall in inches falling that date (2nd column). The columns labeled Rain 1 and Rain 2 reflect rainfall in inches falling (ie. twenty four hours and forty eight hours earlier respectively.

In conclusion the data reported here represents 365 samples collected only from the upper pool over the past seventeen years.

TC/ph

HEALTH DEPT. TOTAL COLIFORM BACTERIA DATA

YEAR HD	DATE M-D	SAMPLES #	MPN AVE.	RAIN INCH	RAIN1 INCH	RAIN2 INCH
71	608	2	23	0.06	0.37	0
	719	2	445	0	0	0
	809	2	730	0	0	0
	824	2	1470	0.42	0	0
72	412	2	19	0	0	0
	502	2	580	0	0.01	0
	605	2	95	0	0	0
	613	2	2400	0.37	0	0.19
	619	2	1650	0.26	3.21	0
	620	3	1263	0	0.26	3.21
	621	3	403	0	0	0.26
	625	3	99	0.02	0.02	0.07
	626	3	114	0	0.02	0.02
	627	6	185	0	0	0.02
	717	3	477	0.01	0.04	0
	724	3	380	0.01	0.9	0.5
	726	2	390	0.01	1.49	0.01
	801	3	51	0.02	0.07	0
	807	3	1867	0.04	0	0
	814	3	109	1.02	0	0
	828	3	106	0	2.2	0.05
	911	3	66	0.08	0	0
	1017	2	95	0	0	0
73	326	3	2400	0	3.17	0
	327	3	667	0	0	3.17
	402	3	2400	0.55	0.18	0
	408	3	130	0.01	0.46	0
	409	3	147	0	0.01	0.46
	410	3	66	0	0	0.01
	625	3	370	0	0	0.48
75	512	3	2400	0.01	0	0.64
	520	3	440	0	0	0
	602	3	270	0.05	0	0
	707	3	362	0.05	0.04	0
	819	3	476	0	0.08	0.6
76	511	3	2400	0	0	0
	517	3	2400	0.86	0	3.86
	518	3	2133	0	0.86	0
	601	3	897	0	0	0
77	606	3	1867	0	0	0.44
	612	3	1450	0	0	0
	613	3	313	0	0	0
78	515	3	156	0	0	0
	725	3	543	0.51	0	0
	803	3	154	0	0.33	0.82
	804	3	290	0	0	0.33
79	618	3	560	0	0	0
	801	3	32	0	0	0
80	721	3	2133			
	723	3	1097			
81	512	3	2400	0	0	0
	809	3	227	0	0	0.45
	810	3	858	0	0	0

HEALTH DEPT. TOTAL COLIFORM BACTERIA DATA

	816	1	240	0	0	0
82	807	1	170	0.07	0	0
83	520	1	49	0	0	0
	621	1	70	0	0.1	0
	801	1	46	0.1		
84	423	1	23	0.15	0	0
	625	1	350	0	0	0.35
	723	1	920	0.8	0.17	0.1
	731	2	1660	0.25	0.3	1.48
	827	3	35	0	0	0
86	106	2	570	0	0	0
	107	3	313	0.25	0	0
	108	3	830	0	0.25	0
	622	3	1287	0.8	0.18	0.04
	623	3	2400	0.43	0.8	0.18
	706	3	1640	0.13	0.4	0
	707	3	347	0.18	0.13	0.4
	708	3	205	0.14	0.18	0.13
	825	2	112	0.37	0	0
87	320	3	56	0	0.28	0.67
	329	3	1867	2.25	0	1.17
	330	3	2400	2.33	2.25	0
	331	3	2400	0.1	2.33	2.25
	405	3	1020	0	0	0.14
	406	3	350	0	0	0
	407	3	147	0	0	0
	412	2	187	0	0	0
	504	3	20	0	0	0
	505	3	6	0	0	0
	506	3	20	0	0	0
	511	3	16	0	0.03	0
	512	3	32	0	0	0.03
	513	3	42	0.22	0	0
	518	3	2400	1.1	0	1.62
	519	3	2400	0.15	1.1	0
	520	3	2133	0	0.15	1.1
	601	3	35	0	0	0
	602	3	62	0	0	0
	603	3	24	0	0	0
	608	3	2400	0	0	0.55
	609	3	1640	0	0	0
	610	3	707	0	0	0
	615	3	603	0	0	0.03
	616	3	217	0	0	0
	617	3	54	0	0	0
	622	3	603	0	0	0
	623	3	730	0	0	0
	624	3	377	0	0	0
	629	3	1867	0.4	0	0.5
	630	3	567	0.34	0.4	0
	701	3	2133	0.6	0.34	0.4
	706	3	1147	0	0	0
	707	3	830	0.95	0	0
	708	3	2133	0	0.95	0
	713	3	2133	1.15	0	0
	714	3	2400	0	1.15	0

HEALTH DEPT. TOTAL COLIFORM BACTERIA DATA

	715	3	1640	0.43	0	1.15
	720	3	2400	2.55	0.21	0
	721	3	2133	0	2.55	0.21
	722	3	2400	0	0	2.55
	727	3	240	0	0	0
	728	3	313	0	0	0
	729	3	430	0	0	0
	803	3	2133	0.03	0.5	0.2
	804	3	2400	0	0.03	0.5
	805	3	793	0	0	0.03
	810	3	893	0.7	0	0.2
	811	3	1867	0	0.7	0
	812	3	2400	1.1	0	0.7
	817	3	1907	0	0	0.1
	818	3	413	0	0	0
	819	3	350	0	0	0
	824	3	96	0	0	0
	825	3	47	0	0	0
	826	3	56	0	0	0
	831	3	45	1.77	0	0
	901	3	2400	0	1.77	0
87	902	3	2400	0.15	0	1.77

APPENDIX O

CITY OF TAMPA WATER QUALITY DATA SULPHUR SPRINGS AND

BERRY RAINFALL DATA FOR SULPHUR SPRINGS

MEMO FROM BURWELL ON RAIN GAUGE LOCATIONS

JANUARY 1988 TOTAL COLI /1000 FPM/FS

Rainfall Berry SS	DAY		TOTAL COLI /1000
	1	0.00	
	2	0.00	
	3	0.00	
	4	0.00	0.10
	5	0.00	0.10
	6	0.00	0.10
.04	7	0.00	
	8	0.00	0.20
.56	9	0.42	
		0.00	
	11	0.00	0.70
		0.00	0.10
	13	0.00	0.10
		0.00	0.10
	15	0.00	0.20
		0.00	
.02	17	0.05	
		0.00	
	19	0.00	0.10
		0.00	0.10
1.30	21	0.80	0.10
		0.00	7.30
	23	0.00	
2.25		0.80	
	25	1.27	
		0.00	1.60
	27	0.00	1.00
		0.00	0.20
	29	0.00	0.90
		0.00	0.10
	31	0.00	

FEBRUARY 1988 TOTAL COLI /1000

Rainfall Berry SS	DAY		TOTAL COLI /1000
	1	0.00	0.10
	2	0.00	0.10
	3	0.00	0.10
	4	0.00	
	5	0.00	0.30
.23	6	0.13	
	7	0.06	
.60	8	0.47	0.60
	9	0.00	2.90
		0.00	1.00
	11	0.00	0.60
		0.00	0.70
	13	0.00	
		0.00	
.65	15	0.70	
		0.00	
	17	0.00	45.50
		0.00	22.60
	19	0.00	0.90
		0.03	
.42	21	0.32	
		0.00	5.00
.10	23	0.00	
		0.50	
	25	0.00	
		0.00	
	27	0.00	
		0.00	
	29	0.00	0.10
		0.00	
	31	0.00	

Rainfall Berry SS. ↓	MARCH 1968 DAY		TOTAL COLI /1000
	1	0.00	0.10
	2	0.00	0.10
	3	0.00	0.20
.32	4	0.20	0.10
1.90	5	1.50	
	6	0.01	
	7	0.00	0.50
	8	0.00	3.60
1.15	9	0.95	1.60
		0.05	0.50
	11	0.00	1.40
		0.00	5.60
.60	13	0.34	0.90
		0.00	0.20
	15	0.00	4.60
1.60 →		0.00	3.80
	17	0.00	
		1.70	
	19	0.14	
		0.00	
	21	0.00	0.20
		0.00	0.10
	23	0.00	0.10
		0.00	
	25	0.00	
		0.00	
	27	0.00	
		0.00	0.30
	29	0.00	0.10
		0.00	0.30
	31	0.00	

Rainfall Berry SS. ↓	APRIL 1968 DAY		TOTAL COLI /1000
	1	0.00	
	2	0.00	
	3	0.00	
	4	0.00	0.10
	5	0.00	
	6	0.00	
	7	0.00	
	8	0.00	
	9	0.00	
		0.00	
.03	11	0.05	0.20
.19 →		0.10	
	13	0.00	
		0.00	
	15	0.00	
		0.00	
	17	0.00	
		0.00	0.30
.72	19	1.23	
		0.00	
	21	0.00	
		0.00	4.20
	23	0.00	
		0.00	
	25	0.00	4.90
.11 →		0.00	3.10
	27	0.00	3.50
		0.00	2.70
	29	0.00	2.20
1.25 →		1.30	
	31		

MAY 1988 — Berry S.S.

RAINFALL	DAY		TOTAL COLI /1000
	1	0.00	
	2	0.00	
	3	0.00	1.30
	4	0.00	1.10
	5	0.00	1.00
	6	0.00	1.10
	7	0.00	
	8	0.00	
	9	0.00	3.00
		0.00	
	11	0.00	
		0.00	0.10
	13	0.00	0.10
		0.07	
	15	0.00	
		0.00	0.10
	17	0.00	
		0.00	
	19	0.00	1.20
		0.00	1.00
	21	0.00	
		0.00	
	23	0.00	0.20
1.80 →		0.50	1.80
	25	1.12	0.30
		0.00	
	27	0.00	
		0.00	
	29	0.00	
		0.00	
	31	0.00	

JUNE 1988 — Berry S.S.

RAINFALL	DAY		TOTAL COLI /1000
	1	0.00	2.00
	2	0.00	0.60
	3	0.00	0.50
.29	4	0.00	
	5	0.10	
	6	0.17	
	7	0.00	0.20
.40	8	0.00	
	9	0.00	
		0.00	
	11	0.00	
		0.00	
	13	0.00	
.50 →		0.85	
	15	0.00	
.30 →		0.25	
	17	0.05	
		0.00	
.11	19	0.00	
3.10 →		0.70	0.30
	21	0.00	
1.5 →		0.47	
.20	23	0.00	
		0.00	
	25	1.60	4.00
		0.13	
.21	27	0.00	
		0.00	0.80
.13	29	0.07	0.10
		0.00	
	31		

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

DATE JULY,1988

SAMPLE DATE	Rainfall Berry S.S.	TOTAL COLIFORMS	LOG VALUE	FECAL COLIFORMS	LOG VALUE
1		600	2.7782		ND
2	↓		ND		ND
3			ND		ND
4			ND		ND
5			ND		ND
6			ND		ND
7		1400	3.1461		ND
8		2400	3.3802		ND
9	1.65		ND		ND
10	0.30		ND		ND
11		4400	3.6435	100	2.0000
12			ND		ND
13		2100	3.3222	300	2.4771
14	1.05		ND		ND
15	.03	2000	3.3010		ND
16			ND		ND
17			ND		ND
18	1.15	1000	3.0000	100	2.0000
19	0.6	1100	3.0414	520	2.7160
20		3800	3.5798	100	2.0000
21	0.05	900	2.9542		ND
22	0.10	400	2.6021		ND
23	0.65		ND		ND
24			ND		ND
25	1.15	300	2.4771		ND
26		100	2.0000		ND
27		700	2.8451		ND
28	0.01	600	2.7782		ND
29		200	2.3010		ND
30			ND		ND
31			ND		ND

ARITHMETIC MEAN	1375	GEOMETRIC MEAN	885	ARITHMETIC MEAN	224	GEOMETRIC MEAN	173

* All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

Total coliforms: % of samples exceeding 1000 CFU/100 ml (not to exceed 20%) 44

Total coliforms: # of samples exceeding 2400 CFU/100 ml (not to exceed 0) 2

Fecal coliforms: % of samples exceeding 400 CFU/100 ml (not to exceed 10%) 20

Fecal coliforms: # of samples exceeding 800 CFU/100 ml (not to exceed 0) 0

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

DATE AUGUST, 1986

SAMPLE DATE	Berry Rainfall SS.	TOTAL COLIFORMS	LOG VALUE	FECAL COLIFORMS	LOG VALUE
1	↓	200	2.3010		ND
2	0.20		ND		ND
3	0.20		ND		ND
4	1.70	1600	3.2041		ND
5	0.1	6500	3.8129		ND
6			ND		ND
7	0.55		ND		ND
8		1600	3.2041	10	1.0000
9		800	2.9031	30	1.4771
10	0.29	600	2.7782	50	1.6990
11	0.16		ND		ND
12	0.35		ND		ND
13			ND		ND
14			ND		ND
15	0.75	200	2.3010	10	1.0000
16	1.95	4300	3.6335	20	1.3010
17	0.10	1000	3.0000	220	2.3424
18	0.85		ND		ND
19	0.15	5500	3.7404		ND
20			ND		ND
21	1.60		ND		ND
22		1000	3.0000	480	2.6812
23			ND		ND
24		300	2.4771	40	1.6021
25		100	2.0000		ND
26		100	2.0000		ND
27	0.60		ND		ND
28			ND		ND
29	0.24	500	2.6990	100	2.0000
30	0.35		ND		ND
31			ND		ND

ARITHMETIC MEAN	1620	GEOMETRIC MEAN	742	ARITHMETIC MEAN	107	GEOMETRIC MEAN	48

* All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

Total coliforms: % of samples exceeding 1000 CFU/100 ml (not to exceed 20%)	33
Total coliforms: # of samples exceeding 2400 CFU/100 ml (not to exceed 0)	3
Fecal coliforms: % of samples exceeding 400 CFU/100 ml (not to exceed 10%)	11
Fecal coliforms: # of samples exceeding 800 CFU/100 ml (not to exceed 0)	0

