Celery Fields Stormwater Reuse Feasibility Study

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CELERY FIELDS STORMWATER REUSE FEASIBILITY STUDY

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Executive Summary

The Celery Fields Regional Stormwater Facility provides an opportunity to reclaim stormwater for supplementing Sarasota County's regional reuse system. This report overviews the feasibility of stormwater reuse and identifies alternatives for storage. It concludes that stormwater reuse is feasible—subject to additional study.

Depending on rainfall, approximately 2,000 ac-ft (650 million gallons) per year of water may be available for diversion from the proposed Celery Fields Regional Stormwater Facility to storage.

A concept project using lakes on Schroeder Manatee Ranch (SMR) property was determined to be the best alternative for storage and for transferring supplemental water into a regional distribution system. These lakes are reclaimed shell pits located near the City of Sarasota's reuse transmission main serving Hi-Hat Ranch. Interconnecting this pipeline to the County's reuse system is consistent with the County's reuse master plan. The concept project described in the report proposes a stormwater pumping station at the Celery Fields, a pipeline to SMR's lakes, a reuse pumping station discharging into the City's transmission main, and interconnecting the transmission main with a reuse pipeline to the County's Bee Ridge WWTP service area.

This project appears to be technically and environmentally feasible and will benefit the County's efforts to conserve water. Further study is needed to analyze the impacts of stormwater pumping on SMR's lakes and to resolve permitting issues.

We recommend:

- Additional stormwater sampling.
- Further discussions with Schroeder Manatee Ranch on use of their Phase I and Phase II lakes for storage.
- Planning for an interconnecting pipeline between Sarasota County's reuse distribution system and the City of Sarasota's reuse transmission main.
- Preparing a water-balance to confirm storage requirements and to refine the sizing criteria for the stormwater and reuse pumping stations.
- Evaluation of impacts of stormwater pumping on Schroeder Manatee's lakes.
- Further discussions with SWFWMD on permitting the concept project.
- Preparing a complete cost-benefit analysis.

Introduction

Background and Goals for the Project

The project consists of the development of a regional stormwater management facility on approximately 266 acres adjacent to the Main C canal of Phillippi Creek, south of Fruitville Road and east of I-75. The project is to be developed as a multiple use facility consisting of stormwater storage for flood control, stormwater treatment for pollution control and *supplemental reuse*, constructed wetlands for stormwater treatment, wildlife habitat and mitigation banking, and public access recreational facilities. The project is designated as the *Celery Fields Regional Stormwater Facility* in reference to the historical use of the site.

As a stormwater management facility, the goal established for the project is to provide capacity to temporarily impound 1,000 ac-ft of water for controlled release into Phillippi Creek. This report addresses one of the subordinate goals of the multiple use project which is to evaluate the feasibility of using surplus stormwater diverted from the Celery Fields facility to supplement Sarasota County's planned regional distribution system for the reuse of reclaimed wastewater. The availability of supplemental water conceivably supports a larger reuse customer base during peak irrigation periods. A larger customer base provides more opportunities for effluent disposal during wet periods when demand for reclaimed wastewater is low. The Sarasota County Utilities Department has indicated that they could immediately use up to 2.0 mgd of supplemental reuse water to meet the current peak demand of existing reuse customers.

Storage of Reclaimed Water for Urban Irrigation

A universal problem relating to the use of reclaimed water for urban irrigation is storage during wet weather when there is reduced demand for irrigation water. Wastewater reuse projects generally are unable to recover more than 70% of the flow due to the need to discharge during wet weather. This concern is reflected in the 1994 Florida APRICOT Act, new legislation which allows for back-up discharges to surface waters not exceeding 30 % of the permitted capacity of a wastewater treatment plant during periods of reduced demand for reuse. Studies done in Manatee County have demonstrated that 100% utilization of treated wastewater for reuse, based on local average demand and customer peaking factors, requires a storage volume 28 times the average daily flow of treatment plant effluent (1). Conceivably, a larger reuse customer base supported by supplemental water supplies could reduce the storage needed for wastewater effluent during wet weather, when demand for irrigation is low. Selling reuse water to a larger customer base is easier if the utility can supply customers from a reservoir during periods of peak demand. The peaking factor for reuse in Sarasota County is about 1.6 times the average monthly consumption during the peak irrigation season (2).

Recovery and storage of surplus stormwater improves water conservation efforts, directly by providing an alternative source for irrigation, and indirectly by increasing utilization of reclaimed wastewater. One of the goals of wastewater reuse, besides water conservation, is the elimination of direct discharge of effluent into sensitive waterways. Supplemental reuse water that can help meet the peak demands of reuse customers increases the marketability of reclaimed water and

Water Quality

Stormwater Quality

Water entering the Celery Fields Stormwater Management Facility drains from a 3,800-acre watershed of agricultural land and older developments that lack stormwater controls. Stormwater quality is highly variable and not easily generalized by reference to published studies. Although only a limited amount of data exists for the stormwater from the project area, data from three sources have been obtained. The sources are: (1) Sarasota County Natural Resource Department; (2) USGS; and (3) field sampling performed on January 30, 1995 and February 2, 1995 authorized as part of this study. The following discussion summarizes the information on stormwater quality obtained for this study.

Sarasota County Natural Resources Department:

The Natural Resources Department collected data in the Phillippi Creek watershed from 1985 until 1990. One of their sample locations (No. 630) was from Main C canal at Palmer Blvd., within the project boundary. The data collected included: total coliform, fecal coliform, fecal streptococcus, temperature, dissolved oxygen, conductivity, salinity, pH, turbidity, color, total nitrogen and total phosphorus. These data are summarized in the following **Table No. 1**.

Table No. 1—Stormwater Quality Data (1985 -1990), Station 630, Palmer Blvd.

Year	1990	1989	1988	1987	1986	1985
Total Coliform (1)	2,519	1,915	2,114	1,624 (10)	1,804	717 (8)
Fecal Coliform (1)	177	234	343	208 (10)	200	301
Fecal Strep (1)	551	428	398	346 (10)	342	2,084
Coli / Strep ratio (2)	0.46	0.81	0.02	0.79 (10)	NA	NA
Temp °C (3)	24.1	24.2	21.3	23.9 (10)	22.3	23.0
DO mg/L (3)	4.6	4.6	6.1	5.2	5.6	4.4
Salinity umohs/cm (3)	923	1,044	852	769 (10)	939	1,143
pH (3)	7.68	7.61	7.62 (8)	7.54 (10)	7.52	7.5
Turbidity NTU (3)	4.0	5.4	4.0	3.8 (10)	2.0	2.9
Color Pt-Co (3)	83	82	81	92 (10)	72	65
Salinity PPTH (3)	0.2	0.6	0.2	0.2 (10)	NA	NA
Total N mg/L (4)	1.63 (5)	2.28	1.84 (6)	1.86	1.08	2.0
Total P mg/L (4)	0.46 (5)	0.63 (3)	0.28 (6)	0.35	0.270	1.0

Source: Sarasota County Natural Resources Department, 1/11/95.
(1) Geometric mean of 9 samples (except as noted) in maximum # of colonies / 100 ml

(2) Ratios of 1:1 or less indicates pollution by animals (agricultural runoff); ratio 4:1, or greater indicates human pollution.
(3) Arithmetic mean of 9 samples except as noted.
(4) Arithmetic mean of 4 samples except as noted.

USGS Data:

At this time, only two water quality samples of Phillippi Creek's stormwater are available from USGS. One sample is from the gauging station at Bahia Vista, and the other one is from a gauge near Riverview High School, both locations downstream from the proposed project. At Bahia Vista, total organic nitrogen and ammonia (NH_3) nitrogen were measured at 1.3 mg/L; combined nitrate (NO_3) and nitrite (NO_2) nitrogen were 0.96 mg/L; and total phosphorous was 0.35 mg/L. At the Riverview gauge these values were, 1.0 mg/L total nitrogen,; 0.5 mg/L nitrate-nitrite; and 0.36 mg/L phosphorous.

USGS has plans to do more sampling at low water conditions in May 1995, and at high water conditions in September 1995. They plan to have 10 sample points in the Celery Fields and 10 sample points in Phillippi Creek. They will be sampling for TDS, TSS, ions, nutrients, and metals. They do not plan to sample for organic chemicals, pesticides or herbicides (3).

Main C Canal Sampling Program:

To supplement the limited water quality data available from USGS and the County Natural Resources Department, it was decided to perform limited sampling as part of this study. The Stormwater Environmental Utility of Sarasota County's Transportation Department, authorized a water quality study to be performed by Professional Service Industries, Inc. (PSI).

Two water samples and one sediment sample were taken, and the report prepared by PSI is included in the Appendix. Water samples were collected from Phillippi Creek Main C canal at a point that is approximately 100 feet north of the Fruitville Road weir. The first water sample, collected on January 30, 1995, was intended to be representative of the first flush of runoff and was taken at 3:30 p.m. on a day that it had been raining since about 8:00 a.m. The second water sample was collected 3 days later on February 2, 1995 at the same location. A sediment sample was collected 5 feet north of the bridge on Palmer Blvd. near the center of the canal on January 1, 1995. Water was flowing in the canal on both days that samples were taken.

The analysis performed included pesticides, nutrients, metals, and water quality indicators.

The quality of the water sampled appears to be quite good. A generalization of the data would be that the water in Main C canal contains about one-half of the pollutant concentration of AWT effluent. The samples were reported to be super-saturated in dissolved oxygen (18.6 mg/L and 17.7 mg/L) and relatively low in turbidity (9.6 NTU both days).

Sediment Sample:

The data for the sediment sample shows high levels for aluminum (1,209 mg/kg) and iron (1,320 mg/kg). Other metals such as copper (10.0 mg/kg), lead (5.47 mg/kg), zinc (20.8 mg/kg), and

nickel (2.73 mg/kg) are present at significant levels but typical for stormwater pond sediment. The total phosphorous retained in the sample was high (3,386 mg/kg); however, because precipitation of phosphorous in the bottom layers of the proposed basins and wetlands will be the primary mechanism for removal of this nutrient, this may be considered a positive indication that phosphorous will actually be retained within the Celery Fields project.

An interpretation of the results of the sediment sample follows:

- Natural muck soils are acidic. Lime is used in agriculture to adjust the pH of the soil. The analytical results indicate that the soil is alkaline (pH 8.0). The alkalinity and high hardness of the soil is the direct result of lime application. Muck is an excellent soil matrix for retention of metal ions and phosphorous.

- The high level of total phosphorous in the sediment sample is due to the use of fertilizers.

- It is significant that pesticides and polychlorobiphenyls (PCBs) were not detected.

- The concentration of total recoverable petroleum hydrocarbons (TRPH) is high due to runoff from roadways in the general vicinity. High levels of TRPH could limit the disposal options for the sediments removed from the project.

- The elevated concentrations of aluminum (1,209 mg/kg), iron (1,320 mg/kg) and zinc (20.8 mg/kg) are the result of fertilizer use. Each of these compounds are micro-elements in fertilizer.

- The concentration of lead (5.47 mg/kg) is a concern. The sediments could be classified as a hazardous waste if the concentration of lead is greater than 5.0 ppm *using the EPA's toxicity leaching test method.* It is recommended that the soils in the project area be sampled for lead and other toxic compounds that could complicate disposal of excavated material.

Reuse Water Quality Criteria

The quality established by the FDEP for reclaimed wastewater used for irrigation on lands with unrestricted access is based on effluent from wastewater treatment plants. Reclaimed wastewater for irrigation can be classified as secondary effluent followed by high level disinfection. To meet the requirements for high level disinfection, treated wastewater is filtered to reduce suspended solids to below 5.0 mg/L prior to chlorination. Low suspended solids is important in achieving destruction of microorganisms. Significantly, reclaimed wastewater supplied to a reuse system is not required to meet the high standards for nutrient removal applied to effluent that is discharged to surface waters. High quality effluent approved for discharge is referred to as AWT (advanced waste treatment) effluent. AWT effluent has the characteristic effluent quality set defined as 5.0 mg/L BOD, 5.0 mg/L TSS, 3.0 mg/L total nitrogen, and 1.0 mg/L total phosphorous. (Reclaimed stormwater meeting or exceeding the standard for AWT effluent could be blended with reclaimed wastewater without causing problems.)