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

DATE SEPTEMBER, 1988

SAMPLE DATE	Berry S.S.	TOTAL COLIFORMS	LOG VALUE	FECAL COLIFORMS	LOG VALUE
1	3.15		ND		ND
2			ND		ND
3			ND		ND
4			ND		ND
5	3.5		ND		ND
6	5.4		ND		ND
7	2.55	2000	3.3010	200	2.3010
8		1000	3.0000	200	2.3010
9	0.70		ND		ND
10	0.15		ND		ND
11			ND		ND
12		1000	3.0000	400	2.6021
13			ND		ND
14			ND		ND
15	0.24	> 20000	> 4.3010		ND
16	0.30	2200	3.3424		ND
17			ND		ND
18			ND		ND
19	0.14	< 100	< 2.0000	< 10	< 1.0000
20		100	2.0000	< 10	< 1.0000
21	0.19	100	2.0000	< 10	< 1.0000
22			ND		ND
23			ND		ND
24			ND		ND
25			ND		ND
26		100	2.0000	10	1.0000
27	0.14	200	2.3010	< 10	< 1.0000
28		200	2.3010	20	1.3010
29		1400	3.1461		ND
30		1000	3.0000		ND
31			ND		ND

ARITHMETIC MEAN	> 2262	GEOMETRIC MEAN	> 557	ARITHMETIC MEAN	< 97	GEOMETRIC MEAN	< 32

* All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

Total coliforms: % of samples exceeding 1000 CFU/100 ml (not to exceed 20%) 31

Total coliforms: # of samples exceeding 2400 CFU/100 ml (not to exceed 0) 1

Fecal coliforms: % of samples exceeding 400 CFU/100 ml (not to exceed 10%) 0

Fecal coliforms: # of samples exceeding 800 CFU/100 ml (not to exceed 0) 0

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

DATE OCTOBER, 1988

SAMPLE DATE	Berry Rainfall ↓	TOTAL COLIFORMS	LOG VALUE	FECAL COLIFORMS	LOG VALUE
1			ND		ND
2			ND		ND
3	0.12		ND		ND
4		< 100	< 2.0000	20	1.3010
5		200	2.3010	30	1.4771
6		100	2.0000	30	1.4771
7		300	2.4771		ND
8			ND		ND
9			ND		ND
10		400	2.6021	10	1.0000
11	0.16		ND		ND
12			ND		ND
13			ND		ND
14			ND		ND
15			ND		ND
16			ND		ND
17		100	2.0000		ND
18			ND		ND
19			ND		ND
20			ND		ND
21			ND		ND
22			ND		ND
23			ND		ND
24		100	2.0000		ND
25			ND		ND
26			ND		ND
27		200	2.3010		ND
28		300	2.4771		ND
29			ND		ND
30			ND		ND
31			ND		ND

ARITHMETIC MEAN	GEOMETRIC MEAN	ARITHMETIC MEAN	GEOMETRIC MEAN
< 200	< 174	23	21

* All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

Total coliforms: % of samples exceeding 1000 CFU/100 ml (not to exceed 20%) 0

Total coliforms: # of samples exceeding 2400 CFU/100 ml (not to exceed 0) 0

Fecal coliforms: % of samples exceeding 400 CFU/100 ml (not to exceed 10%) 0

Fecal coliforms: # of samples exceeding 800 CFU/100 ml (not to exceed 0) 0

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

DATE NOVEMBER, 1988

SAMPLE DATE	Berry Rainfall	TOTAL COLIFORMS	LOG VALUE	FECAL COLIFORMS	LOG VALUE
1		100	2.0000		ND
2		100	2.0000		ND
3	1.4		ND		ND
4			ND		ND
5	0.22		ND		ND
6			ND		ND
7		10000	4.0000	250	2.3979
8		1300	3.1139	20	1.3010
9		200	2.3010	40	1.6021
10			ND		ND
11			ND		ND
12			ND		ND
13			ND		ND
14			ND		ND
15		300	2.4771		ND
16		200	2.3010		ND
17		300	2.4771		ND
18		100	2.0000		ND
19			ND		ND
20			ND		ND
21		300	2.4771	20	1.3010
22	>6.0 E.		ND		ND
23			ND		ND
24			ND		ND
25			ND		ND
26			ND		ND
27	0.12		ND		ND
28	0.15	700	2.8451	10	1.0000
29		800	2.9031	10	1.0000
30		100	2.0000	10	1.0000
31			ND		ND

ARITHMETIC MEAN	1115	GEOMETRIC MEAN	339
ARITHMETIC MEAN	51	GEOMETRIC MEAN	24

* All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

Total coliforms: % of samples exceeding 1000 CFU/100 ml (not to exceed 20%) 15.4

Total coliforms: # of samples exceeding 2400 CFU/100 ml (not to exceed 0) 1

Fecal coliforms: % of samples exceeding 400 CFU/100 ml (not to exceed 10%) 0

Fecal coliforms: # of samples exceeding 800 CFU/100 ml (not to exceed 0) 0

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

Date: JANUARY, 1989

Sample Date	Burry Rain	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	S.S.		ND		ND
2			ND		ND
3	0.03		ND		ND
4			ND		ND
5		100	2.0000		ND
6		100	2.0000		ND
7			ND		ND
8			ND		ND
9		100	2.0000	10	1.0000
10		400	2.6021		ND
11			ND		ND
12			ND		ND
13			ND		ND
14			ND		ND
15			ND		ND
16			ND		ND
17		100	2.0000	10	1.0000
18		5100	3.7076	10	1.0000
19			ND		ND
20			ND		ND
21	3.1		ND		ND
22			ND		ND
23		1800	3.2553	10	1.0000
24		10	1.0000	10	1.0000
25		10	1.0000	10	1.0000
26		100	2.0000		ND
27		100	2.0000		ND
28			ND		ND
29			ND		ND
30		100	2.0000	10	1.0000
31			ND		ND
		668 Arithmetic Mean	137 Geometric Mean	10 Arithmetic Mean	10 Geometric Mean

** All total and fecal coliform values are expressed as CFU/100 ml [illegible]

TOTAL COLIFORMS: % of samples >1000 CFU/100 ml [illegible]
TOTAL COLIFORMS: % of samples >2400 CFU/100 ml
FECAL COLIFORMS: % of samples >400 CFU/100 ml [illegible]
FECAL COLIFORMS: % of samples >800 CFU/100 ml

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

Date: FEBRUARY, 1989

Sample Date	Berry Rain	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	S.S.	100	2.0000		ND
2		<100	< 2.0000		ND
3		400	2.6021		ND
4			ND		ND
5			ND		ND
6		<100	<2.0000	10	1.0000
7		<100	<2.0000	<10	<1.0000
8		100	2.0000	<10	<1.0000
9		200	2.3010		ND
10		200	2.3010		ND
11		100	2.0000	10	1.0000
12			ND		ND
13		<100	< 2.0000	10	1.0000
14		600	2.7782	<10	<1.0000
15		<100	<2.0000	<10	<1.0000
16		200	2.3010		ND
17		200	2.3010		ND
18			ND		ND
19			ND		ND
20		<100	< 2.0000	<10	< 1.0000
21		<100	< 2.0000		ND
22	0.4	<100	<2.0000	<10	<1.0000
23	0.03		ND		ND
24		<100	<2.0000		ND
25			ND		ND
26			ND		ND
27		2300	3.3617	10	1.0000
28		1200	3.0792	10	1.0000
29			ND		ND
30			ND		ND
31			ND		ND
		< 325 Arithmetic Mean	<184 Geometric Mean	<10 Arithmetic Mean	< 10 Geometric Mean

** All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

TOTAL COLIFORMS: % of samples >1000 CFU/100 ml 11.0%
TOTAL COLIFORMS: # of samples >2400 CFU/100 ml 0%

FECAL COLIFORMS: % of samples >400 CFU/100 ml 0%
FECAL COLIFORMS: % of samples >200 CFU/100 ml [illegible]

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

Date: MARCH, 1989

Sample Date	S.S. Berry Rain	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	0.85	1300	3.1139	20	1.3010
2	0.65	500	2.6990		ND
3		<100	<2.0000		ND
4			ND		ND
5			ND		ND
6		200	2.3010	130	2.1139
7		<100	<2.0000	10	1.0000
8		<100	<2.0000	10	1.0000
9		500	2.6990		ND
10		300	2.4771		ND
11			ND		ND
12			ND		ND
13		<100	<2.0000	20	1.3010
14		<100	<2.0000	<10	<1.0000
15		<100	<2.0000	<10	<1.0000
16		500	2.6990		ND
17		100	2.0000		ND
18			ND		ND
19			ND		ND
20		<100	<2.0000	<10	<1.0000
21		<100	<2.0000	30	1.4771
22		<100	<2.0000	<10	<1.0000
23	0.31		ND		ND
24			ND		ND
25			ND		ND
26			ND		ND
27		400	2.6021	<10	<1.0000
28		100	2.0000	<10	<1.0000
29		100	2.0000	<10	<1.0000
30			ND		ND
31			ND		ND
		<258 Arithmetic Mean	<174 Geometric Mean	<22 Arithmetic Mean	<15 Geometric Mean

** All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

TOTAL COLIFORMS: % of samples >1000 CFU/100 ml 5.3%
TOTAL COLIFORMS: # of samples >2400 CFU/100 ml 0

FECAL COLIFORMS: % of samples >400 CFU/100 ml [illegible]
FECAL COLIFORMS: # of samples >800 CFU/100 ml [illegible]

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

Date: APRIL, 1989
Total # of samples collected: (TC) 18 (FC) [illegible]

Sample Date	Berry Rain	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	SS		ND		ND
2			ND		ND
3		100	2.0000	20	1.3010
4		100	2.0000	10	1.0000
5	0.45	100	2.0000	30	1.4771
6		800	2.9031		ND
7		600	2.7782		ND
8			ND		ND
9			ND		ND
10		100	2.0000	10	1.0000
11		100	2.0000	10	1.0000
12		100	2.0000	10	1.0000
13		100	2.0000		ND
14	0.65	100	2.0000		ND
15	0.02		ND		ND
16			ND		ND
17		2800	3.4472	280	2.4472
18		1500	3.1761	100	2.0000
19	0.22	1000	3.0000	90	1.9542
20		500	2.6990		ND
21		2300	3.3617		ND
22			ND		ND
23			ND		ND
24		200	2.3010		ND
25			ND		ND
26			ND		ND
27		200	2.3010		ND
28		100	2.0000		ND
29	0.16		ND		ND
30			ND		ND
		600 Arithmetic Mean	277 Geometric Mean	62 Arithmetic Mean	29 Geometric Mean

** All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

TOTAL COLIFORMS: % of samples >1000 CFU/100 ml [illegible]
TOTAL COLIFORMS: # of samples >2400 CFU/100 ml [illegible]

FECAL COLIFORMS: % of samples >400 CFU/100 ml [illegible]
FECAL COLIFORMS: # of samples >800 CFU/100 ml

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

Date: MAY 1989
Total # of samples collected: (TC)16 (FC) 12

Sample Date	Benny Point S.S.	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	0.52	4000	3.6021	10	1.0000
2	[redacted]	2300	3.3617	600	2.7782
3		7500	3.8751	334	2.5237
4		500	2.6990		ND
5		100	2.0000		ND
6			ND		ND
7			ND		ND
8	<	100	< 2.0000	20	1.3010
9		100	2.0000	20	1.3010
10	0.03 <	100	< 2.0000	20	1.3010
11	<	100	< 2.0000		ND
12	<	100	< 2.0000		ND
13			ND		ND
14			ND		ND
15		2000	3.3010	200	[illegible]
16			ND		ND
17	<	100	< 2.0000	330	2.5185
18			ND		ND
19			ND		ND
20			ND		ND
21			ND		ND
22		100	2.0000	< 10	< 1.0000
23	<	100	2.0000	< 10	< 1.0000
24		100	2.0000	10	1.0000
25		100	2.0000	10	1.0000
26			ND		ND
27			ND		ND
28	0.02		ND		ND
29			ND		ND
30	0.18		ND		ND
31	0.35		ND		ND
		< 1088 Arithmetic Mean	< 269 Geometric Mean	< 131 Arithmetic Mean	28 Geometric Mean

** All total and fecal coliform values are expressed as CFU/100 ml
ND No Data

TOTAL COLIFORMS: % of samples 1000 CFU/100 ml
TOTAL COLIFORMS: % of samples [illegible] CFU/100 ml

FECAL COLIFORMS: % of samples >400 CFU/100 ml
FECAL COLIFORMS: % of samples >200 CFU/100 ml

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

Date: JUNE 1989
Total # of samples collected: (TC) 20 (FC) 9

Sample Date	Berry Rain	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	36	200	2.3010		ND
2		100	2.0000		ND
3			ND		ND
4			ND		ND
5		100	2.0000	10	1.0000
6	1.01	100	2.0000	< 10	1.0000
7	0.05	2500	3.3979	110	2.0414
8			ND		ND
9			ND		ND
10			ND		ND
11	1.7		ND		ND
12	[illegible]	4000	3.6021		ND
13		10000	4.0000	600	2.7782
14		5000	3.6990	1000	3.0000
15		1000	3.0000		ND
16	0.05	1500	3.1761		ND
17			ND		ND
18	1.85		ND		ND
19	0.05	7000	3.8451	850	2.9294
20		7000	3.8451		ND
21		19500	4.2900		ND
22	2.35	19500	4.2900		ND
23	0.05	8000	3.9031		ND
24	1.12		ND		ND
25			ND		ND
26		6000	3.7782	500	2.6990
27	0.99	2000	3.3010	300	2.4771
28	1.30	3000	3.4771	100	2.0000
29		4000	3.6021		ND
30	0.6	2000	3.3010		ND
31			ND		ND
		5125 Arithmetic Mean	2190 Geometric Mean	387 Arithmetic Mean	164 Geometric Mean

** All total and fecal coliform values are expressed as CFUs/100 ml
ND - No data

TOTAL COLIFORMS: % of samples >1000 CFU/100 ml 0.8
TOTAL COLIFORMS: # of samples >2400 CFU/100 ml 12

FECAL COLIFORMS: % of samples >400 CFU/100 ml [illegible]
[illegible]: # of samples [illegible] CFU/100 ml [illegible]