The standard for reuse water quality can be summarized as follows:

Reclaimed water will not exceed 5.0 mg/L of TSS prior to disinfection. High-level disinfection, defined as at least 1.0 mg/L of total chlorine residual, shall be maintained after a 15-minute contact time at maximum daily flow. To document that satisfactory disinfection is occurring, the facility operator is required to collect daily fecal coliform samples. Over a 30-day period, 75% of the total fecal coliform samples must be negative with no single sample exceeding 25 MPN / 100 ml (4).

The regulatory requirement relevant to *stormwater* reuse is high level disinfection. The standard for high level disinfection is met by achieving a TSS of less than 5.0 mg/L, by providing a minimum chlorine contact time of 15 minutes at a minimum chlorine residual of 1.0 mg/L, and by demonstrating no detectable coliform bacteria. At this time, the FDEP has not finalized new regulations (proposed Rule 62-610.470 FAC) on supplemental reuse. The proposed regulations are relevant to this project because the standard for high level disinfection may be relaxed for supplemental reuse water, such as reclaimed stormwater. *The most important difference is that supplemental water may not be required to have a TSS below 5.0 mg/L to meet the standard for high level disinfection* (5)(6). This is important because a TSS limit of 5.0 mg/L is difficult to maintain in an open storage reservoir due to the growth of algae.

Stormwater Treatment

Comparing the water quality requirements for reuse with the data available for stormwater quality, it appears that the stormwater retained in the Celery Fields project will be treatable by extended detention to a water quality standard comparable with AWT effluent. The water withdrawn from storage will require disinfection with chlorine at a minimum concentration of 1.0 mg/L of free chlorine for a minimum detention time of 15 minutes prior to blending with reclaimed wastewater in a reuse system. A specialized filter, such as a NETAFIM disc filter that can remove particles down to 75 microns, will be needed at the reuse pumping station to remove algae and suspended solids that could foul irrigation equipment.

The highest quality water for reuse would be obtained from an intermediate stage of the Celery Fields treatment system, not from the wetland mitigation bank. Settled water may be higher in dissolved nutrients but will probably be lower in suspended solids. The benefit of the wetlands portion of the project is the reduction in nutrients due to uptake by the wetland plantings. Under the right conditions, up to 50% of the dissolved nutrients (nitrogen and phosphorous) may be removed in the wetland mitigation bank. This prediction is based on a SWFWMD study of 18 wetland stormwater treatment systems where median removals were reported as 44.5 % for NH_3-N and 58 % for total phosphorous. However, substantially higher and lower performance than median levels was also reported (7). Nutrient removal in constructed wetlands requires intensive maintenance; otherwise, the nutrients taken up by the biomass will be recycled back into the water. Dissolved nutrients are not a problem for reclaimed water that is applied directly for irrigation. This is reflected in the FDEP water quality standards for effluent reuse which require secondary treatment without nutrient removal. (Ecologically, application of nutrient-rich stormwater on upland irrigation sites is a way of recycling nutrients that had previously infiltrated.) However, nutrients dissolved in stormwater could cause water quality problems in off-site storage reservoirs. If the stormwater is pumped to off-site storage, then the potential impacts of nutrients contained in the stormwater on the reservoir site will have to be addressed.

Studies done by SWFWMD comparing the pretreatment and wetlands portions of stormwater treatment systems have shown the potential for reduced dissolved oxygen and increases in suspended solids and heavy metals for the wetlands portion of the treatment process (8). The higher temperatures and anaerobic characteristics of wetlands account for the reduced oxygen levels although these same characteristics may help in the removal of nutrients such as phosphorous and nitrates. Increased organic matter decay and anaerobic conditions tend to lower pH which increases metal solubility as does higher water temperature. Elevated levels of cadmium and zinc were found in water discharged from wetlands treatment systems studied by SWFWMD, although this effect could also be caused by re-suspension of metal-bearing sediments (9)(10)(11)(12)(13). Results of the SWFWMD studies suggest that the best quality water *for direct reuse by irrigation* would be from an intermediate basin rather than the wetland mitigation bank outfall. Although it may be higher in dissolved nutrients, water from an intermediate location is expected to be generally higher in dissolved oxygen and lower in suspended solids than the water discharged from the final wetlands treatment stage.

Stormwater withdrawn from the Celery Fields project for off-site storage should be taken through a screened inlet located about 2 feet below the normal water surface (16.5 ft) of the Central basin. The inlet design would be similar to that used in a raw water reservoir for surface intake to a water treatment plant using stainless steel wedgewire screened inlets. Provision for connecting an air line should be provided to purge the screen of debris.

Stormwater Treatment Proposed for the Celery Fields Facility

Studies have shown that in Florida, 90% of annual storm events produce 1 inch of rain or less, and 70% of the total volume of stormwater is the result of rainfall events of less than 1-inch precipitation. The first 1/2 inch of runoff carries 80 to 95% of stormwater pollution (14). These facts illustrate the pollution control benefit of treatment for minor storm events.

The treatment available in the Celery Field facility will consist of sedimentation, aeration, and nutrient removal within a three-stage system. The primary method of treatment will be sedimentation resulting from extended detention. The stormwater management system is sized such that for a minor 1-inch event, there is no significant *accumulated* storage within the facility. Therefore, under this condition, the hydraulic detention time is approximately the volume of the basins divided by the predicted flow. In general terms, 90% of the stormwater entering the facility on an annual average will receive treatment by extended-detention, and most of the time the primary function of the facility will be pollution control. During major storms, the primary function of the facility will be flood control as water is accumulated and normal pool elevations of the basins are allowed to overflow into the emergency storage zones designed into the system. Under this condition, stormwater will not receive complete treatment and will not be diverted to storage. Diversion to storage is not anticipated as a component of the project's capacity for flood control. A stormwater pumping station sized to divert stormwater to storage during smaller events, when treatment by sedimentation is possible, will not be large enough to contribute to flood control during major events. During major storms, diversion to off-site storage could cause flooding of the reservoirs and water quality problems from insufficient treatment.

Sedimentation Pond:

The first stage of treatment will be sedimentation in a 55 acre basin that is designed for a water elevation of 16.5 NGVD with variation of up to + 0.5 foot in a major event. Relative to the other basins, this basin is maintained at a relatively constant volume. During a 100-year storm, the area of this basin increases to approximately 60 acres. The normal volume of the sedimentation basin is about 400 ac-ft.

Central Pond:

The central basin has an area of about 40 acres and is shallower than the sedimentation basin. This basin is designed to provide additional sedimentation and aeration during smaller storm events. In a major storm, the flood zone of this basin will increase the surface area to approximately 90 acres.

Wetland Mitigation Bank:

The wetland mitigation bank is designed for extensive flooding during a major storm. The treatment expected from the wetlands area is the removal of dissolved nutrients through biological accumulation, provided the facility is maintained such that the nutrients retained in the biomass are not recycled back into the water. The wetland area is normally about 35 acres of open water. During a major storm this will increase to approximately 110 acres of open water.

Summary of Stormwater Treatment

The water quality modeling performed as part of the preliminary engineering for the Celery Fields Regional Stormwater Facility assumed removal efficiencies for stormwater pollutants shown in **Table No. 2**. The percentages for nutrient removal are based on the Nationwide Urban Runoff Program (NURP) data collected by the EPA. These percentages do not account for the higher values of nutrient removal that might be possible with additional treatment in constructed wetlands.

Table No. 2—Percent Removal Associated with Extended Detention

Pollutant	Percent Removal
BOD	30 %
COD	30 %
TSS	90 %
TDS	- 0 -
Total Phosphorous	30 %
Dissolved Phosphorous	- 0 -
TKN	30 %
Nitrate and Nitrite (NO_3 & NO_2)	20 %
Lead	80 %
Copper	60 %
Zinc	50 %
Cadmium	80 %

Source: Watershed Management Model (WMM), CDM, 1992 and Nationwide Urban Runoff Program (NURP), EPA, 1983. (Values shown are the median removals for the NURP data for treatment by extended detention.)

The proposed withdrawal point for the stormwater pumping station is from the inlet zone of the Central basin; therefore, water removed from this location will have been detained for a shorter time than water that has passed through the entire facility. Assuming no short-circuiting, the detention time for a 1-inch storm event (88 ac-ft) will be 4 to 5 days in the 400 ac-ft sedimentation basin; this will provide sufficient detention to meet the extended-detention criteria

for 1 inch or less storms which will account for 90% of the volume of water passing through the facility.

Depending on the pollutant, it is expected that a 30% to 90% reduction will be achieved during the 1-inch or less storm events where treatment by hydraulic detention and sedimentation will be achieved. The major improvement will be the reduction of suspended solids. As the Celery Fields project treats approximately 10% of the Phillippi Creek watershed, the Celery Fields project will reduce non-point source stormwater pollution that enters Sarasota Bay from Phillippi Creek by approximately 9%.

Stormwater Available for Reuse

Ninety percent of the average annual rainfall of 60 inches occurs in a four-month period in Southwest Florida. This average annual rainfall produces approximately 5,400 ac-ft of runoff in the Main C canal which will flow into the Celery Fields site. The historic base flow of approximately 3,400 ac-ft per year (3.0 mgd) must be allowed to pass on through the Celery Fields project to the lower Main C canal to address environmental concerns. With adequate pumping capacity, storage, and minimal losses, approximately 2,000 ac-ft (650 million gallons) appears to be available for supplemental reuse on an annual average. Further analysis is needed to evaluate the potential volume for surplus stormwater because a portion of the surplus volume is likely to come during major storms when diversion for reuse is not practical.

The amount of stormwater that could be made available for reuse is referred to as surplus stormwater. It is anticipated that the historical base flow in the Main C canal will be maintained. Boyle prepared hydrologic calculations using the EPA's modified Stormwater Management Model (SWMM 4.05) for the project. This analysis is developed in the Celery Fields preliminary engineering report prepared by Boyle. The historic base flow (using the SWMM 2-year trend and historic dry period) averages 3.0 mgd. The SWMM model predicts that the amount of surplus stormwater available for supplemental reuse, after deducting the base flow, will normally be approximately 2,000 ac-ft / year, which is equivalent to a 1.8 mgd annual average daily flow. On average, this volume compares well with the amount of water that the County could effectively utilize.

Conceptual Sizing of the Stormwater Diversion

The diversion of too much fresh water from the Phillippi Creek watershed could have negative downstream ecological impacts. Additionally, there are practical limitations to the amount of stormwater that can be economically collected and diverted. Unlike treated wastewater, which is generated continuously, the availability of stormwater is extremely variable. Obviously, it is uneconomical to size a stormwater diversion pump station to capture the volume of a 25-year storm, when statistically it will only be used at full capacity once every 25 years. This study proposes to size the stormwater diversion for the reuse project by considering the approximate availability of storage, the pumping time for the mean annual storm event, and the capacity for utilization within a regional reuse system.

Assuming off-site storage, the recommended sizing for the stormwater pumping station (the pumps that would be used to transfer the stormwater to storage) is 8,000 gpm (11.5 mgd) using four pumps, each rated for 2,000 gpm. This capacity could transfer a volume of water equal to the mean annual storm of 396 ac-ft (129,000,000 gallons) with 11 days of pumping from the Celery fields project to the storage reservoir.

Demand for Supplemental Reuse

Through an interconnection to a regional reuse system, stormwater recovered from surface reservoirs could help balance the peak demand for Sarasota County's reclaimed wastewater. Potential customers for reclaimed water exist throughout the County and include major agricultural users such as Albritton Groves and Hi-Hat Ranch. If the County could reliably supply these users with reclaimed water, it is conceivable that the County could petition SWFWMD for transfer of withdrawal permits for underground water to the Carlton Reserve for use in meeting the County's potable water demands. The capacity to meet customer's peak demand increases the marketability and commercial value of reclaimed water. Furthermore, unless the County can supply their peak demand, it cannot ask irrigators to decommission their wells. As long as users of reclaimed water must maintain an alternate source of supply, the value of the reuse system is diminished both economically and environmentally.