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 5409

Date: JULY 1989
Total # of samples collected: (TC) 15 (FC) 9

Sample Date	Berry Rain SS.	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	0.15		ND		ND
2	0.35		ND		ND
3		ND	ND		ND
4			ND		ND
5		2000	3.3010	150	2.1761
6	0.22	1000	3.0000		ND
7		2000	3.3010		ND
8			ND		ND
9			ND		ND
10		100	2.0000	10	1.0000
11		700	2.8451	20	[illegible]
12	0.25	400	2.6021	40	[illegible]
13	0.02	4600	3.6628		ND
14			ND		ND
15			ND		ND
16			ND		ND
17		500	2.6990	20	[illegible]
18	0.80	400	2.6021	10	[illegible]
19	1.01	100	2.0000	60	1.7782
20	0.39	ND	ND	ND	ND
21	0.15	2500	3.3979		ND
22	2.10		ND		ND
23	0.65		ND		ND
24	1.85	2600	3.4150	800	2.9031
25	0.62	1600	3.2041	630	[illegible]
26		1400	3.1461	ND	ND
27		NO SAMPLE	ND	NO SAMPLE	ND
28		100	2.0000		ND
29	0.95		ND		ND
30			ND		ND
31	0.45	ND	ND	ND	ND
		1233 Arithmetic Mean	756 Geometric Mean	194 Arithmetic Mean	[illegible]9 Geometric Mean

** All total and fecal coliform values are expressed as CFU/100 ml
ND = No data

TOTAL COLIFORMS: % of samples >1000 CFU/100 ml [illegible]
TOTAL COLIFORMS: # of samples 2400 CFU/100 ml [illegible]

FECAL COLIFORMS: % of samples 400 CFU/100 ml [illegible]
FECAL COLIFORMS: # of samples 800 CFU/100 ml [illegible]

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

Date : AUGUST, 1989
Total # of samples collected: (TC) 19 (FC) 13

Sample Date	Berry Ron	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	55	1200	3.0792	210	2.3222
2	↓	200	2.3010	20	1.3010
3		300	2.4771		ND
4		300	2.4771		ND
5			ND		ND
6			ND		ND
7		100	< 2.0000	< 10	< 1.0000
8		100	< 2.0000	10	1.0000
9	1.95	100	< 2.0000	< 10	< 1.0000
10	0.95	4200	3.6232		ND
11		ND	ND		ND
12	0.35		ND		ND
13	0.03		ND		ND
14		800	2.9031	80	1.9031
15		200	2.3010	80	1.9031
16		300	2.4771	10	1.0000
17			ND		ND
18	0.95		ND		ND
19	0.48	400	2.6021	160	2.2041
20			ND		ND
21	1.5		ND		ND
22	0.7	2100	3.3222	2250	3.3522
23		1500	3.1761	310	2.4914
24	0.23		ND		ND
25	2.95	300	2.4771		ND
26			ND		ND
27	2.55		ND		ND
28		800	2.9031	200	2.3010
29		500	2.6990	120	2.0792
30		100	2.0000		ND
31		100	< 2.0000		ND
		716 Arithmetic Mean	371 Geometric Mean	< 267 Arithmetic Mean	68 Geometric Mean

** All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

TOTAL COLIFORMS: % of samples >1000 CFU/100 ml 21.1%
TOTAL COLIFORMS: # of samples >2400 CFU/100 ml 1

FECAL COLIFORMS: % of samples >400 CFU/100 ml 7.7%
FECAL COLIFORMS: # of samples >800 CFU/100 ml 1

[illegible] ANALYSIS SUMMARY

[illegible] WATER DEPARTMENT
[illegible] SECTION LABORATORY
[illegible] NUMBER 54056

[illegible]
[illegible] (FC) 8

[illegible]	SS. Berry Rain	[illegible] Coliforms	Log Value	Fecal Coliforms	Log Value
[illegible]	1.6	[illegible]	[illegible]		ND
	1.45		ND		ND
			ND		ND
	0.37		ND		ND
	0.66	[illegible]	[illegible]	140	2.1461
[illegible]		[illegible]	[illegible]	130	2.1139
	0.62	[illegible]	[illegible]		ND
		[illegible]	[illegible]		ND
[illegible]	0.03		ND		ND
[illegible]			ND		ND
		500	[illegible]	< 10	< 1.0000
[illegible]		100	2.0000	< 10	< 1.0000
[illegible]			ND		ND
[illegible]		[illegible]	2.7782		ND
[illegible]	0.15	500	[illegible]		ND
[illegible]			ND		ND
[illegible]			ND		ND
[illegible]	0.11	[illegible]	[illegible]	10	1.0000
[illegible]	0.85		ND		ND
[illegible]			ND		ND
[illegible]		2000	[illegible]		ND
[illegible]	1.25	1900	[illegible]		ND
[illegible]	0.42		ND		ND
[illegible]			ND		ND
[illegible]	1.25	400	2.6021	200	2.3010
6		1200	3.0792	180	2.2553
[illegible]		200	2.3010	40	1.6021
28		500	2.7782		ND
29	0.42	200	2.3010		ND
30			ND		ND
31			ND		ND
		[illegible]	[illegible]	90	< 48
		Arithmetic Mean	Geometric Mean	Arithmetic Mean	Geometric Mean

** All total & fecal coliform values are expressed as CFUs/100 ml
ND [illegible]

[illegible] % of samples [illegible] 000 CFU/100 ml [illegible] .5
[illegible] # of samples 2400 CFU/100 ml 1

[illegible] % of samples [illegible] 00 CFU/100 ml 0
[illegible] # of samples [illegible] 00 CFU/100 ml 0

SULPHUR SPRINGS BACTERIOLOGY ANALYSIS SUMMARY

CITY OF TAMPA WATER DEPARTMENT
TECHNICAL SERVICES SECTION LABORATORY
LABORATORY I.D. NUMBER 54096

Date: OCTOBER, 1989

Total # of samples collected: (TC) 12 (FC) 10

Sample Date	Berry Rain	Total Coliforms	Log Value	Fecal Coliforms	Log Value
1	.5		ND		ND
2	↓	600	2.7782	30	1.4771
3			ND		ND
4			ND		ND
5			ND		ND
6			ND		ND
7	1.35		ND		ND
8			ND		ND
9		6000	3.7782	350	2.5441
10	0.66		ND		ND
11			ND		ND
12			ND		ND
13			ND		ND
14	0.26		ND		ND
15			ND		ND
16		9000	3.9542	60	1.7782
17		700	2.8451	< 10	< 1.0000
18		500	2.6990	< 10	< 1.0000
19	0,19		ND		ND
20			ND		ND
21			ND		ND
22			ND		ND
23		100	2.0000	< 10	1.0000
24		100	2.0000	10	1.0000
25		< 100	< 2.0000	< 10	1.0000
26	0.12	250	2.3979		ND
27		100	2.0000		ND
28			ND		ND
29			ND		ND
30		200	2.3010	10	1.0000
31		300	2.4771	< 10	< 1.0000
		< 1496 Arithmetic Mean	< 400 Geometric Mean	< 51 Arithmetic Mean	< 19 Geometric Mean

** All total and fecal coliform values are expressed as CFUs/100 ml
ND = No data

TOTAL COLIFORMS: % of samples >1000 CFU/100 ml 16.7
TOTAL COLIFORMS: # of samples >2400 CFU/100 ml 2

FECAL COLIFORMS: % of samples >400 CFU/100 ml 0
FECAL COLIFORMS: # of samples >800 CFU/100 ml 0

FROM THE DESK OF
MICHAEL J. BURWELL

2/8/89

Rob:

Here are the data the Water Dept. has collected since March 1986. I've placed rainfall (RF) from Seneca Gage opposite the coli numbers for easy comparison. The raingage at Seneca was discontinued in September 1988 and I've substituted our gage at the 12th St. Yard (12th & Twiggs, Downtown) rather than the much drier TIA gage. As you can see the correlation of RF to Coli peaks is very variable.

Have fun and please copy me on anything you produce

M

APPENDIX P

1990 HILLSBOROUGH COUNTY ENVIRONMENTAL PROTECTION COMMISSION

BACTERIA DATA AND BERRY RAINFALL DATA

FOR SULPHUR SPRINGS

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

Sulphur Springs Pool Study

MO	DA	YR	Time	Benny Rainfall inches	MF Coli per 100ml	MF Coli x 100	MF Fecal per 100ml	MF Fecal x 100	Comments
1	2	90	935	0.21	220 J	2.2	10	0.1	
1	3	90	930	0.72	70	0.7	10	0.1	
1	4	90	910	0	30	0.3	10 K	0.1	
1	5	90	920	0	10 J	0.1	10	0.1	
1	6	90	802	0	2600	26	240	2.4	*
1	7	90	950	0	230	2.3	50	0.5	*
1	8	90	925	0	70	0.7	10	0.1	
1	9	90	920	0	20	0.2	10 K	0.1	
1	10	90	930	0	30	0.3	10	0.1	
1	11	90	935	0	10	0.1	10	0.1	
1	12	90	930	0	10 K	0.1	10 K	0.1	
1	13	90	802	0	20	0.2	10 K	0.1	*
1	14	90	1545	0	10	0.1	10 K	0.1	*
1	15	90	1200	0	10 K	0.1	10 K	0.1	*
1	16	90	930	0	10	0.1	10 K	0.1	
1	17	90	915	0	10	0.1	10 K	0.1	
1	18	90	915	0	10	0.1	10 K	0.1	
1	19	90	950	0	10	0.1	10 K	0.1	
1	20	90	902	0	10	0.1	10 K	0.1	*
1	21	90	1030	0	10	0.1	10 K	0.1	*
1	22	90	923	0	10	0.1	10 K	0.1	
1	23	90	929	0	10 K	0.1	10 K	0.1	
1	24	90	935	0	20	0.1	10 K	0.1	
1	25	90	915	0.02	10 K	0.1	10 K	0.1	
1	26	90	908	0	10 K	0.1	10 K	0.1	
1	27	90	758	0	10 K	0.1	10 K	0.1	*
1	28	90	945	0	10 K	0.1	10 K	0.1	*
1	29	90	945	0	10 K	0.1	10 K	0.1	
1	30	90	906	0	10 K	0.1	10 K	0.1	
1	31	90	955	0	10 K	0.1	10 K	0.1	

Codes

K less than
L greater than
J estimated
* exceeds analysis
  time
** pool level low

RECEIVED
27 1990
ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY

Sulphur Springs Pool Study

MO	DA	YR	Time	Benny Rainfall inches	MF Coli per 100ml	MF Coli x 100	MF Fecal per 100ml	MF Fecal x 100	Comments
2	1	90	940	0	10	0.1	10	0.1	
2	2	90	920	0	10	0.1	10 K	0.1	
2	3	90	754	0	10 K	0.1	10 K	0.1	*
2	4	90	1300	0.42	20	0.2	10 K	0.1	*
2	5	90	925	0	700	7	270	2.7	
2	6	90	855	0	3600 L	36	3600	36	
2	7	90	850	0	1000	10	210	2.1	
2	8	90	910	0	150	1.5	20	0.2	
2	9	90	855	0	40	0.4	40	0.4	
2	10	90	757	2.2	100	10	10 K	0.1	*
2	11	90	900	0	1400	14	630	6.3	*
2	12	90	930	0	6900	69	2000	20	
2	13	90	900	0	3500	35	800	8	
2	14	90	935	0	490	4.9	160	1.6	
2	15	90	920	0	280	2.8	80	0.8	
2	16	90	855	0	90	0.9	60	0.6	
2	17	90	758	0	2800	28	310	3.1	*
2	18	90	1400	0	1100	11	230	2.3	*
2	19	90	935	0	390	3.9	70	0.7	
2	20	90	935	0	80	0.8	40	0.4	
2	21	90	907	0	50	0.5	10	0.1	
2	22	90	940	0	70	0.7	10 K	0.1	
2	23	90	915	2.5	60	0.6	20	0.2	
2	24	90		0	200	2	90	0.9	* **
2	25	90	1430	0	2400	24	410	4.1	* **
2	26	90	910	0	310	3.1	90	0.9	**
2	27	90	900	0	150	1.5	10 K	0.1	**
2	28	90	915	0	60	0.6	50	0.5	**

Codes

K less than
L greater than
J estimated
* exceeds analysis time
** pool level low

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY
Sulphur Springs Pool Study

MO	DA	YR	Time	Rainfall inches	MF Coli per 100ml	MF Coli x 1000	MF Fecal per 100ml	MF Fecal x 1000	Comments
3	1	90	940	0	80	0.08	20	0.02	**
3	2	90	940	0	90	0.09	10	0.01	
3	3	90	802	0	20	0.02	10 K	0.01	*
3	4	90	1300	0	30	0.03	10	0.01	*
3	5	90	945	0	20	0.02	10 K	0.01	
3	6	90	930	0	20	0.02	10	0.01	
3	7	90	905	0	10	0.01	10	0.01	
3	8	90	900	0	10 K	0.01	10 K	0.01	
3	9	90	915	0	20	0.02	10	0.01	
3	10	90	755	0	30	0.03	20	0.02	*
3	11	90	1140	0	50	0.05	10 K	0.01	*
3	12	90	930	[illegible]	30	0.03	10 K	0.01	
3	13	90	925		10	0.01	10 K	0.01	
3	14	90	[illegible]		10 J	0.01	10	0.01	
3	15	90	[illegible]		20	0.02	20	0.02	
3	16	90	[illegible]		40	0.04	30	0.03	
3	17	90	755	[illegible]	40	0.04	10	0.01	*
3	18	90	1500		6100 J	6.1	4000	4	*
3	19	90	930		4600 J	4.6	4600	4.6	
3	20	90	935		35000	35	510	0.51	
3	21	90	[illegible]		[illegible]	[illegible]	150	0.15	
3	22	90	[illegible]		600	0.6	70	0.07	
3	23	90	[illegible]		170	0.17	40	0.04	
3	24	90	800		570	0.57	20	0.02	*
3	25	90	118		310	0.31	10 K	0.01	*
3	26	90	[illegible]	0	180	0.18	10 K	0.01	
3	27	90	910	0	110	0.11	10 K	0.01	
3	28	90	[illegible]		200	0.2	10 K	0.01	
3	29	90	[illegible]		[illegible]	0.05	20	0.02	
3	30	90	[illegible]	0	50	0.05	10	0.01	
3	31	90	751	1.[illegible]	100	0.1	40	0.04	*

Codes

K less than
L greater than
J estimated
* exceeds analysis time
** pool level low

ENVIRONMENTAL PROTECTION COMMISSION OF HILLSBOROUGH COUNTY
Sulphur Springs Pool Study

MO	DA	YR	Time	Rainfall inches	MF Coli per 100ml	MF Coli x 1000	MF Fecal per 100ml	MF Fecal x 1000	Comments
4	1	90	1200	0	19000	19	12000	12	*
4	2	90	910	0	30000	30	9000	9	
4	3	90	920	0	1140	1.14	100	0.1	
4	4	90	915	0	9000	9	1000	1	
4	5	90	930	0	1100	1.1	80	0.08	
4	6	90	945	0	430	0.43	220	0.22	
4	7	90	759	0	370	0.37	200	0.2	*
4	8	90	1410	0	230	0.23	70	0.07	*
4	9	90	930	0	190	0.19	70	0.07	
4	10	90	915	0	120	0.12	80	0.08	
4	11	90	915	0.77	100	0.1	20 K	0.02	
4	12	90	1300	0	2000	2	1100	1.1	
4	13	90	1310	0	380	0.38	300	0.3	
4	14	90	759	0	210	0.21	200	0.2	*
4	15	90	1500	0	120	0.12	10	0.01	*
4	16	90	1350	0	90	0.09	30	0.03	*
4	17	90	1215	0	90	0.09	10 K	0.01	
4	18	90	1245	0	70	0.07	10 K	0.01	
4	19	90	1300	0	50	0.05	10	0.01	
4	20	90	1030	0	60	0.06	60	0.06	
4	21	90	800	0	30	0.03	10 K	0.01	*
4	22	90	1415	0	50	0.05	10 K	0.01	*
4	23	90	915	0.02	30	0.03	10 K	0.01	
4	24	90	1255	0	30	0.03	10 K	0.01	
4	25	90	1345	0	10	0.01	10	0.01	
4	26	90	1400	0	20	0.02	10 K	0.01	
4	27	90	1230	0	30	0.03	10	0.01	
4	28	90	757	0.05	20	0.02	10 K	0.01	*
4	29	90	1828	0	20	0.02	10	0.01	*
4	30	90	1400	0	20	0.02	10	0.01	

Codes

K less than
L greater than
J estimated
* exceeds analysis time
** pool level low

APPENDIX Q

CURIOSITY CREEK F-100 DETENTION BASIN CORRESPONDENCE

SSAL - CITY OF TAMPA

CITY OF TAMPA - SSAL

DO YOU KNOW WHERE THE BLUE SINK IS?

Sulphur Springs Action League

"The Springs - let's make it sparkle"

320 W. Waters Ave., Tampa, FL 33604
Phone: (813) 935-3115

March 3, 1989

Mr. Robert P. Wallace, Director
Public Works Department
City of Tampa
306 East Jackson Street
City Hall Plaza, 4th Floor
Tampa, FL 33602

Re: Curiosity Creek Detention Basin
PW 86-100

Dear Mr. Wallace:

Through Ms. Nancy McCann of the City's Environmental Affairs section we obtained the loan of a set of blueprints for the referenced project. We had made the request in order to review the potential water quality impacts of the project on the Sulfur Springs Pool. As you are aware the Blue Sink in this vicinity had historically been shown to be connected to the pool by a travel time of only 40 hours. Therefore, actions which may affect sinkholes in the Curiosity Sink area are of concern to this organization.

We were pleased to see that the three sinkholes by the proposed basin were not scheduled to be filled in under the present plan. Two of the three are within the basin and have a proposed finish perimeter elevation of 24.0. The basin bottom is to be elevation 22.0. Based on these facts we would like inquire about the following:

1. What is the design low and high water levels for the basin?

2. At what frequency will the water elevations exceed elevation 24.0 and introduce water into the existing sinkholes?

3. What is the volume of water anticipated to enter the sinkholes?

4. What is the anticipated water quality of flow entering the sinkholes?

5. Do the existing sinkholes contain debris and waste materials presently? If so, can these be cleaned prior to placing the basin in service and introducing water through such debris?

6. Are any water quality monitoring wells or water table stage wells planned for the basin?

7. Will the construction of this basin eliminate the need for any water to be pumped or piped out of the watershed under seasonal or flood conditions.

Any information you or your staff can provide to us will be appreciated. The project has a great deal of merit and will be of benefit to the citizens of North Tampa. We hope this request for information will not inconvenience you, as we are merely trying to educate ourselves as to the impacts and effects of the Sulphur Springs watershed.

Sincerely,

SULPHUR SPRINGS ACTION LEAGUE

Frederika Russell

FR/nd

cc: Nancy McCann, COT

CITY OF TAMPA

Sandra W. Freedman, Mayor

Department of Sanitary Sewers

Jack P. Morriss, P.E.
Director

Sulphur Springs Action League
320 W. Waters Avenue
Tampa, Florida 33604

March 15, 1989

Attn: Ms. Frederika Russell

Re: Curiosity Creek Detention Basin

Dear Ms. Russell:

Thank you for your letter concerning the Curiosity Creek Detention Basin. We would be glad to answer your questions and address your concerns regarding the basin and its effect on the hydrology of the area.

The Curiosity Creek Basin has been designed to optimize the storage capacity available in the vacant area within the Curiosity Creek floodplain, within the City of Tampa. Its primary purpose is to alleviate the widespread flooding of North Tampa which has occurred at least four times in the last thirty years. This flooding has resulted in widespread property damage and severe disruption of services to the area.

The design of the basin involves the removal of higher areas adjacent to the historical floodplain and the excavation of a portion of the floodplain to increase the storage available. In this manner a volume of water which would have flooded houses and streets in the past may be wholly contained within the detention basin.

The answers to your questions are as follows:

1. There is no "design low and high water levels for the basin". As stated, the design only optimizes the storage available within the constraints of side slopes, maintenance berms and tree protection areas. The "target" elevation is 28.0'. At this point sufficient volume has entered the basin to begin overtopping the banks.

2. It is unknown what frequency the water elevations will exceed 24.0'. There is at least a 10% chance in any given year the entire system will be overwhelmed due to the lack of storage and outfall capacity. During these times the water level should exceed 28.0'.

3. It is unknown what the volume of water will be which will enter the sinkholes south of Curiosity Sink. It is known that, due to the greater storage capacity available in the basin surrounding them, it will be less than in the past for a similar event.

4. Anticipated water quality for water entering the sink is difficult to determine. It will certainly be no worse than in the past and probably better. There will most certainly be less of it.

5. The existing sinkholes do contain trash and debris which will be removed by our contractor as part of the construction of the pond.

6. Water quality monitoring wells have been placed downgradient of the structure by the Southwest Florida Water Management District as part of their ambient groundwater monitoring program.

7. The construction of the pond will not eliminate the need for stormwater to be pumped out of the watershed under flood conditions. As stated, the design is incapable of handling a 10-year event so it will be supplemented by the existing stormwater pumping station at Seneca Avenue and the emergency installation at Bougainvillea when necessary.

In summary, the construction of the Curiosity Creek Detention Facility (F100C) will not significantly alter the present hydrology of the North Tampa area. I hope this answers your questions, if anything is unclear or you need any additional information please feel free to call Michael Burwell of our Stormwater group.

DEPARTMENT OF SANITARY SEWERS

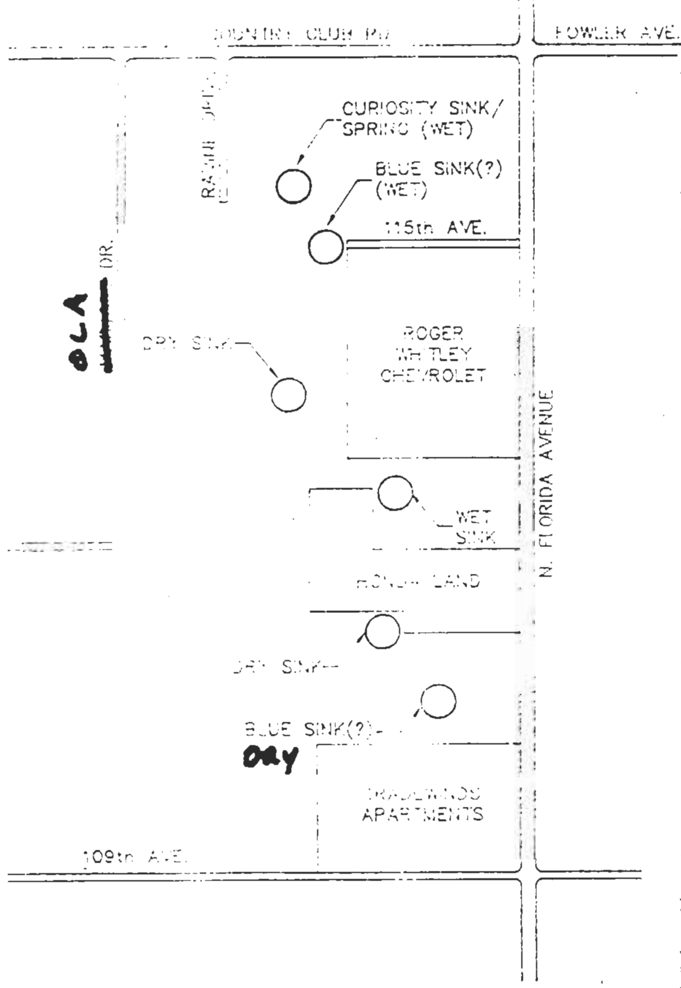
Jack P. M

Jack P. Morriss, P.E.
Director

JM/MB

cc: Chip Hatcher
John Walker
Michael Burwell

Do you know where the Blue Sink is???



The Pool Committee of the Action League is conducting a search of the Curiosity Sink basin area for the old Blue Sink.

Frederica Russell, Tom Mealor and Rob Wallace recently did a walking tour of the area and located several active and dry sinkholes, but there is a debate as to the exact location of Blue Sink.

Part of our information comes from an article in the Tampa Times Florida Accent, June 11, 1972 that was sent us by Mamie Wadsworth. The writer tells of sinks changed "from an abundant work of nature to a blight of man," with once beautiful, clear sinkholes then filled with trash and junk of all descriptions.

Many people have stories of objects - dye, oranges, sawdust, even a body disappearing from Blue Sink and showing up at Sulphur Springs. The sides of the sink were lined with beautiful blue clay, said Phil Foxworth in the story. Mamie Wadsworth recalled the hour-long trip in a horse-drawn wagon, and the gallons of fresh-picked berries they would bring home.

Historically Curiosity Creek (formerly Hay Pond Slough) disappears into a hole several hundred yards north of Blue Sink and would flow down into blue Sink and go underground.

In the 40's the Tampa Federation of Garden Clubs tried to get the land around Blue Sink donated for a county park. In 1972 then city engineer Wayne Jump looked at creating a retention basin in the area that could also be used for recreation. Now, 17 years later, the plan is on the verge of becoming reality.

The Pool Committee is hoping to have some input into the creation of the water retention area. They need to hear from those who remember the Blue Sink and the surrounding area.

They have a couple of names already to contact but if you remember the Blue Sink, please drop a line to: Frederica Russell, 57 Hamilton Heath, Tampa, FL 33604.

(As a point of general interest, the Accent story ends with a comment that pollution had been recently found in Curiosity Creek and "since the City of Tampa occasionally siphons drinking water from Sulphur Springs, the implications are ominous - to say the least." One can only wonder at the effects of all those years of pollution and hope that it is corrected in the near future.)

APPENDIX R

MR. LEON BERRY

RAINFALL DATA - 8208 N. 13TH STREET

SULPHUR SPRINGS RAINFALL

1988/89/90

Mr. Leon Berry
8208 N. 13th Street
Tampa, Florida
Phone: 931-3429

1/M/88

1/7/88	4/100
1/9/88	50/100
1/17/88	2/100
1/21/88	1 20/100
1/24/88	2 25/100
	--------
	4 1/100

2/M/88

2/6/88	23/100
2/8/88	60/100
2/15/88	65/100
2/21/88	42/100
2/23/88	10/100
	-------
	2 0/100

3/M/88

3/4/88	32/100
3/5/88	1 90/100
3/9/88	1 15/100
3/13/88	60/100
3/18/88	1 60/100
	--------
	5 51/100

4/M/88

4/11/88	3/100
4/12/88	19/100
4/19/88	72/100
4/26/88	11/100
4/30/88	1 25/100
	--------
	2 30/100

5/M/88

5/24/88	1 80/100

6/M/88

6/4/88	29/100
6/8/88	40/100
6/14/88	30/100
6/16/88	30/100
6/19/88	11/100
6/20/88	3 10/100
6/22/88	1 5/100
6/22/88	20/100
6/27/88	21/100
6/29/88	13/100
	--------
	6 11/100

Mr. Leon Berry
8208 N. 13th Street
Tampa, Florida
Phone: 931-3429

7/M/88

7/9/88	1 65/100
7/10/88	30/100
7/14/88	1 5/100
7/15/88	3/100
7/18/88	1 15/100
7/19/88	60/100
7/21/88	75/100
7/22/88	10/100
7/23/88	60/100
7/25/88	1 10/100
7/28/88	21/100
	---------
	7 74/100

8/M/88

8/2/88	20/100
8/3/88	2/100
8/4/88	1 70/100
8/5/88	10/100
8/9/88	55/100
8/10/88	29/100
8/11/88	10/100
8/12/88	30/100
8/15/88	80/100
8/16/88	1 95/100
8/17/88	10/100
8/18/88	85/100
8/19/88	15/100
8/21/88	1 60/100
8/27/88	60/100
8/29/88	21/100
8/30/88	35/100
	--------
	9 93/100

9/M/89

9/1/88	3 15/100
9/5/88	3 50/100
9/6/88	5 40/100
9/8/88	2 55/100
9/9/88	70/100
9/10/88	15/100
9/15/88	24/100
9/16/88	30/100
9/19/88	14/100
9/21/88	19/100
9/27/88	14/100
	---------
	16 46/100

10/M/88

10/3/88	12/100
10/11/88	16/100

	38/100

11/M/88

11/3/88	1 40/100
11/5/88	22/100
11/22 & 23/88	6 0/100
11/27/88	12/100
11/28/88	15/100
	--------
	7 89/100