Supplemental reuse water could be used immediately in the Bee Ridge WWTP service area. The County has commitments for reclaimed wastewater that cannot be met under existing conditions. As shown in the following **Table No. 3**, commitments to reuse customers exceed the supply on average. Using a 1.6 peaking factor, the maximum demand exceeds the Bee Ridge WWTP's *design* average daily flow by 1.3 mgd (2). The actual flow into the Bent Tree WWTP averages 0.54 mgd and this is the flow that will be initially diverted into the new Bee Ridge WWTP in October 1995 when this facility is completed. Using this figure, the deficit during peak demand is 2.29 mgd (15).

Table No. 3—Reuse Customers Bee Ridge WWTP

Reuse Customer	Commitment	ADF Bee Ridge WWTP
Gator Creek	0.19 mgd	
Misty	0.36 mgd	
Bent Tree	0.27 mgd	
Laurel Oaks	0.75 mgd	
Sarasota Golf Club	0.20 mgd	
Total	**1.77 mgd (peak 2.83 mgd)**	**1.50 mgd design (currently 0.54 mgd)**

Alternatives for Storage

Because the primary objective of the Celery Fields project is flood control, the wet weather storage of surplus stormwater within the project conflicts with the intended purpose of the project. The Celery Fields basins will be maintained at the minimum possible level during wet weather in anticipation of the need to attenuate storm flow. Therefore, all feasible wet weather storage alternatives assume off-site storage. The four alternatives considered for the Celery Fields project are: (1) reservoirs constructed on adjacent property; (2) existing APAC pits; (3) existing Quality Aggregates pits; and (4) underground storage in a confined aquifer.

Adjacent Property Acquisition

One alternative for providing storage would be to acquire additional property on which to construct reclaimed stormwater reservoirs. This concept could include control structures so that surplus water could be diverted into side-stream reservoirs without pumping. Five parcels have been identified as available sites for construction of reservoirs, as shown in **Exhibit No. 1.** The following **Table No. 4** summarizes the potential storage and approximate cost associated with each available parcel.

Table No. 4—Comparison of Available Property Acquisitions for Storage

Parcel No.	1	2	3	4	5
Area	19.4 ac	19.4 ac	33.8 ac	28.4 ac	24 ac
Existing Elevation	18.75 ft	19.5 ft	22.5 ft	20.0 ft	22.0 ft
Volume at Elevation 21.0	80 ac-ft	80 ac-ft	150 ac-ft	125 ac-ft	100 ac-ft
Acquisition Cost (1)	$349,200	$349,200	$608,000	$511,000	$432,000
Excavation Required	70,400 cy	94,000 cy	327,000 cy	160,000 cy	213,000 cy
Cost of Excavation (2)	$140,800	$188,000	$654,000	$320,000	$426,000
Approximate Total Cost	$490,000	$537,200	$1,262,400	$831,000	$858,000
Approximate Cost of Storage Capacity **(3)**	$6,125/ac-ft	$6,715/ac-ft	$8,416/ac-ft	$6,648/ac-ft	$8,580/ac-ft

(1) Assumes $18,000 / acre
(2) Assumes $2.00 / cy
(3) Average cost of storage is approximately $7,500 / ac-ft

Constructing reservoirs is an expensive approach to providing storage for supplemental reuse water. This has been a major problem in wastewater management where the need to store excess water is more compelling because, unlike stormwater, treated wastewater cannot always be discharged. Less expensive storage could be obtained by using reservoirs that have already been constructed where the cost of excavation was balanced by the economic value of the removed material. Examples are shell pits (quarries). Two quarries are in close proximity to the proposed project; these are identified as the APAC Pits, about 2-miles north on the west side of I-75, and

the Quality Aggregate Pits located east of I-75 on property owned by Schroeder Manatee Ranch, Inc. (SMR).

APAC Pits

The APAC shell pits, located just east of I-75 and north of Fruitville road present an attractive alternative for storage. The larger south lake has an area of approximately 300 acres and is 30 feet deep. APAC stopped pumping water from this excavation two years ago, and the water level in the basin is now about 8 feet deep. It is estimated that it may take 5 years to fill the South Lake. There is a legal problem with the use of APAC pits for storage. As the result of a lawsuit by SMR, alleging that the diversion of Cooper Creek around the pits caused flooding on SMR's property, APAC has agreed to allow Cooper Creek to flow naturally into the South Lake. It is planned for the South Lake to be maintained at a specific level (20 foot elevation) and designs are being prepared for the inflow and outflow structures.

North Lake is much smaller and is about 100 acres in area. Plans for North Lake include planting with littoral zones, using 4:1 side slopes to 2 feet below a design water surface of elevation 22 feet. North Lake is scheduled to be sold to developers and would not be available for stormwater storage. North Lake is not considered a candidate for storage.

After planned improvements, South Lake will be considered jurisdictional waters of the State and will provide attenuation of storm flows from the Cooper Creek water shed draining Long Swamp on SMR property. Cooper Creek flows into the Braden River and Evers Reservoir watershed. The implication is that diversion of surface water from the modified APAC pits could interfere with Bradenton's public water supply.

From discussions with Mr. David A. Donofrio, PE, President, APAC Florida, Inc., it appears that the APAC pits are not feasible sites for storage of reclaimed stormwater from the Celery Fields project. The North Lake is scheduled for real-estate development, and the South Lake will be hydraulically connected to the watershed providing Bradenton's public water supply. Both Lakes are planned for a constant level once improvements are completed (16)(17).

Quality Aggregates Pits

The shell pits are operated by Quality Aggregates, Inc. are located on property owned by Schroeder Manatee Ranch, Inc. (SMR). Representatives of Boyle have met with Mr. John Clarke, President and Mr. Rex Jensen, Vice President of SMR. The purpose of the meeting was to discuss the feasibility of using the shell pits owned by SMR for storage of surplus stormwater pumped from the proposed Celery Fields facility. It was explained that the reason for storing the surplus water will be to make supplemental water available to Sarasota County's planned regional reuse system.

Mr. Clarke and Mr. Jensen expressed interest in cooperating with the County and outlined the potential storage that could be available:

Phase I: This lake is 122 acres is size but has 14 acres of littoral shelves that would be inundated by a variable water surface. SMR would have to arrange a trade of the littoral zone with an area of the mitigation wetlands being constructed as part of the Celery fields project. It is observed that the environmental value of the Phase I lake as a place to store and conserve water is probably greater than its value as a site for man-made littoral shelves.

The practical range for water surface variability is between 2 and 3 feet if the littoral shelves can be eliminated; otherwise it is about 18 inches. Since SMR plans to develop property around the lakes, 3 feet would be the maximum variation that could be tolerated in any case.

Phase II: This phase includes another 63 acre lake that has a wetland area bordering its northwest side. Consideration will have to be given to maintenance of the hydroperiod of the wetland area which will limit the variability of the water level. The Phase II lake would probably be restricted to about 2 feet of variable water surface.

Phase III and Phase V: These projects total 258 additional acres of lakes that are still being developed and are scheduled for reclamation in 5 to 10 years.

As previously stated, SMR representatives expressed willingness to cooperate with Sarasota County in the development of a regional stormwater storage facility. They presented the following issues to be addressed in an agreement between the County and SMR:

- No reclaimed wastewater would be mixed with the stormwater.
- The amount withdrawn would not exceed the amount that was pumped from the Celery Fields. (This would also be a minimum condition for SWFWMD approval.)
- SMR would have access to the water for irrigation.
- The stormwater would be treated in the Celery Fields prior to pumping.
- The water quality of the lakes (turbidity, dissolved oxygen) would not be degraded when stormwater is pumped into them.
- The 14 acres of littoral zones built as a reclamation feature of the Phase I restoration would be removed and banked in the Celery Fields project as part of the 100 plus acres of constructed wetlands. (This is necessary to be able to significantly vary the water surface in this lake.)
- The stormwater transmission main leading to the SMR property from the Celery Fields would follow a ROW generally aligned with a northern extension of Coburn Road. Sufficient ROW would be acquired by the County so that future utilities and a future extension of Coburn Road would follow the same alignment. SMR has offered to participate on a fair share basis in the cost for the Coburn Road extension if it was constructed.

The SMR pits appear to have the immediate potential of providing approximately 400 ac-ft of storage in the Phase I and Phase II pits, assuming an area of 200 acres and a 2 foot variation in water surface (18). *(At this time it is not known what the actual impacts stormwater pumping, or withdrawal, will have on the lake water levels because the levels in the lakes are likely to be function of seasonal groundwater and hydrogeologic conditions not addressed in this study.)*

Because the storage will be needed during seasonal wet periods and the withdrawal will occur during seasonal dry periods, storage in the SMR lakes could accentuate the normal ranges in water levels. The effect of the storage and withdrawal cycles on the SMR lakes and the impact on water quality from pumping large volumes of stormwater into them will have to be studied in more detail.

Aquifer Storage and Recovery

Another method of storing large amounts of water without the high capital cost of reservoir construction is underground storage in a confined or semi-confined aquifer. Aquifer storage and recovery (ASR) has been used successfully in West-Central Florida to store surplus surface water during periods of high stream flow for future recovery during periods of low stream flow when diversions are restricted. Aquifer storage may be a cost-effective means for storing large quantities of reclaimed water during wet periods for withdrawal during dry periods. Underground storage also reduces algae growth, a major source of suspended solids that degrades the quality of water stored in surface reservoirs.

A complication to this approach is the attitude of FDEP and SWFWMD regarding the potential for pollution of potable ground water supplies. Presently, ASR is only practiced on the condition that the surplus surface water is *completely treated to drinking water quality prior to injection.* ASR is practiced effectively at the Lake Manatee Water Treatment Facility in Manatee County and at the Avon Park ASR project at the Peace River Regional Water Supply Facility on the Peace River in DeSoto County. At these locations, ASR is used to store surplus surface water in the form of *treated potable water* produced during periods of high stream flow. Potable water is recovered from aquifer storage during periods of low stream flow. An important feature of *existing* ASR projects, relevant to a discussion of stormwater storage, is that the water injected for aquifer storage and subsequent recovery is drinking water; and therefore, does not risk contamination of potential public water supplies.

Aquifer storage and recovery of surplus stormwater would require permits to inject non-potable water into an aquifer. At present, the only ASR projects approved in Florida inject potable water for future recovery. However, there are plans to study ASR with reclaimed wastewater in Manatee County. St. Petersburg is also investigating the possibility of recovering reclaimed effluent from aquifer storage. In these projects, treated effluent will be injected into and recovered from a non-potable saline aquifer. The concept is to create a fresh water bubble within the salty groundwater. A feature of the Manatee project is that the reclaimed wastewater will be stored at depths of 1,100 to 1,800 feet in a coastal saline aquifer (*Avon Park)* that has TDS concentrations up to 30,000 mg/L. Ground water in this zone is unsuitable for use as a public water supply; in fact, high levels of chlorides in the aquifer may contaminate the fresh water

bubble to the extent that the water withdrawn may not even be suitable for irrigation. Evaluation of this problem will be part of the Manatee County pilot study. Manatee County's project will take several years to complete and it is not likely that the FDEP will consider permitting an additional non-potable ASR project until the results of the Manatee County demonstration are known.

Obtaining a permit to use non-potable ASR implies injection into a poor quality aquifer that has the potential to increase the salinity of the stored water, which diminishes its usefulness. At present, an aquifer that could be permitted for ASR of non-potable water would have to meet requirements for aquifer protection similar to those required to permit deep well injection of wastewater effluent.

The aquifers underlying the Celery Fields site are in the transition zone of the Floridan Aquifer. This is a zone where Total Dissolved Solids range between 500 and 1,000 mg/L (19). Although ground water in this area does not generally meet drinking water standards without treatment, the water is still of a relatively high quality and could be used for potable water supplies with treatment by reverse osmosis or electrodialysis. This makes it unlikely that permits could be obtained for ASR without extensive testing.

Eventually, aquifer storage may prove to be the most economical technique for storing large amounts of reclaimed water for seasonal withdrawal. In the short term, aquifer storage is not a feasible alternative due to the extensive groundwater modeling and pilot studies that would be necessary to obtain permits for underground storage of anything other than potable water.

Discussion of Storage Alternatives

The four storage alternatives for reclaimed stormwater considered in this report are: (1) reservoirs constructed on adjacent property; (2) existing APAC pits; (3) existing Quality Aggregates pits; and (4) underground storage in a confined aquifer.