12/M/88

12/11/88	1 30/100
	--------
	1 30/100

Mr. Leon Berry
8208 N. 13th Street
Tampa, Florida
Phone: 931-3429

1/M/89

1/16/89	3/100
1/21/22/89	3 10/100
	3 13/100

2/M/89

2/22/89	40/100
2/23/89	3/100
	43/100

3/M/89

3/01/89	85/100
3/02/89	65/100
3/23/89	37/100
	1 87/100

4/M/89

4/05/89	45/100
4/14/89	65/100
4/15/89	2/100
4/19/89	22/100
4/29/89	16/100
	1 48/100

5/M/89

5/01/89	52/100
5/10/89	3/100
5/28/89	2/100
5/30/89	18/100
	75/100

Mr. Leon Berry
8208 N. 13th Street
Tampa, Florida
Phone: 931-3429

6/M/89

6/06/89	1	1/100
6/07/89		5/100
6/11/89	1	70/100
6/12/89		2/100
6/16/89		75/100
6/18/89	1	85/100
6/19/89		70/100
6/22/89	2	35/100
6/23/89		75/100
6/24/89	1	12/100
6/27/89		99/100
6/28/89	1	30/100
6/30/89		60/100

	13	80/100

7/M/89

7/1/89		15/100
7/2/89		35/100
7/6/89		22/100
7/12/89		23/100
7/13/89		2/100
7/18/89		30/100
7/19/89	1	1/100
7/20/89		39/100
7/21/89		18/100
7/22/89	2	10/100
7/23/89		65/100
7/24/89	1	85/100
7/25/89		62/100
7/29/89		95/100
7/30/89		95/100
7/31/89		45/100

	7	57/100

Mr. Leon Berry
8208 N. 13th Street
Tampa, Florida
Phone: 931-3429

8/M/89

8/09/89	1 90/100
8/10/89	75/100
8/12/89	35/100
8/13/89	3/100
8/18/89	95/100
8/19/89	48/100
8/21/89	1 50/100
8/22/89	72/100
8/24/89	23/100
8/25/89	2 90/100
8/27/89	2 55/100
	12 36/100

9/01/89	1 60/100
9/02/89	1 45/100
9/03/89	37/100
9/05/89	66/100
9/07/89	02/100
9/09/89	03/100
9/15/89	19/100
9/18/89	11/100
9/19/89	85/100
9/22/89	1 20/100
9/23/89	48/100
9/25/89	1 25/100
9/29/89	42/100
	8 63/100

October 1989

10/07/89	1 35/100
10/10/89	02/100
10/14/89	26/100
10/18/89	19/100
10/26/89	12/100
	1 94/100

RAINFALL READINGS

SULPHUR SPRINGS

By: Mr. Leon Berry
8208 N. 13th Street
Tampa, Florida
Phone: 931-3429

November 1989

9	63/100
16	11/100
23	35/100
25	63/100
26	03/100
	1.75

December 1989

8/9	1.70
12	64/100
16	44/100
18	47/100
19	8/100
20	2.15
	6.43

January 1990

1	21/100
2	72/100
25	02/100
	0.95/100

February 1990

4	0.42
10	2.20
22	2.50
23	2.50
	5.12

March 1990

17	0.31
31	1.80
	2.11

APPENDIX S

ALASKA SINK

CLEAN-UP EFFORTS

FDER - SSAL

PRESS REPORTS

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT
4520 OAK FAIR BLVD.
TAMPA, FLORIDA 33610-9544
813-623-5561
SunCom—552-7612

BOB MARTINEZ
GOVERNOR
DALE TWACHTMANN
SECRETARY
DR. RICHARD D GARRITY
DEPUTY ASSISTANT SECRETARY

September 1, 1988

Ms. Frederica Russell
57 Hamilton Heath
Tampa, Florida 33604

Dear Ms. Russell:

This is in reference to your proposal to clean the debris from the Alaska Avenue Sinkhole (Section 19, Township 28S, Range 19E, Hillsborough County).

Based upon the submitted information and field inspection by this office, it has been determined that the Alaska Avenue Sinkhole is not jurisdictional for DER per Section 17-4.022, Florida Administrative Code. At this time no permit is required for your project by this Department. Any modifications in your plans should be submitted for review, as changes may result in permits being required. This letter does not relieve you from the need to obtain any other permits (local, state or federal) which may be required.

If you have any questions, please contact me.

Sincerely,

Bob Stetler

Bob Stetler
Wetlands Management Supervisor

BS/jdj

cc: Jay Ahern (SWFWMD, Brooksville)

ST PETE TIMES

St Pete Times 4/11/87

Times photo — SCOTT WHEELER

Sweeping out a sinkhole

Luis Menoyo throws a battery onto a pile of garbage hauled out of a sinkhole at Alaska and Waters avenues on Thursday and Friday. Items found in the sinkhole include a television, a moped, shopping carts, bowling balls and bedsprings.

CLEAN-UP PROJECT
ALASKA SPRING
(Waters & Alaska Ave.)

Alaska Spring BEFORE clean-up
Thursday, April 9, 1987

Alaska Spring AFTER clean-up
Saturday, April 11, 1987

APPENDIX T

ORCHID SINK STORMWATER

RETROFIT PLANS

EPC STORMWATER SAMPLE

CITY OF TAMPA TO EPC

SSAL TO BOARD OF COUNTY COMMISSIONERS

EPC TO FDOT/CITY OF TAMPA

BOARD OF COUNTY COMMISSIONERS TO SSAL

CITY OF TAMPA TO EPC

COMMISSION

1900 9th AVE
TAMPA FLORIDA 33605

TELEPHONE (813) 272-5960

Environmental Protection Commission
of Hillsborough County

Laboratory Results

ple Type: Storm water, grab samples taken at end of pipe

ple Date: July 13, 1987

pled by: C. Bohlke/T. Cardinale

	Orchard Avenue Sinkhole			Poinsettia Sinkhole
ameter	East Pipe #1 (2:30pm)	North Pipe #2 (2:35pm)	West Pipe #3 (2:41pm)	East Pipe #4 (2:54pm)
(pH units)	8.5	8.2	8.1	8.2
ductivity, µmho/cm	56	76	93	83
bidity (NTU)	34	62	53	54
al Coliform (No./100 ml)	>57,000	>89,000	12,000	17,000
al Coliform (No./100ml)	57,000	89,000	12,000	6,000
al Strep. (no./100ml)	158,000	201,000	132,000	91,000
[illegible]	0.36	0.44	0.09	0.07
d, Total (mg/l)	0.11	0.12	0.13	0.04
d, Dissolved* (mg/l)	0.04	0.03	<0.02	0.02
n, Total (mg/l)	1.03	1.36	0.84	0.73
n, Dissolved* (mg/l)	<0.06	<0.06	<0.06	<0.06
omium, Total (mg/l)	<0.04	<0.04	<0.04	<0.04
omium, Dissolved* (mg/l)	<0.04	<0.04	<0.04	<0.04
mium, Total (mg/l)	<0.003	<0.003	<0.003	<0.003
mium, Dissolved* (mg/l)	<0.003	<0.003	<0.003	<0.003

*Dissolved metals were filtered in the lab.

LR-1)

January 13, 1989

Hillsborough County Environmental Protection Commission
1900 9th Avenue
Tampa, Florida 33605

Attention: Mr. Roger Stewart
Director

Reference: **Orchid Avenue Sinkhole - Pollution Abatement Project**

Dear Mr. Stewart:

A meeting was held on November 29, 1988 to discuss the Orchid Avenue water quality treatment project. The purpose of the meeting was to present a plan to the Hillsborough County Environmental Protection Commission (HCEPC) to retrofit two existing storm sewer outfalls to allow for pollution abatement. The discharges were considered by HCEPC to be in violation of the provisions of HCEPC Act 84-446 as amended. Attendees at the meeting included personnel from the Florida Department of Transportation - District 7 (FDOT), City of Tampa (City), HCEPC, Greiner, Inc., Florida Department of Environmental Regulation (FDER), and Southwest Florida Water Management District (SWFWMD). An on-line treatment system was recommended by the City and FDOT which will receive discharge from the Nebraska Avenue outfall in the North and a small outfall pipe from the West. Other options were discussed, but were not considered as part of this pilot program.

The results of the meeting were a set of design guidelines. The guidelines include the following:

1. The pond will be an on-line system with discharges passing into or through the pond. The control structure will be a box fitted with a weir which will be sized to pass the entire runoff minus treatment volume. Two to one (2:1) side slopes and a maintenance ramp will be used as part of the design (Maintenance will be performed from the bottom of the pond). The first portion of runoff will be treated through an underdrain system which will discharge to the sinkhole.

2. The pond will be designed to treat the small basin to the west and the Nebraska Avenue basin. Discharge from the 62 acre basin east of the pond will continue to discharge directly to the Orchid Avenue sinkhole. The pond will serve as a pilot project and will be evaluated using water quality monitoring data measured at the site. The results of the tests will be used to assess the abatement capabilities of the system and if the methods should be used elsewhere.

3. The cost of this project will be divided between the City and FDOT. FDOT will be responsible for the cost of designing the project and additional land costs. The City will provide up to $100,000.00 for construction of the project. If the estimated cost of construction exceeds this amount, the HCEPC will be requested to assist in its funding. The City will administer the construction contract.

4. HCEPC will develop the water quality monitoring program used for the pilot project with assistance and guidance from the City. Coordination of this program with the final design plans is integral for obtaining accurate test results and allowing for a proper determination of the success of the treatment system.

Greiner, Inc. will begin final design of the project upon written notice of acceptance by HCEPC of this design concept and Notice to Proceed by FDOT. Please contact either Mr. Larry Gaddy (FDOT) at 871-7390 or Mr. Michael Burwell (City) at 223-8736 if you have any questions.

Sincerely,

Mr. Larry Gaddy, P.E. District Drainage Engineer FDOT - District 7	Mr. Ralph L. Metcalf, II, P.E. Deputy Director, Department of Sanitary Sewers City of Tampa

LG/RLM:ES:vaj

Sulphur Springs Action League
"The Springs - let's make it sparkle"
320 W. Waters Ave., Tampa, FL 33604
Phone: (813) 935-3115

February 6, 1989

RECEIVED
MAR 24 1989
ENVIRONMENTAL ENGINEERING
CONSULTANTS, INC.

Commissioner Jan Platt
Board of County Commissioners
P.O. Box 1110
Tampa, FL. 33601

Dear Commissioner Platt,

I read with dismay the other day the story in the Tribune about the problem EPC is having with spending the fines in the Pollution Recovery Fund. I am sorry we missed out completely on the $200,000 alloted for an exhibit at Lowry Park. Is that totally committed, no chance of recall?

As you can imagine, the Action League would be most interested in obtaining some of the funds for redirecting untreated storm water from the North Tampa sinkholes where the water enters the aquifer system. The story said that "water management officials" - SWFMD?- have discussed asking for funds to treat stormwater runoff in the eastern part of the county. That at least starts to look like a worthwhile project. We appreciate the strong stand you have been taking in the face of high opposition and I would like to apologize for not being there to back you in the past. The only excuse I can offer is that in our newness there are still a lot of things that go on that we have not gotten active in and certainly the EPC meetings are a prime example.

We are not making much headway with the city - some, but not much, and EPC, who we thought would be our champion, has turned out to be another beaurocratic maze. Last time I talked to our contact there, Cathy Boelke, she gave me a report on current activities, which was not a lot, and when I asked about DER involvement, she said, "Oh, yes, they were going to get back to us - I guess that was about a year ago, maybe I'll call them." If I hadn't "gotten back to" someone within a year they would probably figure I was dead, and rightly so!

The more I think about it, I see we have missed a lot of opportunities in this last year to learn about the workings of the EPC and have an impact on many issues. There's just too much going on for X number of people to handle sometimes. Anyhow, we do want to have a chance to get better acquainted with you, and find out how we can help on some of these issues so you aren't out there fighting alone. I will be checking into the EPC meetings and find someone good to attend for us.

Back to our concern about the sinkholes and the Springs - I talked to Cathy about they city applying for some of this money and she said that Burwell has asked her several times if they could get some of the money and she tells them - apply for it and find out, but as far as we know, they haven't gone past that.

I will be speaking with Burwcell this week about their applying for this money. I would appreciate hearing from you when you have a chance so we could do some strategy planning.

Sincerely,

Linda Hope, president SSAL

Remembering the past - Working for the future

ENVIRONMENTAL PROTECTION COMMISSION
HILLSBOROUGH COUNTY

ROGER P. STEWART
DIRECTOR

1900 - 9th AVE
TAMPA, FLORIDA 33605

TELEPHONE (813) 272-5960

RECEIVED
MAR 13 1989
DEPT. OF SANITARY SEWERS
EXECUTIVE OFFICE

March 9, 1989

Larry Gaddy, P.E.
F.D.O.T., District 7
1300 North Westshore, Suite 201
Tampa, Florida 33607

Ralph L. Metcalf II, P.E.
City of Tampa
Department of Sanitary Sewers
306 East Jackson, 6th Floor, East Wing
Tampa, Florida 33602

Dear Gentlemen:

SUBJECT: ORCHID AVENUE SINKHOLE - POLLUTION ABATEMENT PROJECT

Your letter to Mr. Roger Stewart, dated January 13, 1989, concerning the referenced subject matter was received on February 2, 1989. Please accept this letter as an acknowledgement of the Environmental Protection Commission of Hillsborough County's (EPCHC) conceptual approval of your proposed project with one or two minor modifications to the proposed language as follows:

1. It is not certain if this project will need any financial assistance from EPCHC through the use of our Pollution Recovery Fund. Furthermore, we are not sure about the eligibility of the project as determined according to the Pollution Recovery Fund rule. However, the staff recognizes the environmental merits and significance of this undertaking and is in full concurrence with you in your request. It is, therefore, recommended that in case of need for funding assistance, a request be submitted specifying the amount and your justifications for eligibility.

2. In regard to the development and implementation of a water quality monitoring program, the EPCHC will provide assistance and guidance.

We look forward to working with you in implementing this pilot project with hopes to enhance the quality of our environment.

Should you have any questions, please feel free to contact us. Thank you for your continued cooperation.