For the short-term, it appears that the most feasible alternative for storage is the SMR pits located approximately 2 miles north of the withdrawal point in the Celery Fields project. Compared to the average cost of developing new reservoir capacity of $7,500 ac-ft, the 400 acres of storage available on SMR property has an attractive equivalent value of $3.0 million. The APAC South Lake is being incorporated into the Cooper Creek drainage basin which will complicate plans for using it as a water reservoir. However, the improved APAC South Lake will attenuate discharges from Long Swamp, north of the SMR pits. Because of this, SMR does not see the need to use their pits for flood control, making them more available for an alternative use.

Reservoirs already constructed are the most economically feasible alternatives for storage because the cost of excavation has been absorbed by others in return for benefits unrelated to water storage. Because of recent developments regarding the diversion of Cooper Creek explained previously, the SMR pits are preferred over the APAC pits. Also, the SMR pits are closer to the project and on the east side of I-75, reducing the cost of a stormwater transmission pipeline. Finally, representatives of SMR have indicated a willingness to cooperate with the County to develop a stormwater storage and reuse project.

ASR may be the best long-term solution to storage of large quantities of reclaimed water. Presently FDEP has not allowed ASR storage of non-potable water. This situation may change in the future.

Conceptual Reuse Project

In order to assess the approximate cost of storage, a concept project is proposed that assumes storage in the SMR Phase I and Phase II lakes (Quality Aggregates pits).

Sizing of the reuse project is based on the assumption that a 400 ac-ft (130 million gallons) storage reservoir would in some way be available at the SMR property. This capacity assumes the availability of approximately 200 acres of surface water and tolerance for a 2-foot variation in water level. *For comparison of scale, a component of the City of Sarasota's reuse system is the 180 million-gallon reservoir located at the Hi-Hat Ranch which has an average daily demand of 3.5 mgd.*

Assuming that the annualized base flow in Phillippi Creek Main C will be maintained at 3,400 ac-ft/yr (3.0 mgd annual average flow), the surplus water available for supplemental reuse is predicted to average 2,000 ac-ft/yr (1.8 mgd annual average daily flow) depending on the yearly rainfall.

Stormwater pumping capacity will transfer the mean annual storm event (4.5-inch rainfall) with 11 days of pumping from the Celery Fields Regional Stormwater Facility to off-site storage. The mean annual storm is equivalent to 396 ac-ft (129,000,000 gallons) collected in the Celery Fields project, which will have a stormwater storage capacity of approximately 1,000 ac-ft for flood control. The stormwater pumping station will have four 100 hp pumps rated for 2,000 gpm each (11.5 mgd capacity). The pump station would be positioned in the project site as shown in **Exhibit No. 2** and would withdraw water from the Central treatment basin through a screened intake.

A 20-inch transmission main would be constructed to the SMR lakes as shown in **Exhibit No. 3**

At the SMR location, a reuse pumping station sized for 2.0 mgd would be constructed. With 130 million gallons of storage, this is equal to a 65-day supply at the maximum withdrawal rate. The reuse pumping station will include a chlorine contact chamber sized for 15 minute detention at a flow of 2.0 mgd, and will include 75-micron filters to remove particles that could cause fouling of micro-irrigation equipment. The reuse pumping station could discharge directly into the City of Sarasota's existing 36-inch reuse pipeline located just south of the SMR pits adjacent to the powerline. This will require sufficient head to overcome the residual pressure in the reuse pipeline and consideration for backflow prevention to reduce the possibility of reclaimed water entering SMR's lakes. This reuse transmission main serves the Hi-Hat Ranch. The interconnection with the City of Sarasota is consistent with the County's reuse master plan (20). The County's reuse master plan suggests connecting a 20-inch north-south reuse pipeline, aligned with DeBrecken Road, into the City's transmission main. With this interconnection in place, the water stored at the SMR reservoirs can be transported south to the Bee Ridge WWTP reuse service area and other locations within the County.

Project Budget

Excluding the cost of land and the costs associated with the development of the SMR sites, the stormwater storage project described in the preceding paragraphs would cost approximately $1.750 million to construct. A charge of $0.23 / 1,000 gallons would amortize the $1.750 million capital cost of the proposed project, assuming average sales of 1.8 mgd, a 20-year analysis period, and a 6% discount rate. Power costs for pumping the surplus stormwater to storage at the SMR site would be about $0.03 / 1,000 gallons, bringing the total cost of stored water to about $0.26 / 1,000 gallons. For comparison, a 400 ac-ft side-stream reservoir, that would not require a stormwater pumping station or transmission main, would cost about $3.5 million to construct, including the reuse pumping station.

The dollar amounts shown in the a budget-level cost breakdown presented in **Table No. 5** are opinions of the current cost to construct the project. These cost projections are for *comparing alternatives* based on published unit prices, budget level quotations from vendors, and engineering judgment. The cost breakdown does not include an allowance for contingencies. The actual bid prices for constructing this work in the future could be higher or lower. The amounts do not include the cost of improvements to the SMR lakes that might be needed, or the value of littoral zone mitigation and other benefits that might accrue to SMR as a result of negotiating an agreement with Sarasota County. The value of site and ROW acquisition is not included as these costs are not currently known and are difficult to predict with reasonable accuracy.

Table No. 5—Opinion of Probable Construction Cost

Stormwater Pumping Station:		
(4) 100 hp pumps rated for 2,000 gpm (11.5 mgd capacity)	$65,000	
24 inch screened intake with air purge	$15,000	
24 inch inlet piping	$10,000	
Header piping and pump supports	$70,000	
20 inch magnetic flow meter and totalizer	$15,000	
Control building and structures	$100,000	
Sub-total	**$275,000**	
Electrical and Instrumentation (20%)	$55,000	
General Facilities (20%)	$55,000	
Total Construction Stormwater Pumping Station	**$385,000**	**$385,000**
Reuse Pumping Station:		
(3) 100 hp pumps rated for 700 gpm (2.0 mgd capacity with one pump out of service)	$30,000	
VFD speed control	$70,000	
14 inch screened intake	$10,000	
14 inch inlet piping	$8,000	
Header piping and pump supports	$50,000	
2.0 mgd capacity NETAFIM disc filter	$60,000	
21,000 gallon capacity chlorine contact basin and structures	$80,000	
Chlorination equipment	$15,000	
12 inch magnetic flow meter and totalizer	$15,000	
Backflow preventer and discharge piping	$14,000	
Sub-total	**$352,000**	
Electrical and Instrumentation (20%)	$70,000	
General Facilities (20%)	$70,000	
Total Construction Reuse Pumping Station	**$492,000**	**$492,000**
20-inch Transmission Main:		
10,600 LF @ $55 / ft	**$583,000**	**$583,000**
Sub-total Construction	**$1,460,000**	
Allowance for Permitting, Engineering & Testing @ 20%	$290,000	$290,000
Project Budget		**$1,750,000**

Regulatory Issues

FDEP

Presently, the FDEP does not regulate the use of stormwater for supplemental reuse although proposed rules are currently going through the review process. However, in general, FDEP encourages the concept of stormwater reuse. Although a permit is not required from FDEP, the agency wants to be informed of projects where supplemental water is blended with reclaimed wastewater.

The quality of reclaimed stormwater will generally exceed that of reclaimed wastewater for common water quality indicators such as concentrations of TSS, BOD, dissolved oxygen, and nutrients. Stormwater may contain trace pollutants such as agricultural chemicals that are not typically found in wastewater. To the extent that stormwater quality exceeds the quality of wastewater effluent, and does not contain trace amounts of toxic chemicals, blending of stormwater with reclaimed wastewater should be acceptable to the FDEP (21)(22).

SWFWMD

In general, SWFWMD also appears to encourage the concept of stormwater reuse as a way of reducing the demand on groundwater supplies. In concept, obtaining permits to withdraw water from the SMR lakes for reuse should be possible as long as the quantity of the water withdrawn does not exceed the quantity of the water transferred into the SMR lakes for storage, if there are no adverse impacts. Because stormwater will be stored in wet weather for withdrawal in dry weather, the normal seasonal variation in the water surface of the SMR lakes may be accentuated by pumping. As the lake water level is probably hydraulically connected to the surrounding seasonal groundwater level, pumping from the lakes could impact local water supplies. Additional study is need to address these concerns.

Maintaining the base flow in Phillippi Creek is a significant concern. This has been anticipated and addressed in the conceptual project. It is planned to divert only the *surplus* stormwater, which is proposed to be the volume in excess of the base flow in the Main C canal. This should be sufficient in a channeled urban watershed where the natural hydroperiod has already been highly disturbed. The inter-basin transfer of water, from the Phillippi Creek watershed to the Cooper Creek watershed, should be approved by SWFWMD, provided that the transfer is related to a regional water supply (23).

Recommendations

This report addresses the feasibility of stormwater reuse from the Celery Fields Regional Stormwater Facility. The report overviews the concept of stormwater reuse, addresses water quality and regulatory issues, identifies alternatives for storage and provides a preliminary screening of those alternatives. From the information obtained during the study, a concept project was developed that assumes storage in the existing lakes reclaimed from shell pits on the Schroeder Manatee Ranch. The purpose of the concept project is to provide guidance on the regulatory issues and the costs associated with stormwater reuse. The concept project appears to be feasible and beneficial—subject to cooperation from the Schroeder Manatee Ranch and the City of Sarasota, a further study of impacts, and approval of SWFWMD.

The most feasible storage alternative identified in this study is the Quality Aggregates shell pits located on the Schroeder Manatee Ranch. These pits are being reclaimed as small lakes. SMR representatives have expressed an interest in cooperating with the County on the use of their lakes for stormwater storage. This option should be pursued in more detail by both parties.

In coordination with discussions with SMR, the County should enter into discussions with the City of Sarasota regarding an interconnect to their 36-inch reuse transmission main for the proposed reuse pump station and for a reuse transmission main extending north from the Bee Ridge WWTP service area.

The quality of stormwater in Phillippi Creek Main C canal at the location of the Celery Fields appears to be adequate for blending with reclaimed wastewater. A more serious concern is the impact of stormwater pumped from the Celery Fields facility on the quality of the natural water in SMR's lakes. It is recommended that additional sampling be conducted so that a more complete water quality profile is available to evaluate the impacts on SMR's lakes from pumping and storing stormwater. A water quality modeling study should be conducted to predict the consequences of seasonal pumping into and out of the lakes.

In addition to water quality issues, the hydrologic impact of seasonal pumping on the lakes, including potential effects on surrounding water tables, will need to be addressed. A detailed water balance could predict more accurately the amounts of water to be stored and withdrawn from the lakes and the actual storage available. It is recommended to conduct a water balance study for dry, normal, and wet years. This will also provide better information for sizing the pumping stations and pipelines.

With this additional information, serious discussions with SWFWMD should be initiated on permitting issues related to water quality, water transfer, and seasonal storage in the SMR lakes.

In anticipation of the successful resolution of these concerns, the design of the Celery Fields Regional Stormwater Facility should include provisions for a future stormwater transfer pumping station.

REFERENCES

(1) Master Plan for Urban Reuse - Manatee County, CDM, March 1990.

(2) *Bee Ridge Water Reclamation Facility - Preliminary Design Report,* CDM, February 1993.

(3) Personal communication with John Trommer USGS, 12/15/94.

(4) DER 17-610 *Reuse of Reclaimed Water and Land Application 12/92*

(5) Personal communication with David York, Ph.D., PE, Reuse Coordinator, FDEP, 1/3/95.

(6) Draft revisions to Chapter 62-610 FAC, issued by memorandum from David York, Reuse Coordinator, FDEP, December 7, 1994.

(7) *Water Quality Considerations in the Design and Use of Wet Detention and Wetland Stormwater Management Systems,* Eric Livingston, Stormwater Section FDEP, on-going.

(8) Personal communication with Mark Kehoe, SWFWMD, 1/4/95.

(9) *A Survey of Wetlands-Treatment Stormwater Ponds,* Mark Kehoe, Craig Dye, and Betty Rushton, Environmental Section SWFWMD, August 1994.

(10) *A Native Herbaceous Marsh Used for Stormwater Treatment,* David W. Carr, Environmental section SWFWMD, 1993.

(11) *Results Documented form Wet-Detention Stormwater Studies,* Betty Rushton, et. al., Stormwater Research Program, SWFWMD, November 1993.

(12) *Effectiveness of Permitted Stormwater Systems for Water Quality Control,* Betty Rushton and Craig Dye, SWFWMD, 1993.

(13) *Significant Conclusions Documented from Stormwater Research,* Betty Rushton and Mark Kehoe, SWFWMD, May 1993.

(14) *Design of Urban Runoff Quality Controls,* Larry Roesner, ed., Eric Livingston (1986).

(15) The average daily flow of the Bent Tree WWTP from Jan 1994 to Jan 1995 is reported as 0.539 mgd in the operations report provided by Sarasota County Utilities Department, 4/19/95.

(16) Meeting with David A. Donofrio, PE, President, APAC-Florida, Inc. - Sarasota Division, 1/10/95.

(17) Personal communication with Tim Doyle, PE, Bishop Associates, Sarasota.

(18) Meeting with John Clark, President SMR, and Rex Jensen, Vice President SMR, 1/20/95.

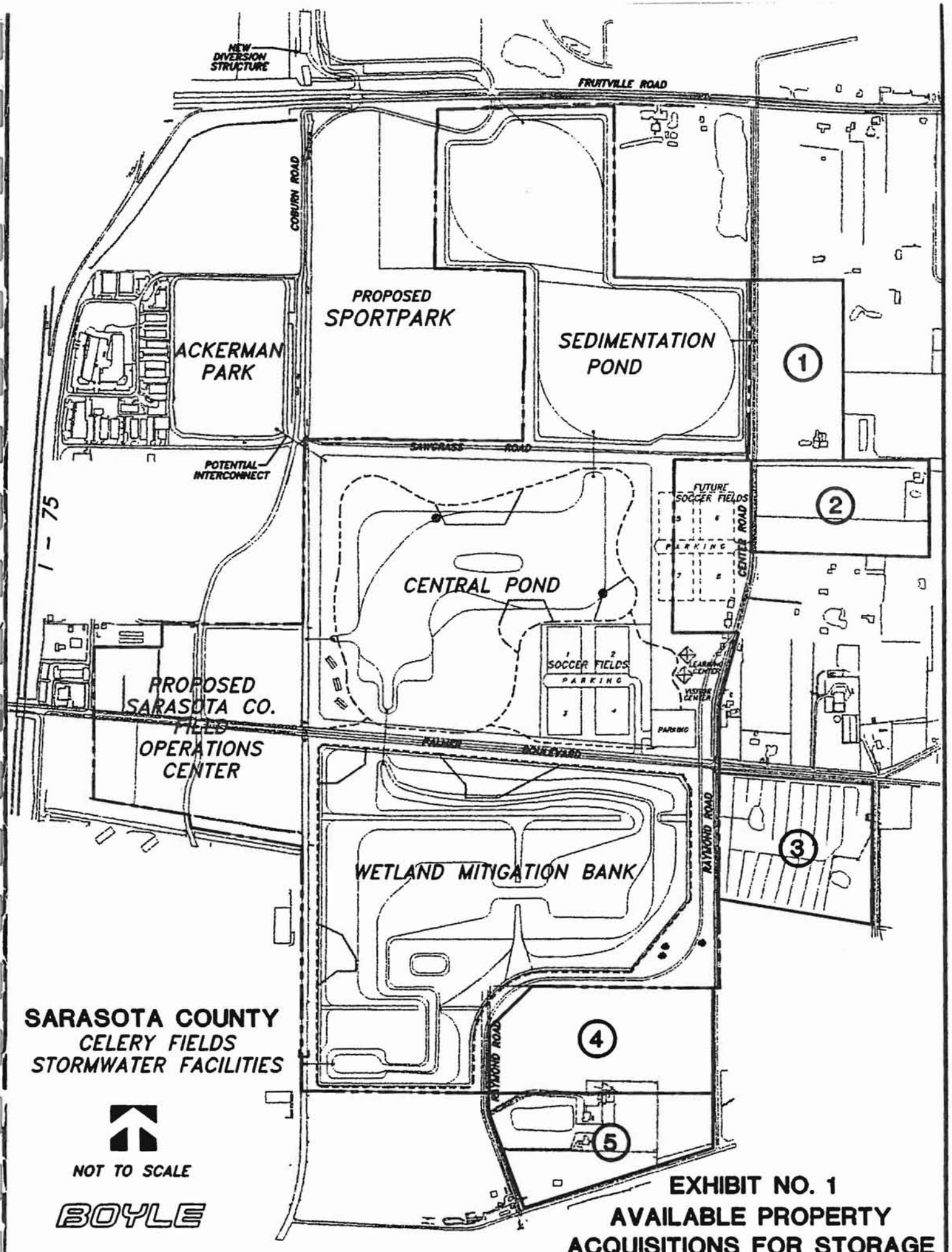
(19) *Hydrology of the Floridan Aquifer in West-Central Florida,* USGS Professional Paper 1403-F.

(20) *Franchise, Acquisition, Consolidation, Implementation Plan - Reuse Master Plan,* Sarasota County Utilities Department, November 1994.

(21) Personal communication with David York, Ph.D., PE, Reuse Coordinator FDEP, 3/30/95.

(22) Personal communication with John Cox, Stormwater Management FDEP, 3/30/95.

(23) Personal communication with Tom Harrison, Engineering Section, SWFWMD, 4/5/95.

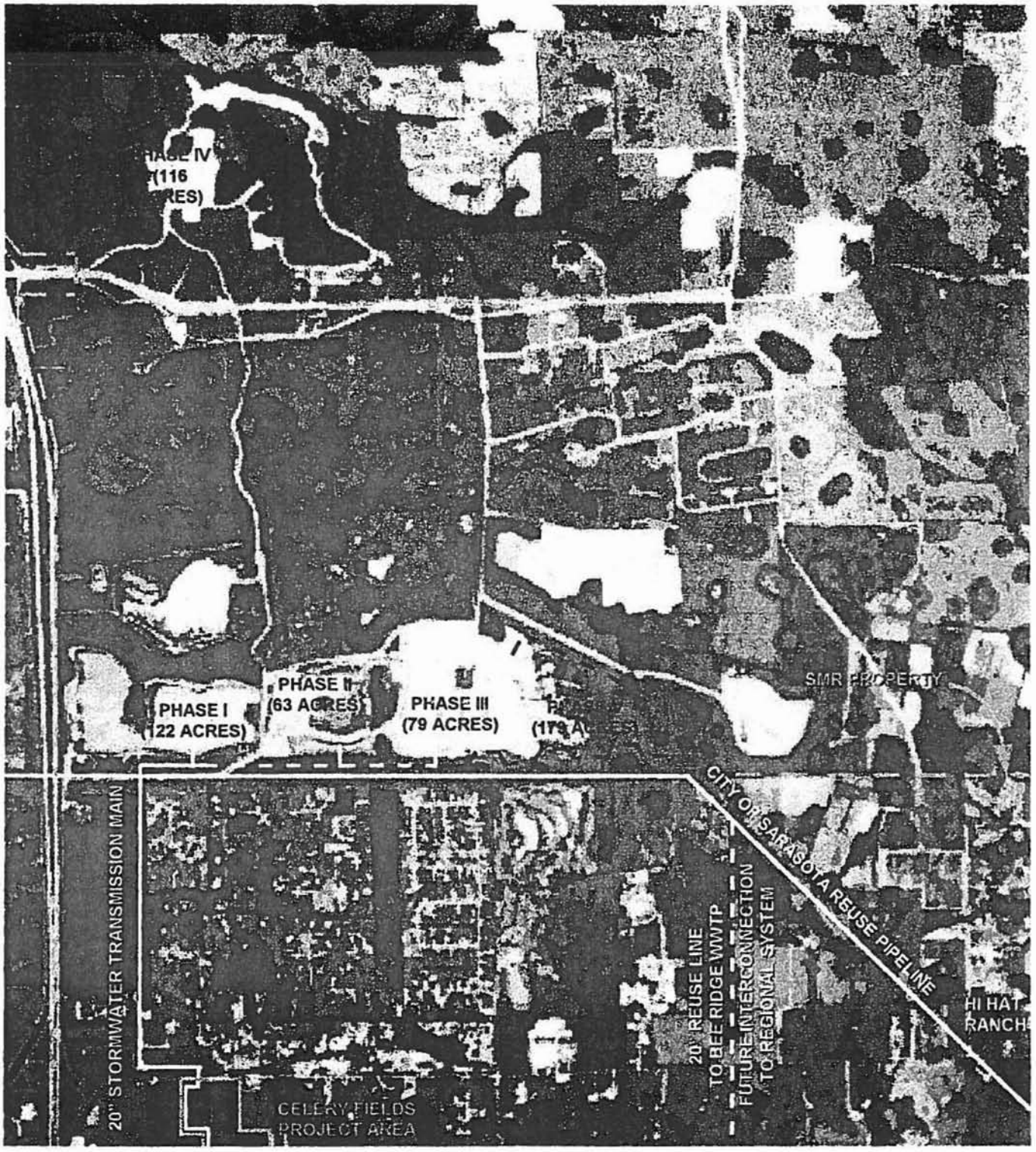


SARASOTA COUNTY
CELERY FIELDS
STORMWATER FACILITIES

NOT TO SCALE

BOYLE

EXHIBIT NO. 1
AVAILABLE PROPERTY
ACQUISITIONS FOR STORAGE

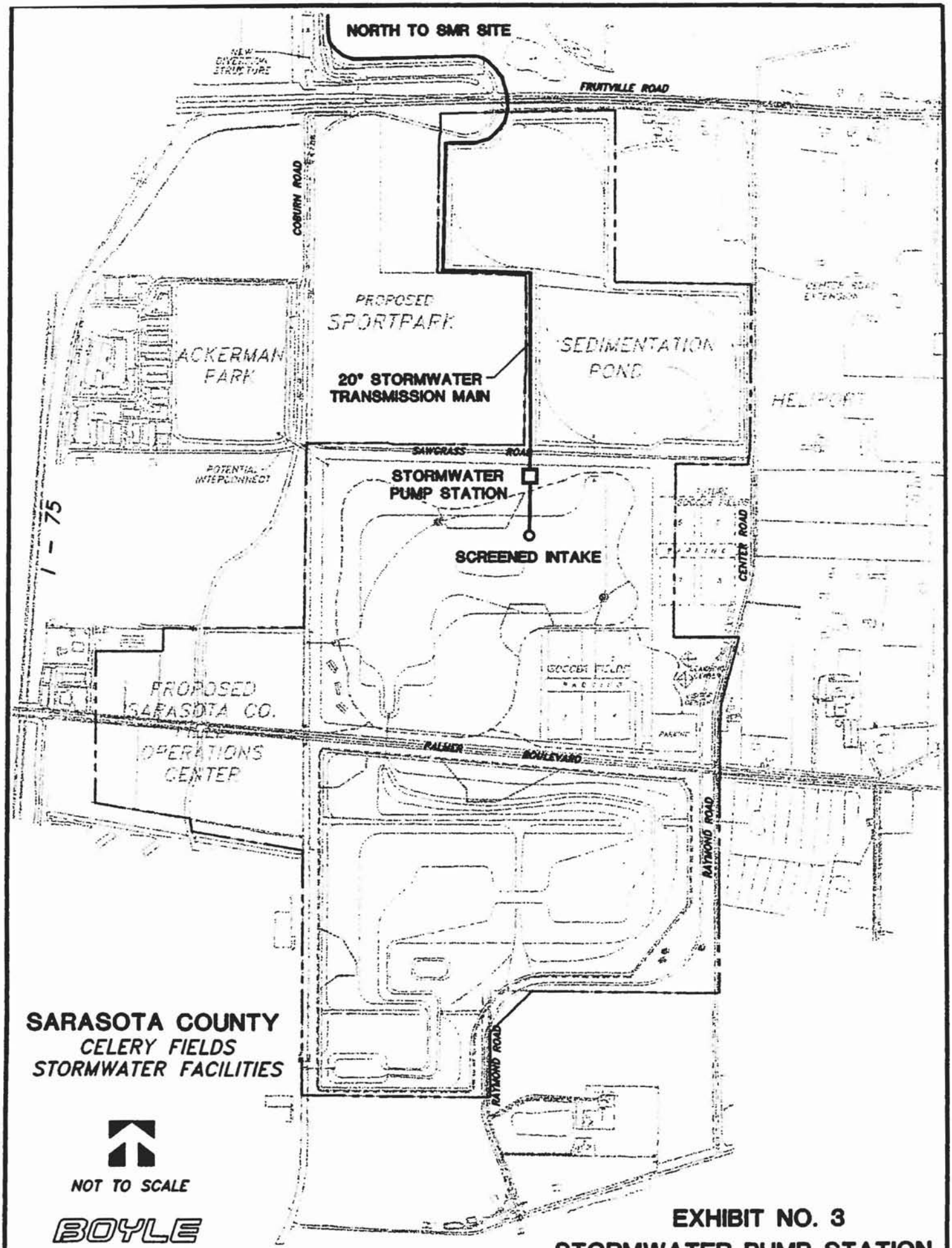


TRANSMISSION AND STORAGE AT SCHROEDER MANATEE RANCH

EXHIBIT NO. 2

BOYLE

CELERY FIELDS STORMWATER FACILITIES



SARASOTA COUNTY
CELERY FIELDS
STORMWATER FACILITIES

NOT TO SCALE

BOYLE

EXHIBIT NO. 3
STORMWATER PUMP STATION

APPENDIX

WATER QUALITY TESTING
PHILLIPI CREEK MAIN "C" CANAL
SARASOTA, FLORIDA
PSI PROJECT NO. 387-50057

Professional Service Industries, Inc.