Sincerely,

Catani Boostani for

Hooshang Boostani, P.E.
Environmental Manager
Environmental Protection Commission
of Hillsborough County

lw

(L.279)

BOARD OF COUNTY COMMISSIONERS
HILLSBOROUGH COUNTY, FLORIDA

Office of the County Administrator

Larry J. Brown
County Administrator

P.O. Box 1110
Tampa, Florida 33601

March 24, 1989

Linda Hope
President, Sulphur Springs Action League
320 West Waters Avenue
Tampa, Florida 33604

Dear Ms. Hope:

It was a pleasure talking with you today regarding your group's efforts in preserving Sulphur Springs.

I contacted Hillsborough County's Environmental Protection Commission (EPC) regarding the EPC Pollution Recovery Fund and the $200,000 allotted for an exhibit at Lowry Park has been approved by the EPC Board but has not been approved by the Board of County Commissioners (BOCC). Should the BOCC approve this allocation, there will be approximately $100,000 remaining. It is up to the EPC Board to determine how these funds can be utilized; therefore, as Commissioner Platt suggested, you should address your request to the EPC members.

As we discussed, there may be a possibility of securing funds from the State Pollution Recovery fund which is administered by the Department of Environmental Regulation (DER). I will contact DER first thing next week and obtain information on applying for funding.

In the meantime, should you have any questions please feel free to call me at 272-5890.

Sincerely,

Yvonne Lewis Alfonso

Yvonne Lewis Alfonso
Grants Coordinator
Fiscal Policy and Budget Team

cc: Larry J. Brown, County Administrator
Edwin Hunzeker, Assistant County Administrator, Fiscal Policy and Budget Team

CITY OF TAMPA

Sandra W. Freedman, Mayor

Department of Sanitary Sewers

Jack P. Morriss, P.E.
Director

RECEIVED
SEP 5 1989
STORMWATER MANAGEMENT
DIVISION

Mr. Roger Stewart
Hillsborough County
Environmnetal Protection Commission
1900 9th Avenue
Tampa, Florida 33605

August 31, 1989

Subject: Stormwater & North Tampa Sinks - Pollution Recovery Fund

Dear Mr. Stewart:

On August 14, 1989 members of your staff met with Mike Salmon, City staff, representatives from the Florida Department of Environmental Regulation, a a representative from Jim Davis' office and myself. We discussed current City proposals for reduction of the flow of stormwater into the North Tampa sinks. As you know, the City of Tampa and the Florida Department of Transportation (FDOT) have been cooperating for some time on a project to reduce pollution currently entering the Orchid Sink via storm sewers serving Nebraska Avenue. We are reaching the end of the design phase and now have a reasonable estimate of the cost of these improvements.

Attached is a set of preliminary drawings of the proposed facility.

As we've informed you in the past, the City of Tampa has budgeted $100,000 for the construction of this improvement. FDOT has contributed the design costs and is currently engaged in purchasing additional land to supplement that already owned by the City and dedicated to this project. We now find there is a shortfall of approximately $45,000 between the most recent engineer's estimate and that budgeted for construction and would like to take this opportunity to solicit your assistance.

We understand you are currently requesting suggestions for projects to be funded by the Pollution Recovery Fund. Since this problem is of a regional, cross-jurisdictional nature and since it could be considered a pilot program whose efficacy will be studied by your agency and others, we believe the Orchid Avenue Sinkhole Water Quality Treatment Pond would be a worthwhile candidate. You and your staff have expressed an interest and desire for the completion of this project and have informed us of the availability of these funds. We are thus requesting funding to insure the construction can be completed in a reasonable time frame. Failure to obtain this funding will most likely result in the project being postponed until next fiscal year.

If we receive positive results from this initial project we would like to expand the program to incorporate the runoff from the eastern outfall into the Orchid Sink as well as the flow into Jasmine/Poinsettia. This would have to entail supplemental funding from either HEPC, FDER or both since the City does not have the funding necessary to implement this program at this time.

We would also like to meet with your staff to initiate the sampling program we have discussed in the past. Since we wish to capture both "before" and "after" conditions, we should begin now to collect samples to gain an adequate picture of the existing situation.

If you have any questions we would be glad to answer them. Please feel free to call me at 223-8070 or Michael Burwell at 223-8736.

SANITARY SEWERS DEPARTMENT

Jack P. Morriss

Jack P. Morriss
Director

JM/MB

cc: Chip Hatcher
Michael J. Burwell
R.M. Salmon
Larry Gaddy, FDOT
Dr. Richard Garrity, FDER

APPENDIX U

SULPHUR SPRINGS ACTION LEAGUE AND THE
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
HILLSBOROUGH RIVER BASIN BOARD AGREEMENT
SWFWMD - SSAL
AGREEMENT

Southwest Florida Water Management District

MICHAEL ZAGORAC, JR., Chairman, Belleair WALTER H. HARKALA, Vice Chairman, Plant City
ANNE M. BISHOPRIC, Secretary, Sarasota HORACE F. HERNDON, Treasurer, Lake Wales
ROY G. HARRELL, JR., St. Petersburg ROBERT T. BRAMSON, M.D., Tampa
WILLIAM H. WILCOX, Ph.D., Port Charlotte MARY ANN HOGAN, Brooksville CHARLES A. BLACK, Crystal River

GARY W. KUHL, Executive Director DANIEL P. FERNANDEZ, General Counsel
WILLIAM K. HENNESSEY, PETER G. HUBBELL, JERRY I. SIMPSON, Deputy Executive Directors

July 15, 1988

Ms. Frederica Russell
Program Director
Sulphur Springs Action League
57 Hamilton Heath
Tampa, Florida 33604

Dear Frederica:

At its last meeting on June 18, 1988, the Hillsborough Basin Board agreed to fund the $15,097 Sulphur Springs Action League project proposal from Fiscal Year 1988 (FY 88) reserves rather than from the FY 89 budget. Depending on the length of time necessary to fully address the funding stipulations outlined in my May 19, 1988, letter (i.e., permitting verification and legal considerations), the Board's action may allow for the availability of project funding prior to October 1, 1988.

As I also mentioned in my last letter, the Action League's funding request was to undergo review by the District's legal staff. Completion of that review has led to the identification of a number of staff concerns regarding this project. These concerns include:

1) Since the dive sites are not District property, the divers and the District would have to obtain written permission from the property owners involved and waivers of liability in connection with such permission.

2) If the divers are refused access to the City of Tampa's property at Sulphur Springs, which staff understands has already occurred, a portion of the proposed work effort may not be feasible.

3) Regardless of the divers signing waivers of liability, staff has strong concerns over exposing the District to the potential liability which could be involved in allowing volunteers to engage in an inherently dangerous activity on its behalf.

4) The District would have to enter into a formal agrement with the parties doing the work, probably the individual divers, to properly address the

expenditure of funds, deliverables to be provided, disposition of purchased equipment and any other concerns.

5) Any District action should be closely coordinated with the Hillsborough County Health Department, Hillsborough County Environmental Protection Commission and City of Tampa Stormwater Management Department, since each of these of these agencies have participated in evaluations of the problem.

The staff concerns noted above will be presented to the Hillsborough River Basin Board on July 21, 1988. The meeting is scheduled to begin at 9:00 a.m. in the District's Tampa Service Office on U.S. 301.

You may wish to have a representative available at the meeting to provide input to the discussion. If you have any questions regarding the staff concerns, please feel free to contact me or, in my absence, David Meinhart of my staff at 1-800-423-1476.

Sincerely,

David Meinhart

for Richard S. Owen
Planning Director

RSO:DWM
cc: Hillsborough River Basin Board
Bill Hennessey
Dan Fernandez
Ed Helvenston
Jay Ahern
Daryl Pokrana
David Meinhart
Rand Baldwin

July 6, 1988

MEMORANDUM

TO: Richard Owen, Director, Planning Department

FROM: Edward B. Helvenston, Assistant General Counsel EBH

SUBJECT: Sulphur Springs Action League Funding Request

In response to your memorandum on the above subject, I have several serious concerns with this request. First of all, the sites where the diving is to take place are not District property, and the divers and District would have to obtain written permission from the property owners involved and presumably grant waivers of liability in connection with such permission. It is my understanding that the City of Tampa, one of the property owners, has already refused to allow the divers access to the property at Sulphur Springs for safety reasons, which would appear to preclude accomplishment of some of the work proposed.

More importantly, the District should under no circumstances expose itself to the potential liability which could be involved in allowing volunteers to engage in an inherently dangerous activity on its behalf. This is true regardless of whether the divers would be willing to sign a waiver of liability. As an additional consideration, there has apparently been no clear indication as to whether these people possess an appropriate level of training to competently do the mapping work and the other work which the District would be funding at considerable expense. Another complication is that the District would have to enter into a formal agreement with the parties doing the work in order to properly address the expenditure of funds, deliverables to be provided, disposition of purchased equipment and other problems. This agreement would probably have to be with the individual divers, since I doubt the Sulphur Springs Action League would be an appropriate body with which to contract.

It is my understanding that the Hillsborough County Health Department, Hillsborough County Environmental Protection Commission and City of Tampa Stormwater Management Department have been involved in evaluations of this problem. Any District action should obviously be coordinated closely with these agencies. Rather than the District independently funding a group of volunteers in this dangerous and complex project, it would appear that the appropriate way to handle this situation would be for the local governments, if they think that the problem is significant and that District assistance would be useful, to present a proposal to the District for funding assistance in any evaluation and cleanup efforts. Such an arrangement would not only be a better way to handle the problem from the standpoint of local government coordination but would also preclude some of the liability and contractual problems indicated above.

Please contact me if you have further questions concerning this matter.

EBH:mdh
cc: David Meinhart Dan Fernandez

AGENDA

Hillsborough River Basin Board
Southwest Florida Water Management District

Tampa, Florida July 21, 1988

9 a.m.

1. Call to Order and Roll Call

2. Minutes of the Meeting of June 16, 1988

3. Election of Officers

4. Withlacoochee Riverine Corridor "D" -
   Pasco County's Request to Surplus Lands for
   Zephyrhills Bypass, SWF Parcel No. 13-400-145X

5. Hillsborough County FY 89 Outside Funding Request -
   Itchepackasassa Creek

6. Status Reports
   a. Sulphur Springs Action League Funding Request
   b. Surface Water Improvement and Management Program
   c. Others

7. Announcements
   a. Next meeting is scheduled for August 18, 1988.

8. Adjournment

AGREEMENT BETWEEN
THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
AND THE SULPHUR SPRINGS ACTION LEAGUE
TO PROVIDE FINANCIAL ASSISTANCE
FOR REMOVAL OF DEBRIS AT ALASKA SPRING AND
WATER QUALITY ANALYSES AT ALASKA SPRING AND SULPHUR SPRINGS

THIS AGREEMENT, made and entered into this ______________ day of ____________________, 1988, by and between the SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, a public corporation created by Chapter 61-691, Laws of Florida, as amended, for itself and on behalf of the HILLSBOROUGH RIVER BASIN BOARD, hereinafter collectively referred to as the "DISTRICT", and the SULPHUR SPRINGS ACTION LEAGUE, a not-for-profit corporation incorporated under the laws of the State of Florida, hereinafter referred to as the "LEAGUE",

WITNESSETH:

WHEREAS, the discovery of bacterial contamination in the Sulphur Springs Pool has resulted in the elimination of public access to this recreational area; and

WHEREAS, the source(s) of the bacterial contamination remains scientifically unknown; and

WHEREAS, Sulphur Springs serves as an alternative source of fresh water supply to the City of Tampa; and

WHEREAS, a primary function of the LEAGUE is to resolve the bacterial contamination problem in the Sulphur Springs Pool; and

WHEREAS, the LEAGUE has requested the DISTRICT's financial assistance in the removal of debris from Alaska Spring and the subaqueous sampling and analysis of water emanating from Alaska Spring and Sulphur Springs, hereinafter referred to as the PROJECT.

NOW, THEREFORE, in consideration of the mutual terms, covenants and conditions herein contained, the parties agree as follows:

1. The DISTRICT shall make available, from funds budgeted in fiscal year 1988, a sum not to exceed FIFTEEN THOUSAND NINETY-SEVEN DOLLARS ($15,097.00) toward the cost of removal of debris from Alaska Spring and the subaqueous sampling and analysis of water emanating from Alaska Spring and Sulphur Springs and other related activities as may be authorized in writing by the DISTRICT's Project Manager. All changes in excess of FIVE HUNDRED DOLLARS ($500.00) within the itemized listing in Exhibit "A" must be approved by the Hillsborough River Basin Board. Changes shall not cause the total amount of this agreement to exceed FIFTEEN THOUSAND NINETY-SEVEN DOLLARS ($15,097.00).

2. The LEAGUE, its agents, employees and subcontractors shall not enter the subaqueous cave system thought to connect Alaska Spring and Sulphur Springs as a part of the PROJECT.

3. The LEAGUE shall administer and be fully responsible for the PROJECT and shall perform as an independent contractor and not as an employee, representative, or agent of the DISTRICT.

4. The LEAGUE shall obtain approval, as necessary, of all governmental authorities and private parties having jurisdiction

over the PROJECT or property to be entered in conjunction with the PROJECT.

5. The LEAGUE shall obtain all required permits prior to commencing work or obtain written confirmation if permits are not necessary.

6. The LEAGUE shall abide by all applicable federal, state and local laws, rules, regulations and guidelines relative to performance under this agreement.

7. The LEAGUE shall engage only properly qualified and certified professional divers and water quality analysts to complete the PROJECT.

8. The LEAGUE shall lease and/or obtain all necessary equipment in accordance with the price schedule attached hereto and incorporated herein as Exhibit "A". The DISTRICT shall not reimburse the LEAGUE for amounts in excess of those found in Exhibit "A" or for items not listed in Exhibit "A", unless such modifications to Exhibit "A" are authorized by the DISTRICT's Project Manager in writing and do not exceed the total amount indicated in Exhibit "A". All changes in excess of FIVE HUNDRED DOLLARS ($500.00) within the itemized listing in Exhibit "A" must be approved by the Hillsborough River Basin Board.