Professional Service Industries, Inc.

February 21, 1995

Sarasota County Transportation
Stormwater Environmental Utilities
1301 Cattlemen Road
Sarasota, Florida 34232
Attention: Mr. Terry W. Liby, P.E.

RE: Water Quality Testing
Phillipi Creek Main "C" Canal
Sarasota, Florida
PSI Project No. 387-50057

Dear Mr. Liby:

Attached please find the results of the Water Quality Testing performed by PSI's analytical office on samples obtained from Phillipi Creek Main "C" Canal just north of the Fruitville Road Weir. We have also included data collected in the field during the sampling process. A soil sample was also collected just south of Palmer Boulevard. The results from the analysis of the soil sample are contained in Report No. 385-5P028-0005.

PSI appreciates the opportunity to have been of service to you on this project. Should you have any questions, please contact us at your convenience.

Respectfully submitted,

PSI

Keith L. Butts, E.I.
Staff Engineer

KLB:tkf.38750057

Attachments: Field Data Information
PSI Report Nos. 385-5P028-0005; 385-5P028-0006
PSI Report Nos. 214-2P090-541; 214-2P090-542

xc: Boyle Engineering Corporation
Attention: Mr. Mitch McKnight, P.E.

FIELD DATA

Water Sample No. 1

Sample Date/Time:	1-30-95/3:30 p.m.
Temperature:	19.5°C
Dissolved Oxygen:	18.6 mgl
Turbidity:	9.62 ntu

Water Sample No. 2

Sample Date/Time:	2-02-95/8:00 a.m.
Temperature:	19.0°C
Dissolved Oxygen:	17.7 mgl
Turbidity:	9.68 ntu

Professional Service Industries, Inc.

ANALYTICAL REPORT

TESTED FOR:	PSI, Inc. 430 Interstate Court Sarasota, Florida 34240	**PROJECT:**	Phillipi Creek Main "C" 387-50057
ATTENTION:	Keith L. Butts	**SAMPLE DATE:**	February 2, 1995
DATE:	February 16, 1995	**OUR REPORT NUMBER:**	385-5P028-0006

Attached, please find our analytical report for samples described on the Chain-of-Custody (C-O-C). Please note that our laboratory has assigned unique sample numbers to each of your samples as shown on the attached C-O-C. Please reference our report number and direct any questions on this report to the individual designated below or to one of our Customer Service Representatives.

Reviewed By,

Anthony R. Febbraro, Department Manager

Respectfully submitted,
Professional Service Industries, Inc.

HRS #84218
HRS #E84388

/dlt

AB #: 02023-01
Client ID: 1

PESTICIDES/PCB'S

Matrix: Water

nalyte	Results	Units	Method	MDL/DF
A-BHC	<0.5	ug/l	EPA 608	0.5/1
-BHC	<0.5	ug/l	EPA 608	0.5/1
-BHC	<0.5	ug/l	EPA 608	0.5/1
D-BHC	<0.5	ug/l	EPA 608	0.5/1
Heptachlor	<0.5	ug/l	EPA 608	0.5/1
ldrin	<0.5	ug/l	EPA 608	0.5/1
eptachlor epoxide	<0.5	ug/l	EPA 608	0.5/1
Endosulfan I	<0.5	ug/l	EPA 608	0.5/1
eldrin	<0.5	ug/l	EPA 608	0.5/1
p'-DDE	<0.5	ug/l	EPA 608	0.5/1
Endrin	<0.5	ug/l	EPA 608	0.5/1
ndosulfan II	<0.5	ug/l	EPA 608	0.5/1
p'-DDD	<0.5	ug/l	EPA 608	0.5/1
Endrin Aldehyde	<0.5	ug/l	EPA 608	0.5/1
Endosulfan Sulfate	<0.5	ug/l	EPA 608	0.5/1
p'-DDT	<0.5	ug/l	EPA 608	0.5/1
hlordane	<0.5	ug/l	EPA 608	0.5/1
Toxaphene	<0.5	ug/l	EPA 608	0.5/1
CB 1016	<0.5	ug/l	EPA 608	0.5/1
CB 1221	<0.5	ug/l	EPA 608	0.5/1
PCB 1232	<0.5	ug/l	EPA 608	0.5/1
PCB 1242	<0.5	ug/l	EPA 608	0.5/1
CB 1248	<0.5	ug/l	EPA 608	0.5/1
CB 1254	<0.5	ug/l	EPA 608	0.5/1
PCB 1260	<0.5	ug/l	EPA 608	0.5/1

Extraction Date: 02/06/95
Analysis Date: 02/08/95
Analyst: SP

nalyte	Results	Units	Method	Analysis Date	Analyst	MDL
otal Recoverable Petroleum Hydrocarbons	<1.0	mg/l	EPA 418.1	02/08/95	AM	1.0

NUTRIENT ANALYSES

nalyte	Results	Units	Method	Analysis Date	Analyst	MDL
otal Cyanide	<0.005	mg/l	EPA 335.2	02/13/95	MC	0.005
trate + Nitrite	0.258	mg/l	EPA 353.3	02/09/95	MC	0.01
henols	0.055	mg/l	EPA 420.1	02/07/95	MC	0.05
KN	1.5	mg/l	EPA 351.3	02/09/95	MC	0.10
otal Phosphorous	0.20	mg/l	EPA 365.2	02/08/95	MC	0.05

SURROGATE RECOVERY SUMMARY

Matrix: Water

PSI LAB #	1-Bromo-2 -Dichloropropane (601/8010)	a,a,a-TFT (602/8020)	2,4,5,6-Tetrachloro m-xylene (608/8080)	Dibutyl Chlorendate (608/8080)	2-Fluorobiphenyl (610/8100)	Nitrobenzene (610/8100)
02023-01				51		

CHAIN OF CUSTODY RECORD

Professional Service Industries, Inc.

PROJECT NAME	REPORT TO	INVOICE TO
Phillipi Creek Main "C"	PSI	PSI
PROJECT NUMBER	**PROJECT MANAGER**	**ADDRESS**
387-50057	Keith L. Butts	430 Interstate Court
P.O. NUMBER	**ADDRESS**	**CITY / STATE / ZIP**
N/A	430 Interstate Court	Sarasota, Florida 34240
REQUIRED DUE DATE	**CITY / STATE / ZIP**	**ATTENTION**
2-16-95	Sarasota, Florida 34240	Keith L. Butts
SAMPLES TO LAB VIA	**TELEPHONE** (813) 378-9001	**TELEPHONE**
Technician	**FAX** (813) 378-3972	(813) 378-9001
NUMBER OF COOLERS	**REPORT VIA** VERBAL (FAX)	
1	U.S. MAIL/OVERNIGHT	

LABORATORY SUBMITTED TO:

- ☐ 6913 Hwy. 225, Deer Park, TX 77536, (713) 479-8307
- ☐ 4820 W. 15th Street, Lawrence, KS 66049, (800) 548-7901
- ☑ 6056 Ulmerton Road, Clearwater, FL 34620, (813) 531-1446
- ☐ 850 Poplar Street, Pittsburgh, PA 15220, (412) 922-4000

TRANSFER NUMBER	RELINQUISHED BY DATE / TIME	ACCEPTED BY DATE / TIME	SEAL NUMBER
	Vern Aeglet 8:15 2-3-95	BPalmieri 8:15 2-3	

LABORATORY USE ONLY

FIELD SERVICES Y/N $

SHIPPING Y/N $

LABORATORY USE ONLY

ANALYTICAL DUE DATE 2-14-95

REPORT DUE DATE

INORGANIC Sect ____ Row ____ ORGANIC Sect ____ Row ____

PSI PROJECT NAME

PSI PROJECT # 50028-0006

PSI BATCH #

LABORATORY USE ONLY

SAMPLE CUSTODIAN | DATE / TIME

PARAMETER LIST

See attached list

	SAMPLE IDENTIFICATION	DATE / TIME	COMP-C GRAB-B	SOIL-S WATER-W WASTE-X	LAB USE ONLY LAB NUMBER	NUMBER OF CONTAINERS
01	02023 1	2-2/8:00a	B	W		

RECEIVED FEB 03 1995

ADDITIONAL REMARKS

SAMPLER'S SIGNATURE Keith L Butts

PSI A-600-10 (1)

LABORATORY WORK

1. Oil & Grease
2. BOD5
3. COD
4. TSS
5. TOC
6. Lead
7. Copper
8. Zinc
9. Iron
10. Aluminum
11. Arsenic
12. Cadmium
13. Nickel
14. Cyanides
15. TKN
16. Nitrate/Nitrite
17. Total P
18. pH
19. Color
20. Alkalinity
21. Hardness
22. Endosulfan
    Pentachlorophenol
    Chlorodane
    Phenol

100%

Professional Service Industries, Inc.

ANALYTICAL REPORT

TESTED FOR: PSI/ST. PETERSBURG
1770 Commerce Ave. North
Metropoint Centre
St. Petersburg, Fl 33716

PROJECT: Phillipi Creek
Main "C"
PROJECT #: 387-50057

P.O. #: 01248

ATTENTION: Tony Febbraro

Lab# 502032 and #502033

DATE: February 9, 1995

OUR REPORT NUMBER# 214-2P090-541

Attached, please find our analytical report for samples described on the Chain-of-Custody (COC). Please note that our laboratory has assigned unique sample numbers to each of your samples as shown on the attached COC. Please reference our report number and direct any questions on this report to the individual designated below or to our Manager. Thank you for supporting our laboratory.

Reviewed by
James Rhubottom, Jr., Inorganic Supervisor

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.

CHAIN OF CUSTODY RECORD

Professional Service Industries, Inc.