9. Rodgers Brothers Services and all other agents or subcontractors of the LEAGUE utilized for crane services or similar services utilizing machinery for the cleaning of debris shall obtain and maintain during the entire term of this contract, broad form comprehensive general liability combined

single limit insurance coverage for bodily injury and property damage with limits not less than FIVE HUNDRED THOUSAND DOLLARS ($500,000.00) per occurrence and aggregate with a company or companies authorized to do business in the State of Florida. Such subcontractors shall also obtain workers compensation coverage as required by Florida law. A certificate of coverage showing evidence of such required insurance shall be furnished to the DISTRICT prior to commencement of work under this contract. The DISTRICT, its officers and employees shall be named as an additional insured party on the liability policies of any such subcontractors. All certificates shall provide for ten (10) days notice to the DISTRICT prior to cancellation or modification of any policies.

10. The League shall defend, indemnify and save harmless the DISTRICT and its Governing Board, officers, and employees from and against all actions, causes, claims, demands, judgments, payments, recoveries and suits of any kind or nature arising under or resulting from this agreement.

11. All agents, subcontractors, members or employees of the LEAGUE who perform diving work or otherwise perform services for the LEAGUE on the property at Sulphur Springs or Alaska Spring in connection with this agreement shall, prior to commencing work, execute a copy of the waiver of liability form , attached hereto as Exhibit "B", releasing the DISTRICT from any liability in connection with work performed pursuant to this agreement and waiving any and all claims such persons may have against the

DISTRICT. The LEAGUE shall ensure that no such person shall undertake any work in connection with this agreement until a waiver form has been properly executed.

12. The LEAGUE and the DISTRICT shall each designate a Project Manager to act as primary contact for all matters relevant to this agreement.

13. The DISTRICT shall, upon receipt of a properly documented request, within thirty (30) days provide funds in a lump sum toward those items listed in Exhibit "A", or items otherwise authorized in writing by the DISTRICT's Project Manager, except for Items 11 and 12 of Exhibit "A", Water Quality and Hydrogeological Testing and Travel Time Test. Payment shall be made in the amounts listed in Exhibit "A" or as otherwise authorized in writing by the DISTRICT's Project Manager. Actual receipts for expenditures for items listed in Exhibit "A", or items otherwise authorized in writing by the DISTRICT's Project Manager, shall be forwarded to the DISTRICT within thirty (30) days from receipt of funds for review and approval. The LEAGUE shall return to the DISTRICT any unexpended funds at this same time. Expenditures not made in accordance with this agreement shall not be the funding responsibility of the DISTRICT. Reimbursement for Items 11 and 12 of Exhibit "A", Water Quality and Hydrogeological Testing and Travel Time Test, shall only be made upon receipt of invoices for completed testing.

14. It is understood by the parties that the LEAGUE is responsible for the appropriate expenditure of the funds provided

to it by the DISTRICT and shall only expend such funds pursuant to the terms and conditions of this agreement and shall not utilize such funds for any other purpose.

15. The LEAGUE shall utilize the funds provided for the sole purposes of purchasing and leasing equipment to be used for cleanup of the mouth of the spring at Alaska Spring and conducting water quality analyses at Alaska Spring and Sulphur Springs and other related expenditures as may be authorized in writing by the DISTRICT's Project Manager. The LEAGUE shall provide to the DISTRICT upon completion of this agreement a copy of a report summarizing the results of the water quality analyses performed at Alaska Spring and Sulphur Springs and the cleanup efforts at Alaska Spring and any other authorized activities. Water quality parameters to be sampled will include: total dissolved solids, nitrates, magnesium, calcium, fecal coliform, total coliform, fecal strep, lead, chromium, oil and grease, pH and conductivity. Sampling procedures will be those outlined in the Florida Department of Environmental Regulation-approved Generic Quality Assurance plan submitted by a qualified water quality sampling professional. Sampling frequencies and locations will be based on a plan submitted by Environmental Engineering Consultants or other consultants of the LEAGUE and will be subject to review and approval by the DISTRICT's Project Manager. A schedule of interim reports on testing results to be submitted to the DISTRICT will be provided for in the plan. No funds will be released under this agreement until the plan has

been approved by the DISTRICT's Project Manager. At a minimum of two locations, Sulphur Springs and Alaska Spring, a total of four samples will be taken in a sequence conducive to measuring seasonal variations in water quality. Based on the availability of funds in the project budget, additional locations and/or samples may be authorized by the DISTRICT's Project Manager. With regard to cleanup, the LEAGUE agrees to perform a thorough cleanup of debris from Alaska Spring. All equipment purchased with DISTRICT funds shall become the property of the DISTRICT upon termination of this agreement, and shall be returned to the DISTRICT in operating condition.

16. The LEAGUE shall not prepare, publish, or release any formal news release or press releases on or about purposes or goals of the PROJECT without prior review and approval by the DISTRICT.

17. It is understood by the parties hereto that the DISTRICT may terminate this agreement without prior notice to the LEAGUE, if at any time the DISTRICT determines, at its sole discretion, that the LEAGUE and/or its agents, contractors or employees are not performing in accordance with the terms and/or conditions of this agreement.

18. This agreement shall be effective on the last date of signing by the parties involved. Costs incurred by the LEAGUE prior to the effective date of this agreement are not fundable by the DISTRICT.

19. This agreement constitutes the entire agreement between the parties and may be amended or extended only in writing, signed by both parties and attached to the original hereof.

20. The DISTRICT and the LEAGUE agree that this agreement shall terminate on March 31, 1990 unless it is terminated or specifically extended as provided above.

IN WITNESS WHEREOF, the lawful representatives of the parties have entered into this agreement on the day and year above indicated.

Attest:	SULPHUR SPRINGS ACTION LEAGUE, a Florida not-for-profit corporation
By George P. Bartholomew	By Linda B. Hope — PRESIDENT; 9/12/88 DATE
Attest:	SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
By__________	By__________ MICHAEL ZAGORAC, JR. ____ DATE

Approved by	Date	Initial
Orig. Dept.	9-9-88	RJO
Finance Dept.	9-9-88	[illegible]
Legal Office	9-9-88	[illegible]
Bas. Adm.	9-12-88	JTA

EXHIBIT "A"

DETAILED EQUIPMENT AND ITEMIZED COST LISTING

1.	2 Viking Pro Surveyor Suits w/thermal insulation	$3,218.00
2.	2 Viking Aga Masks w/audio communications diver/diver/surface	$3,736.00
3.	2 Exploration lights Dive Rite - m6035 project model	$1,094.00
4.	3 100 fill Air Cards	$ 450.00
5.	25 Oxygen Tank fills at $10	$ 250.00
6.	4 rolls survey line	$ 60.00
7.	Maintenance cost on Viking Dry Suits/18 months 2 suit seal sets/each	$ 425.00
8.	Maintenance cost on Aga Masks 2 seal sets/each/18 months	$ 400.00
9.	Crane rental/with operator $80.00/hr. for 20 hours	$1,600.00
10.	Pump Rental $83.00/hr. for 16 hours	$1,328.00
11.	Water Quality & Hydrogeological Testing including Velocity	$2,266.00
12.	Travel Time Test	$ 270.00
	TOTAL	$15,097.00

EXHIBIT "B"

HOLD HARMLESS AGREEMENT

DATE:________________

________________________________ shall forever protect, save and hold the Southwest Florida Water Management District harmless and indemnify the District against and from any and all claims, demands, losses, costs, damages, suits, judgments, penalties, expenses and liability of any kind or nature whatsoever arising directly or indirectly out of or in connection with any activities of the undersigned individual in conjunction with that certain agreement dated __________________ between the Sulphur Springs Action League, a not-for-profit corporation, and the Southwest Florida Water Management District. The undersigned individual further agrees to waive any and all claims of whatever nature which he/she may have against the Southwest Florida Water Management District arising out of the undersigned individual's activities in conjunction with that agreement.

Signed at ____________________________, Florida, this ________ day of ______________________, __________.

BY: ____________________________

____

STATE OF FLORIDA

COUNTY OF ________________________.

Before me personally appeared ___________________________ to me known and to me known to be the person or persons described in and who executed the foregoing instrument, and acknowledged to and before me that _________________ executed said instrument for the purposes therein expressed.

WITNESS my hand and official seal this ___ day of ________ A. D., 19__.

____

NOTARY PUBLIC
STATE OF FLORIDA

My commission expires: ______________________________

APPENDIX V

WATER QUALITY SAMPLING PLAN FOR
ALASKA AND SULPHUR SPRINGS

WATER QUALITY SAMPLING PLAN

FOR

ALASKA AND SULPHUR SPRINGS

Prepared For:

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
2379 BROAD STREET
BROOKSVILLE, FLORIDA 33512-9712

Prepared On Behalf Of:

SULPHUR SPRINGS ACTION LEAGUE

BY:

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.
5119 NORTH FLORIDA AVENUE
TAMPA, FLORIDA 33603

OCTOBER 3, 1988

BACKGROUND:

The Alaska Spring is the closest known aquifer access point upstream of Sulphur Springs. It is privately owned and has been the subject of several cleanup efforts by the Sulphur Springs Action League (SSAL). The remaining cleanup effort will remove the last amount of debris blocking the entrance to the aquifer. Once that blockage is removed it will be possible for divers to obtain water quality samples from within or as near as possible to the main aquifer flow. No divers are to access the aquifer itself so sampling devices must be used which extend the reach of the divers as far as possible.

The intent of the sampling is to establish the water quality of aquifer at two points under several hydrogeological conditions. This data will help to provide information about dilution in the aquifer between the two points which may help in discovering the direction from which contamination is coming.

PROCEDURE:

After access to the aquifer is obtained the divers will release dye at the access point and samples will be taken at Sulphur Springs to determine the travel time between the two points. From previous dye tests performed by the City of Tampa it is estimated to be less than one hour and judging the velocity at Sulphur Springs may be about 0.25 hours.

The dye test should be done with the flood gates raised and lowered at Sulphur Springs so that two hydraulic data points can be discovered. Water levels of the whole system should be noted in all sampling locations as well as Trinity Springs and other associated retention ponds.

Establishing the travel time is important to setting up the most accurate water quality sampling possible. A grab sample may be the only feasible sample that may be obtainable depending on the degree of difficulty. However, it would be preferable to obtain a composite sample over time to more accurately define the water quality constituents. It is proposed to take two (2) hour composites comprised of five (5) aliquots on 0.5 hour intervals. The sampling at Alaska would proceed at a specified time with the sampling at Sulphur lagging the established travel time behind the upstream effort. For practical purposes the flow will be steady state so this technique should afford data to be analyzed on a mass-balance basis to determine the dilution, if any, from Alaska to Sulphur by other possible tributaries. If the effort can be extended upstream to Trinity Springs a more comprehensive picture will be formed.

SAMPLING TECHNIQUE:

If the Alaska aquifer vent is such that it is situated above the main flow of the aquifer then a weighted Kimmerer-type sampler will be utilized to take a sample from a deeper depth. If the aquifer vent is horizontal to the main flow of the aquifer then retractable extension arm will be devised to allow a sample to be retrieved. In either case the sampling device will be thoroughly cleaned and disinfected in accordance with Environmental Engineering Consultants, Inc. (EEC) Generic Quality Assurance Plan (GQAP) as approved by the Florida Department of Environmental Regulation.

If several aliquots are obtainable then successive cleaning and disinfection of the device prior to each sample will be performed. The proposed 0.5 hour interval is deemed sufficient to secure a sample, perform the field pH and Conductivity analysis, composite the sample in an iced 2.5 gal. (or larger) clean plastic container and prepare the samples for the next sample aliquot.

The parameters to be tested are as follows:

Parameter	EPA Test Procedure or Equivalent	Sample Size
pH	LaMotte Chemical pH Meter	200 ml
Conductivity	LaMotte Chemical Conductivity Meter	200 ml
Total Dissolved Solids TDS	160.2	200 ml
Nitrates, NO3	353.3	200 ml
Magnesium, Mg	242.1	200 ml
Calcium, Ca	215.1	200 ml
Fecal Coliform, Fc	*	50 ml
Fecal Streptococcus, Fs	*	50 ml
Total Coliform, Tc	*	50 ml
Lead, Pb	239.1	100 ml
Chromium, Cr	218.1	100 ml
Oil and Grease (Petroleum)	413.2	200 ml
	Total Sample Needed	1,750 ml

* Methods are contained in EPA-600/8-78-017, December, 1978 "Microbiological Methods For Monitoring the Environmental, Water and Wastes.

The one time grab or iced composite sample after thorough mixing will be distributed into the appropriate sample jars, placed back on ice and transported to Thornton Laboratories or approved equal. Chain of Custody tags will be utilized to maintain sample integrity.

SAMPLING SEQUENCE:

In order to establish the response of the aquifer system to rainfall events and hydrogeological variables the sampling will occur in the following order.

October - November, 1988	Perform dye tests, noting system flow rates.
May, 1989	Perform 1st water quality sampling at Alaska and Sulphur Springs. Dry weather conditions.
Late June - Early July, 1989	Perform 2nd water quality sampling at Alaska and Sulphur Springs. Initial wet weather conditions.
Early September, 1989	Perform 3rd water quality sampling at Alaska and Sulphur Springs. Mid wet weather conditions.
October, 1989	Perform 4th water quality sampling at Alaska and Sulphur Springs. End of wet weather conditions.

This sequence of events is intended to see if water quality data will follow a pattern of responding to rainfall events. It would be anticipated that the dry weather testing in May, 1989 would have low flow conditions with little contamination yet, mineral constituents (TDS, Mg, Ca) may be high.

The wet weather sampling will proceed after the first heavy sustained rainfall taken place on the system, marked by increased flows at Sulphur Springs and an increase of water levels in associated Springs and sinkholes. This "first flush" sample should be dilute mineral constituents, but higher in urban runoff contaminants. The two remaining wet weather samples should see a diminution of contamination as the system cleanses itself by sustained flushing provided by the 3 months rainfall.

Upon completion of the analytical testing and interpretation of the results a report will be submitted to the Southwest Florida Water Management District's Project Manager detailing the data collected in the effort.

During the time between the Alaska Springs cleaning/dye testing and the water quality testing, other agencies within the City of Tampa government, the Hillsborough County Environmental Protection Commission, the Health Department, the U.S. Geological Survey and the Florida Department of Environmental Regulation will be contacted to see what resources they may be able to contribute to extend the scope and intensity of the test event.