PROJECT NAME: Phillips Creek Main	REPORT TO: CLW Analytical	INVOICE TO:
PROJECT NUMBER: 387-50057	PROJECT MANAGER: Anthony Febbraro	ADDRESS:
P.O. NUMBER: 01248	ADDRESS:	CITY / STATE / ZIP:
REQUIRED DUE DATE: 2-14-95	CITY / STATE / ZIP:	ATTENTION: DAMG
SAMPLES TO LAB VIA: Fed-Ex	TELEPHONE: 813-579-4464 FAX:	TELEPHONE:
NUMBER OF COOLERS: 1	REPORT VIA: VERBAL FAX / U.S. MAIL/OVERNIGHT	

LABORATORY SUBMITTED TO:

- 6910 Hwy. 225, Deer Park, TX 77536, (713) 479-8307
- 4820 W. 15th Street, Lawrence, KS 66049, (800) 548-7901
- 6056 Ulmerton Road, Clearwater, FL 34620, (813) 531-1446
- 850 Poplar Street, Pittsburgh, PA 15220, (412) 922-4000

TRANSFER NUMBER	RELINQUISHED BY DATE / TIME	ACCEPTED BY DATE / TIME	SEAL NUMBER
	Anderson 1300 1-31	[signature] 2/1/95 1200	

LABORATORY USE ONLY — SAMPLE CUSTODIAN: — DATE / TIME:

LABORATORY USE ONLY — FIELD SERVICES Y/N $ — SHIPPING Y/N $

LABORATORY USE ONLY — ANALYTICAL DUE DATE: — REPORT DUE DATE: — INORGANIC Sect ___ Row ___ — ORGANIC Sect ___ Row ___ — PSI PROJECT NAME: — PSI PROJECT #: — PSI BATCH #:

SAMPLE IDENTIFICATION	DATE / TIME	COMP-C GRAB-G	SOIL-S WATER-W WASTE-X	LAB USE ONLY LAB NUMBER	NUMBER OF CONTAINERS	PARAMETER LIST: cod	PARAMETER LIST: Toc
1	1-30 / 3:30	G	W	502032	1	X	X
2	1-30 / 4:00	G	S	502033	1	X	X

ADDITIONAL REMARKS _____

SAMPLER'S SIGNATURE _____

Professional Service Industries, Inc.

ANALYTICAL REPORT

TESTED FOR: PSI/ST. PETERSBURG
1770 Commerce Ave. North
Metropoint Centre
St. Petersburg, Fl 33716

PROJECT: Phillipi Creek

PROJECT #: 387-50057

P.O. #: 02023

ATTENTION: Tony Febbraro

Lab# 502104

DATE: February 9, 1995

OUR REPORT NUMBER# 214-2P090-542

Attached, please find our analytical report for samples described on the Chain-of-Custody (COC). Please note that our laboratory has assigned unique sample numbers to each of your samples as shown on the attached COC. Please reference our report number and direct any questions on this report to the individual designated below or to our Manager. Thank you for supporting our laboratory.

Reviewed by,
James Rhubottom, Jr., Inorganic Supervisor

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.

Client #: 1 Grab 02/02/95, 0800
Lab #: 502104

Matrix: Water

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL/DF
COD	15	mg/L	EPA 410.2	02/07/95	SB	1/1
TOC	15.9	mg/L	EPA 415.1	02/06/95	JR	1.0/1

QUALITY CONTROL DATA: INORGANIC ANALYTES

Analyte	Blank	MDL	Units	%RSD	%REC	Method	Matrix
COD	<1	1	mg/L	0	100	EPA 410.2	Water
TOC	<1.0	1.0	mg/L	1	103	EPA 415.1	Water

CHAIN OF CUSTODY RECORD

psi Professional Service Industries, Inc.

PROJECT NAME	REPORT TO	INVOICE TO
Phillipi Creek	Clw Analytical	SAME
PROJECT NUMBER 387-50057	PROJECT MANAGER Anthony Febbraro	ADDRESS
P.O. NUMBER 02023	ADDRESS	CITY / STATE / ZIP
REQUIRED DUE DATE 2-14-95	CITY / STATE / ZIP	ATTENTION
SAMPLES TO LAB VIA Fed-EX	TELEPHONE 813-579-4464 FAX	TELEPHONE
NUMBER OF COOLERS 1	REPORT VIA VERBAL FAX U.S. MAIL/OVERNIGHT	

LABORATORY SUBMITTED TO:

- ☒ 6913 Hwy. 225, Deer Park, TX 77536, (713) 479-8307
- ☐ 4820 W. 15th Street, Lawrence, KS 66049, (800) 548-7901
- ☐ 6056 Ulmerton Road, Clearwater, FL 34620, (813) 531-1446
- ☐ 850 Poplar Street, Pittsburgh, PA 15220, (412) 922-4000

LABORATORY USE ONLY: ANALYTICAL DUE DATE; REPORT DUE DATE; INORGANIC Seal Rec; ORGANIC Seal Rec; PSI PROJECT NAME; PSI PROJECT #; PSI BATCH #

TRANSFER NUMBER	RELINQUISHED BY DATE / TIME	ACCEPTED BY DATE / TIME	SEAL NUMBER
	[illegible signature] 2-5 830	C. [illegible signature] 2-6-95/10:25am	

LABORATORY USE ONLY: FIELD SERVICES Y/N $; SHIPPING Y/N $

LABORATORY USE ONLY: SAMPLE CUSTODIAN; DATE / TIME

PARAMETER LIST

SAMPLE IDENTIFICATION	DATE / TIME	COMP-C GRAB-B	SOIL-S WATER-W WASTE-X	LAB USE ONLY LAB NUMBER	NUMBER OF CONTAINERS	COD	TOC
1	2-2/800	B	W	502104	1	X	X

ADDITIONAL REMARKS

SAMPLER'S SIGNATURE

Professional Service Industries, Inc.

ANALYTICAL REPORT

TESTED FOR:	PSI, Inc. 430 Interstate Court Sarasota, Florida 34240	**PROJECT:**	Phillipi Creek Main "C" 387-50057
ATTENTION:	Keith L. Butts	**SAMPLE DATE:**	January 30, 1995
DATE:	February 16, 1995	**OUR REPORT NUMBER:**	385-5P028-0005

Attached, please find our analytical report for samples described on the Chain-of-Custody (C-O-C). Please note that our laboratory has assigned unique sample numbers to each of your samples as shown on the attached C-O-C. Please reference our report number and direct any questions on this report to the individual designated below or to one of our Customer Service Representatives.

Reviewed By,

Anthony R. Febbraro, Department Manager

Respectfully submitted,
Professional Service Industries, Inc.

HRS #84218
HRS #E84388

/dlt

LAB #: 01248-01
Client ID: 1

PESTICIDES/PCB'S

Matrix: Water

Analyte	Results	Units	Method	MDL/DF
A-BHC	<0.5	ug/l	EPA 608	0.5/1
B-BHC	<0.5	ug/l	EPA 608	0.5/1
G-BHC	<0.5	ug/l	EPA 608	0.5/1
D-BHC	<0.5	ug/l	EPA 608	0.5/1
Heptachlor	<0.5	ug/l	EPA 608	0.5/1
Aldrin	<0.5	ug/l	EPA 608	0.5/1
Heptachlor epoxide	<0.5	ug/l	EPA 608	0.5/1
Endosulfan I	<0.5	ug/l	EPA 608	0.5/1
Dieldrin	<0.5	ug/l	EPA 608	0.5/1
p,p'-DDE	<0.5	ug/l	EPA 608	0.5/1
Endrin	<0.5	ug/l	EPA 608	0.5/1
Endosulfan II	<0.5	ug/l	EPA 608	0.5/1
p,p'-DDD	<0.5	ug/l	EPA 608	0.5/1
Endrin Aldehyde	<0.5	ug/l	EPA 608	0.5/1
Endosulfan Sulfate	<0.5	ug/l	EPA 608	0.5/1
p,p'-DDT	<0.5	ug/l	EPA 608	0.5/1
Chlordane	<0.5	ug/l	EPA 608	0.5/1
Toxaphene	<0.5	ug/l	EPA 608	0.5/1
PCB 1016	<0.5	ug/l	EPA 608	0.5/1
PCB 1221	<0.5	ug/l	EPA 608	0.5/1
PCB 1232	<0.5	ug/l	EPA 608	0.5/1
PCB 1242	<0.5	ug/l	EPA 608	0.5/1
PCB 1248	<0.5	ug/l	EPA 608	0.5/1
PCB 1254	<0.5	ug/l	EPA 608	0.5/1
PCB 1260	<0.5	ug/l	EPA 608	0.5/1

Extraction Date: 02/06/95
Analysis Date: 02/08/95
Analyst: SP

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
Total Recoverable Petroleum Hydrocarbons	<1.0	mg/l	EPA 418.1	02/03/95	SM	1.0

NUTRIENT ANALYSES

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
Total Cyanide	<0.005	mg/l	EPA 335.2	02/03/95	MC	0.005
Nitrate + Nitrite	0.234	mg/l	EPA 353.3	02/10/95	MC	0.01
Phenols	<0.050	mg/l	EPA 420.1	02/14/95	MC	0.05
TKN	1.4	mg/l	EPA 351.3	02/09/95	MC	0.10
Total Phosphorous	0.191	mg/l	EPA 365.2	02/08/95	MC	0.05

psi

LAB #: 01248-01
Client ID: 1

METALS ANALYSIS

Matrix: Water

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
Total Aluminum	<0.500	mg/l	EPA 202.1	02/14/95	CP	0.500
Total Arsenic	<0.050	mg/l	EPA 206.2	02/07/95	CP	0.050
Total Cadmium	1.14	ug/l	EPA 213.2	02/13/95	CP	0.800
Total Copper	<0.020	mg/l	EPA 220.1	02/10/95	CP	0.020
Total Iron	1.29	mg/l	EPA 236.1	02/14/95	CP	0.050
Total Lead	5.77	ug/l	EPA 239.2	02/06/95	CP	5.00
Total Nickel	<0.050	mg/l	EPA 249.1	02/10/95	CP	0.050
Total Zinc	<0.200	mg/l	EPA 289.1	02/10/95	CP	0.200

MICROBIOLOGY

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
BOD	3	mg/l	EPA 405.1	02/07/95	MC	2

INORGANIC ANALYSES

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
Alkalinity	158	mg $CaCO_3$/l	EPA 310.1	02/13/95	MC	1
Color	60	CPU	EPA 110.2	02/11/95	HM	5
pH	7.70	SU	EPA 150.1	02/09/95	HM	1
TSS	10	mg/l	EPA 160.2	02/13/95	HM	1
Hardness	357	mg $CaCO_3$/l	SM 2340B	02/14/95	CP	1

LAB #: 01248-02
Client ID: 2

PESTICIDES/PCB'S

Matrix: Soil

Analyte	Results	Units	Method	MDL/DF
A-BHC	<0.02	mg/kg	SW 8080	0.02/1
B-BHC	<0.02	mg/kg	SW 8080	0.02/1
G-BHC	<0.02	mg/kg	SW 8080	0.02/1
D-BHC	<0.02	mg/kg	SW 8080	0.02/1
Heptachlor	<0.02	mg/kg	SW 8080	0.02/1
Aldrin	<0.02	mg/kg	SW 8080	0.02/1
Heptachlor epoxide	<0.02	mg/kg	SW 8080	0.02/1
Endosulfan I	<0.02	mg/kg	SW 8080	0.02/1
Dieldrin	<0.02	mg/kg	SW 8080	0.02/1
p,p'-DDE	<0.02	mg/kg	SW 8080	0.02/1
Endrin	<0.02	mg/kg	SW 8080	0.02/1
Endosulfan II	<0.02	mg/kg	SW 8080	0.02/1
p,p'-DDD	<0.02	mg/kg	SW 8080	0.02/1
Endrin Aldehyde	<0.02	mg/kg	SW 8080	0.02/1
Endosulfan Sulfate	<0.02	mg/kg	SW 8080	0.02/1
p,p'-DDT	<0.02	mg/kg	SW 8080	0.02/1
Chlordane	<0.02	mg/kg	SW 8080	0.02/1
Toxaphene	<0.02	mg/kg	SW 8080	0.02/1
PCB 1016	<0.02	mg/kg	SW 8080	0.02/1
PCB 1221	<0.02	mg/kg	SW 8080	0.02/1
PCB 1232	<0.02	mg/kg	SW 8080	0.02/1
PCB 1242	<0.02	mg/kg	SW 8080	0.02/1
PCB 1248	<0.02	mg/kg	SW 8080	0.02/1
PCB 1254	<0.02	mg/kg	SW 8080	0.02/1
PCB 1260	<0.02	mg/kg	SW 8080	0.02/1

Extraction Date: 02/07/95
Analysis Date: 02/08/95
Analyst: SP

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
Total Recoverable Petroleum Hydrocarbons	65.1	mg/kg	SW 9073	02/03/95	SM	10.0