APPENDIX W

CORRESPONDENCE ON SULPHUR SPRINGS

CITY OF TAMPA - CITY COUNCIL

HILLSBOROUGH COUNTY HEALTH DEPARTMENT - FDER

SSAL - HILLSBOROUGH COUNTY HEALTH DEPARTMENT MEETING AGENDA

FDER TALLAHASSEE MEMO TO RICK GARRITY

FDER TO ROBERT WALLACE

City of Tampa, Florida

KF

Date: February 26, 1987

File 87-21

MAR 5 1987

RECD MAR 05 1987 CITY COUNCIL OF TAMPA

To: Members of City Council

From: Nancy McCann, Urban Environmental Coordinator

Subject: Report on the Sulphur Springs Pool

The Sulphur Srings Pool is now closed at the direction of the Hillsborough County Health Department due to periodic high bacteria counts. There has been a cooperative effort between several City departments to solve this problem. My office (OEC) has been working with the Water, Sewer, Stormwater and Recreation Departments. We are approaching this problem from two angles.

First, for a short-term solution, we are seeing what can be done to open the pool no later than June 1st when the rest of the City's swimming facilities open. We are in the process of developing a new sampling program to present to the Health Department because there is evidence that total coliform counts are not a good indicator of the safety of water for swimming. Rather, EPA recently published guidelines recommending that two specific types of bacteria (E. Coli and enterococcus) be measured, as these bacterial groups have been directly associated with human health disorders. Yet, the tests that closed the Sulphur Springs Pool for swimming were based on total coliform counts, which may, or may not, indicate that the water presents a health hazard. We hope to convince the Health Department to use the progressive approach, and follow the new EPA guidelines which we understand they have the authority to do. This may not totally eliminate pool closings, but could considerably reduce the amount of time the pool is closed. We understand that similar facilities in Florida have periodic, high total coliform counts, but are staying open due to the local Health Department cooperating with the responsible agency.

The second, long-term approach is to conduct a series of studies related to the water quality of the area. The following is in progress:

1. Last week, the Stormwater Division of the Department of Public Works conducted dye tests so that we can better understand the hydrogeology of Sulplhur Springs and nearby sinkholes.

2. A graduate student from the USF School of Public Health is conducting specific bacterial analyses at Sulphur Springs and nearby sinkholes.

3. Discussions are taking place with the Sewer Department to determine the best way to detect leaks in pipes. The sewer line immediately north of Sulphur Springs has already been checked and no problems were found.

Copies issued to Councilmembers 3-5-87

Once we see where these studies and discussions with the Health Department lead, we can make further decisions as to what to do next.

I wish to emphasize that this is a complex problem with many contributing factors. There has been considerable time and effort spent by several members of the City staff, and we will continue to do so.

NMc/me:20-36

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

Interoffice Memorandum

For Routing To Other Than The Addressee	
To:	Location:
To:	Location:
To:	Location:
From:	Date:

TO: Rick Garrity

THROUGH: Randy Armstrong SA
Howard Rhodes
Roxane Dow RD

FROM: Eric Livingston EHL

DATE: September 25, 1987

SUBJECT: Existing Stormwater Discharges to Sinkholes

F/I

copies
Clober ✓
Harry
Roger Stewart

PC

As requested, I have reviewed materials relating to the discharge of stormwater to sinkholes in Hillsborough County and offer the following:

1. The Groundwater Rule prohibits the direct discharge of stormwater to groundwater through sinkholes unless the stormwater meets the appropriate water quality criteria contained in Chapter 17-3. Based on the data contained in Mr. Stewart's letter of August 6 violations of our groundwater standards are occurring, especially for coliform bacteria.

2. Given the loss of beneficial uses in Sulphur Springs and related sinkholes the situation certainly calls for clean up. However, a 30 day time period to develop a proposal for solving these problems is unreasonable.

3. I recommend that Hillsborough County, City of Tampa and Florida Department of Transportation officials cooperatively develop a watershed assessment and management plan. This effort should identify water quality problem areas, inventory and map the existing stormwater system (determine drainage boundaries, pipe sizes, location of structures, etc.) identify future land use changes, and any planned transportation improvements, identify publicly owned lands that could be used for stormwater management, etc. Based on this analysis, a detailed watershed management plan that integrates the upgrading of the existing stormwater system (and problems) with planned construction activities in the watershed should be developed and implemented. In designing such a plan an obvious need will be to identify methods to reduce coliform loads to the sinkholes.

4. Please keep us informed of any activities undertaken by the city, county or FDOT. If you have any questions or need additional technical assistance, please call met at SunCom 278-0782.

EHL/las

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

BOB MARTINEZ
GOVERNOR

DALE TWACHTMANN
SECRETARY

January 11, 1988

RECEIVED
JAN 15 1988
ENVIRONMENTAL ENGINEERING
CONSULTANTS, INC.

Mr. Robert Wallace
Professional Engineer
Environmental Engineering Consultants
Post Office Box 7853
Tampa, Florida 33673

Dear Mr. Wallace:

I apologize for the slight delay in compiling the information you requested. Unfortunately, as you will see, information associated with bacterial contamination and the capacity of various stormwater treatment techniques to sequester these effects does not exist. At least, I am not familiar with work in this area if it has been done.

However, indirect evidence based on studies of "slow sand filters" for waste-water treatment suggest that either detention with underdrains or filters; as well as, retention and percolation through the soil should all be effective systems for the control of bacteria contamination. We also feel that permanently wet detention facilities can help to reduce bacterial levels to satisfy state standards.

Evidence shows that sedimentation is an important removal mechanism. Light intensity has also been determined to be directly related to die off. Consequently, we presume that ponds should be constructed with compartments. The first should be deeper with a relatively long residence time to promote sedimentation. All inflows should enter this portion of the facility. As water exists the pond or lake it should flow through the second compartment. It should be much more shallow to promote light penetration through the entire water column. The prevention of turbulence and subsequent resuspension of settled material is also crucial to the design.

I hope this brief discussion and the attached materials are of some help. If you require more assistance don't hesitate to call. My phone number is (904) 488-0782.

Sincerely,

John Cox

John Cox
Environmental Specialist
Nonpoint Source Management Section

JC/sps

Protecting Florida and Your Quality of Life

ATTACHMENTS

SENATOR PAT COLLIER FRANK
23rd District

THE FLORIDA SENATE

Tallahassee, Florida 32399-1100

COMMITTEES:
Economic, Community and Consumer Affairs
Judiciary-Civil
Personnel, Retirement and Collective Bargaining
JOINT COMMITTEE:
Administrative Procedures

July 19, 1988

Mr. Gary Kuhl, Executive Director
Southwest Florida Water Management District
2379 Broad Street
Brooksville, FL 34609-6899

Dear Gary:

Thank you for the comprehensive update on the SWIM Program. which I received today. I am pleased to note that "Tampa Bay and its tributaries" hold such a high priority.

There is a matter with which I am concerned that is not mentioned, i.e., the pollution of Sulphur Springs via the sinkholes which serve as drainage retention ponds for that section of the County, including the runoff from I-275.

It occurs to me that as a tributary to Tampa Bay, the Hillsborough River, which is fed by Sulphur Springs, would qualify this program as one to be considered as a stormwater retrofit project. I am sure such a designation would accelerate the cleanup of this very important water source.

My understanding of the status of the project at present is as follows:

- The EPC has been working with the City of Tampa to find a solution. Sulphur Springs, of course, is a source of drinking water for the City. The City has a study underway.

- DER is working with the EPC for an engineering study.

- The Hillsborough River Basin Board has budgeted $15,000 toward a cleanup.

- The DOT is looking to the EPC and the City for expertise.

REPLY TO:
☒ 300 Hyde Park Avenue, Tampa, Florida 33606-2234 (813) 272-6614
☐ 312 Senate Office Building, Tallahassee, Florida 32399-1100 (904) 487-5075

I do hope that the cleanup of this source of water to Tampa Bay is being considered as a preferred stormwater retrofit project. The problem has developed over a long period and I have no doubt in my mind that you can make a difference under the SWIM Program.

I await your reply.

Sincerely,

Pat Frank

PAT FRANK

PF/tlp

cc: Commissioner Jan Platt
Mayor Sandy Freedman
Ms. Frederica Russell, the Action League
Mr. Roger Stewart, EPC
Mr. Jim Kennedy, DOT
Dr. Richard Garrity, DER
Members, Hillsborough River Interlocal Planning Board

Sulphur Springs Action League, Inc.
"The Springs......let's make it sparkle"

320 W. WATERS AVE.
TAMPA, FL. 33604

(813) 935-3115

September 9, 1988

Mr. Ronnie Mason, Councilman
City Council, District 7
315 E. Kennedy Boulevard
Tampa, FL 33602

Re: Sulphur Springs Pool
Task Force

Dear Councilman Mason:

We want to thank you for your efforts in getting the resolution through City Council recently. To follow up on that effort we wanted to approach you to make a motion that a Task Force comprised of City Personnel be organized to direct resources to effect the opening of the pool again.

Attached is a list of City Personnel that should probably be included on the Task Force. We will contact you shortly to set up a meeting to discuss this.

Your valuable assistance is appreciated.

Sincerely,

SULPHUR SPRINGS ACTION LEAGUE

Rob Wallace

Robert E. Wallace III, P.E.

REW/nd

Enclosure

cc: Frederica Russell

SULPHUR SPRINGS POOL TASK FORCE

Parks and Recreation

Sanitation/Solid Waste

Stormwater

Environmental Coordination

Water Department

Wastewater Department

Attorney's Office

Mayor's Office

Council Member

Sulphur Springs Action League Observer - Rob Wallace

BOARD OF COUNTY COMMISSIONERS

HILLSBOROUGH COUNTY, FLORIDA

P.O. Box 1110
Tampa, Florida 33601
(813) 272-5660

Larry I. Brown, County Administrator

September 26, 1989

Linda Hope, President
SULPHUR SPRINGS ACTION LEAGUE
320 W. Waters Avenue
Tampa, FL 33604

Dear Linda,

Thank you for writing me on behalf of the Sulphur Springs Action League concerning the possible need to request Pollution Recovery Funds for the retrofit project at Sulphur Springs Pool.

Thank you for continuing to keep me informed. I will keep your letter in mind if this issue comes before the EPC.

Best wishes,

Pam Iorio
Pam Iorio
County Commissioner

PDI/vg

THE FLORIDA SENATE

Tallahassee, Florida 32399-1100

SENATOR HELEN GORDON DAVIS
23rd District

COMMITTEES:
Economic, Professional & Utility Regulation,
Vice Chairman
Appropriations, Sub. C
Community Affairs
Health and Rehabilitative Services
Higher Education
Judiciary-Civil
SELECT COMMITTEE:
Seaports

September 29, 1989

Sulphur Springs Action League
Linda Hope, President
320 W. Waters Ave.
Tampa, Fl. 33604

Dear Ms. ~~Hope~~: Linda

I have contacted Secretary Twachtmann's office regarding your request for information and assistance in re-opening the Sulphur Springs pool. Their office will respond within two weeks.

You have my support in your efforts and I am pleased you have enlisted city, county, and state officials in your effort.

Please keep me informed as to your progress and if there is anything else I can do to help you in your efforts.

Sincerely,

Helen

Helen Gordon Davis
Senator - ~~Davis~~ District 23

HGD/ch

If they do not call, please let me know.

REPLY TO:
☐ 178 East Davis Boulevard, Tampa, Florida 33606 (813) 272-6720
☐ 312 Senate Office Building, Tallahassee, Florida 32399-1100 (904) 487-5075

BOB CRAWFORD
President

ARNETT E. GIRARDEAU
President Pro Tempore

Florida Department of Environmental Regulation

Southwest District • 4520 Oak Fair Boulevard • Tampa, Florida 33610-7347 • 813-623-5561

Bob Martinez, Governor | Dale Twachtmann, Secretary | John Shearer, Assistant Secretary
Dr. Richard Garrity, Deputy Assistant Secretary

October 26, 1989

Dr. Donald Kwalick, Director
Hillsborough County Public Health Unit
Post Office Box 5135
Tampa, Florida 33673-5135

Dear Dr. Kwalick:

I recently received a copy of a letter sent to you September 21, 1989 by the Sulphur Springs Action League in which they recommended working with you to develop a management plan to allow restricted swimming at the Sulphur Springs Pool. I am offering you assistance from my staff if you wish to take advantage of their experience with ground and surface water quality.

I hope we can be of assistance to you.

Very truly yours,

Richard D. Garrity

Richard D. Garrity, Ph.D.
Deputy Assistant Secretary

RDG/klj

cc: Eric Livingston, DER Tallahassee
Sulphur Springs Action League:
Frederica Russell
Linda Hope, President

HRS STATE OF FLORIDA
DEPARTMENT OF HEALTH AND REHABILITATIVE SERVICES

October 16, 1989

Ms. Linda Hope,
President
SULPHUR SPRINGS ACTION LEAGUE
320 W. Waters Avenue
Tampa, Florida 33604

Dear Ms. Hope:

Thank's for your letter of September 21st, 1989 regarding the Sulphur Springs Pool.

About three years ago my staff and I met with officials from the city and explained our reasons for closing the pool for swimming purposes. These included the failure to pass a sanitary survey based on storm water run off, unpredictable high coliform counts, extreme turbidity of the water.

I'm unaware of any circumstances which have occurred that might change the situation in any way. If you are aware of some positive steps that have been taken to improve conditions please inform me, I'm sorry we can't be more optimistic but I'd be interested in any "management plan" or "investigative" ideas that you might have which would be consistent with public health standards and protection.

Best regards,

Donald Kwalick, M.D., M.P.H.
Director
Hillsborough County Health Dept.

DK:fr

Sulphur Springs Action League
"The Springs - let's make it sparkle"
320 W. Waters Ave., Tampa, FL 33604
Phone: (813) 935-3115

AGENDA

2/13/90

Dr. Donald Kwalick, Director Hillsborough County Health Department Meeting Sulphur Springs Action League

Re: Recreational Use Of Sulphur Springs Pool

1. Status of pool closure and history.
2. Background of dye trace studies.
3. Hillsborough River Basin Board Study Dye Trace and Water Quality Study.
4. Predictability of bacteria levels.
5. Management Plan proposal allowing intermittent use of pool for swimming.