NUTRIENT ANALYSES

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
Total Cyanide	<0.25	mg/kg	SW 9010	02/03/95	MC	0.25
Nitrate + Nitrite	0.326	mg/kg	EPA 353.3	02/10/95	MC	0.1
Phenols	0.77	mg/kg	EPA 420.1	02/14/95	MC	0.5
TKN	279	mg/kg	EPA 351.3	02/09/95	MC	0.10
Total Phosphorous	3,386	mg/kg	EPA 365.2	02/08/95	MC	0.5

LAB #: 01248-02
Client ID: 2

METALS ANALYSIS

Matrix: Soil

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
Total Aluminum	1,209	mg/kg	SW 7020	02/14/95	CP	10.0
Total Arsenic	<1.0	mg/kg	SW 7060	02/07/95	CP	1.0
Total Cadmium	<1.0	mg/kg	SW 7130	02/08/95	CP	1.0
Total Copper	10.0	mg/kg	SW 7210	02/10/95	CP	0.50
Total Iron	1,320	mg/kg	SW 7380	02/14/95	CP	1.0
Total Lead	5.47	mg/kg	SW 7420	02/12/95	CP	4.0
Total Nickel	2.73	mg/kg	SW 7520	02/12/95	CP	1.0
Total Zinc	20.8	mg/kg	SW 7950	02/12/95	CP	0.50

INORGANIC ANALYSES

Analyte	Results	Units	Method	Analysis Date	Analyst	MDL
Alkalinity	2,780	mg/kg as $CaCO_3$	EPA 310.1	02/13/95	MC	1
pH in Soil	8.00	SU	SW 9045	02/09/95	MC	1
Hardness	14,464	mg/kg as $CaCO_3$	SM 2340B	02/14/95	CP	1

psi

QUALITY CONTROL DATA: INORGANIC ANALYTES

Matrix: Water/Soil

Analyte	Lab Batch#	Analytical Blank	MDL	Units	QC %REC	Spike %REC	Dup %RPD	Method
Aluminum	AB0214	<0.500	0.500	mg/l	111	92	2	202.1
Arsenic	AB0207	<0.050	0.050	mg/l	93	98	0	206.2
Cadmium	AB0213	<0.800	0.800	ug/l	122	96	0	213.2
Copper	AB0210	<0.020	0.020	mg/l	99	108	0	220.1
Iron	AB0214	<0.050	0.050	mg/l	87	97	0	236.1
Lead	AB0207	<5.00	5.00	ug/l	98	105	1	239.2
Nickel	AB0210	<0.050	0.050	mg/l	96	104	0	249.1
Zinc	AB0208	<0.200	0.200	mg/l	106	113	0	289.1
Cadmium	AB0208	<0.050	0.050	mg/l	90	99	0	7130
Lead	AB0208	<0.100	0.100	mg/l	97	103	0	7420

QUALITY CONTROL DATA: ORGANIC ANALYTES

Matrix: Water

Analyte	Lab Batch#	Analytical Blank	MDL	Units	QC %REC	Spike %REC	Dup %RPD	Method
A-BHC	AB0206	<0.5	0.5	ug/l		30		608
B-BHC		<0.5	0.5	ug/l		91		608
G-BHC		<0.5	0.5	ug/l		30		608
D-BHC		<0.5	0.5	ug/l		53		608
Heptachlor		<0.5	0.5	ug/l		40		608
Aldrin		<0.5	0.5	ug/l		54		608
Heptachlor epoxide		<0.5	0.5	ug/l		54		608
Endosulfan I		<0.5	0.5	ug/l		54		608
Dieldrin		<0.5	0.5	ug/l		60		608
p,p'-DDE		<0.5	0.5	ug/l		58		608
Endrin		<0.5	0.5	ug/l		41		608
Endosulfan II		<0.5	0.5	ug/l		84		608
p,p'-DDD		<0.5	0.5	ug/l		60		608
Endrin Aldehyde		<0.5	0.5	ug/l		89		608
Endosulfan Sulfate		<0.5	0.5	ug/l		100		608
p,p'-DDT		<0.5	0.5	ug/l		99		608
Chlordane		<0.5	0.5	ug/l				608
Toxaphene		<0.5	0.5	ug/l				608
PCB 1016		<0.5	0.5	ug/l				608
PCB 1221		<0.5	0.5	ug/l				608
PCB 1232		<0.5	0.5	ug/l				608
PCB 1242		<0.5	0.5	ug/l				608
PCB 1248		<0.5	0.5	ug/l				608
PCB 1254		<0.5	0.5	ug/l				608
PCB 1260		<0.5	0.5	ug/l				608

psi

QUALITY CONTROL DATA: ORGANIC ANALYTES

Matrix: Soil

Analyte	Lab Batch#	Matrix Blank	MDL	Units	QC %REC	Spike %REC	Dup %RPD	Method
A-BHC	MB0207	<0.02	0.02	mg/kg		57		8080
B-BHC		<0.02	0.02	mg/kg		101		8080
G-BHC		<0.02	0.02	mg/kg		53		8080
D-BHC		<0.02	0.02	mg/kg		81		8080
Heptachlor		<0.02	0.02	mg/kg		74		8080
Aldrin		<0.02	0.02	mg/kg				8080
Heptachlor epoxide		<0.02	0.02	mg/kg		80		8080
Endosulfan I		<0.02	0.02	mg/kg		75		8080
Dieldrin		<0.02	0.02	mg/kg		82		8080
p,p'-DDE		<0.02	0.02	mg/kg		79		8080
Endrin		<0.02	0.02	mg/kg		72		8080
Endosulfan II		<0.02	0.02	mg/kg		102		8080
p,p'-DDD		<0.02	0.02	mg/kg		87		8080
Endrin Aldehyde		<0.02	0.02	mg/kg		112		8080
Endosulfan Sulfate		<0.02	0.02	mg/kg		127		8080
p,p'-DDT		<0.02	0.02	mg/kg		123		8080
Methoxychlor		<0.02	0.02	mg/kg		109		8080
Chlordane		<0.02	0.02	mg/kg				8080
Toxaphene		<0.02	0.02	mg/kg				8080
PCB 1016		<0.02	0.02	mg/kg				8080
PCB 1221		<0.02	0.02	mg/kg				8080
PCB 1232		<0.02	0.02	mg/kg				8080
PCB 1242		<0.02	0.02	mg/kg				8080
PCB 1248		<0.02	0.02	mg/kg				8080
PCB 1254		<0.02	0.02	mg/kg				8080
PCB 1260		<0.02	0.02	mg/kg				8080

Matrix: Water

Analyte	Lab Batch#	Analytical Blank	MDL	Units	QC %REC	Spike %REC	Dup %RPD	Method
Total Recoverable Petroleum Hydrocarbons	AB0203	<1.0	1.0	mg/l	84	88		418.1

Matrix: Soil

Analyte	Lab Batch#	Matrix Blank	MDL	Units	QC %REC	Spike %REC	Dup %RPD	Method
Total Recoverable Petroleum Hydrocarbons	MB0203	<10.0	10.0	mg/l	101		9	9073

SURROGATE RECOVERY SUMMARY

Matrix: Water/Soil

PSI LAB #	1-Bromo-2 -Dichloropropane (601/8010)	a,a,a-TFT (602/8020)	2,4,5,6-Tetrachloro m-xylene (608/8080)	Dibutyl Chlorendate (608/8080)	2-Fluorobiphenyl (610/8100)	Nitrobenzene (610/8100)
01248-01				99		
01248-02				73		

CHAIN OF CUSTODY RECORD

psi — Professional Service Industries, Inc.

PROJECT NAME	REPORT TO	INVOICE TO
Phillipi Creek Main "C"	PSI	PSI
PROJECT NUMBER	**PROJECT MANAGER**	**ADDRESS**
387-50057	Keith L. Butts	430 Interstate Court
P.O. NUMBER	**ADDRESS**	**CITY / STATE / ZIP**
N/A	430 Interstate Court	Sarasota, FL 34240
REQUIRED DUE DATE	**CITY / STATE / ZIP**	**ATTENTION**
2-14-95	Sarasota, FL 34240	Keith L. Butts
SAMPLES TO LAB VIA	**TELEPHONE** (813) 378-9001	**TELEPHONE**
Bernie Martin	**FAX** (813) 378-3972	(813) 378-9001
NUMBER OF COOLERS	**REPORT VIA** VERBAL (FAX)	
1	U.S. MAIL/OVERNIGHT	

LABORATORY SUBMITTED TO:

- ☐ 6913 Hwy. 225, Deer Park, TX 77536, (713) 479-8307
- ☐ 4820 W. 15th Street, Lawrence, KS 66049, (800) 548-7901
- ☑ 6056 Ulmerton Road, Clearwater, FL 34620, (813) 531-1446
- ☐ 850 Poplar Street, Pittsburgh, PA 15220, (412) 922-4000

TRANSFER NUMBER	RELINQUISHED BY DATE / TIME	ACCEPTED BY DATE / TIME	SEAL NUMBER
	C.B. Nicholas 1/31/95	R. Dalal 1/31/95 11:20	

LABORATORY USE ONLY

SAMPLE CUSTODIAN	DATE / TIME

LABORATORY USE ONLY

FIELD SERVICES Y/N $

SHIPPING Y/N $

LABORATORY USE ONLY

ANALYTICAL DUE DATE 2-14-95

REPORT DUE DATE

INORGANIC Sect ____ Row ____ ORGANIC Sect ____ Row ____

PSI PROJECT NAME

PSI PROJECT # 5P028-0005

PSI BATCH #

PARAMETER LIST

	SAMPLE IDENTIFICATION (01248)	DATE / TIME	COMP-C GRAB-B	SOIL-S WATER-W WASTE-X	LAB USE ONLY LAB NUMBER	NUMBER OF CONTAINERS
01	1	1-30/3:30	G	W		see attached list
02	2	1-30/4:00	G	S		

RECEIVED JAN 31 1995 BY

ADDITIONAL REMARKS

SAMPLER'S SIGNATURE Keith L. Butts

PSI A-809-10 (1)

APPENDIX A: NARRATIVE

LABORATORY PROJECT ID: 01248 INORGANIC / ORGANIC

A. SAMPLE RECEIPT	YES	NO	COMMENT	INIT.
1. C-O-C present & complete	✓			BD
2. Samples match with C-O-C	✓			
3. Temperature @ 4°C	✓			
4. Shuttle Seal Present	✓			
5. Container Condition Acceptable	✓			
6. Other _____				

B. GENERAL OBSERVATIONS	YES	NO	COMMENT	INIT.
1. Sediment				
2. Headspace				
3. Appropriate Container				
4. Enough Sample				
5. Odor/Color (Describe)				
6. Homogeneous				
7. MultiPhasic				
8. Other _____				

C. ANALYTICAL OBSERVATIONS	YES	NO	COMMENT	INIT.
1. Analyzed within Holding times				
2. Confirmation (Describe MS, 2nd Column, 2nd Detection)				
3. Matrix interferences	✓			
4. Other _____				

D. GENERAL COMMENTS:

-BOD PROBLEMS: INITIAL D.O. OF SAMPLE [redacted] > 9.0 ppm
Sample is either supersaturated with Oxygen or shows false reading.
BOD analysis did not follow the correct trend - results questionable
due to this interferance

BY: MC DATE: 2/7

APPENDIX A: NARRATIVE

ABORATORY PROJECT ID: 01248 INORGANIC / ORGANIC

A. SAMPLE RECEIPT	YES	NO	COMMENT	INIT.
1. C-O-C present & complete	✓			BP
2. Samples match with C-O-C	✓			
3. Temperature @ 4°C	✓			
4. Shuttle Seal Present	✓			
5. Container Condition Acceptable	✓			
6. Other _____				

B. GENERAL OBSERVATIONS	YES	NO	COMMENT	INIT.
1. Sediment				
2. Headspace				
3. Appropriate Container				
4. Enough Sample				
5. Odor/Color (Describe)				
6. Homogeneous				
7. MultiPhasic				
8. Other _____				

C. ANALYTICAL OBSERVATIONS	YES	NO	COMMENT	INIT.
1. Analyzed within Holding times	✓			fw
2. Confirmation (Describe MS, 2nd Column, 2nd Detection)		✓		
3. Matrix interferences		✓		
4. Other _____				

D. GENERAL COMMENTS:

BY: _____ DATE: _____