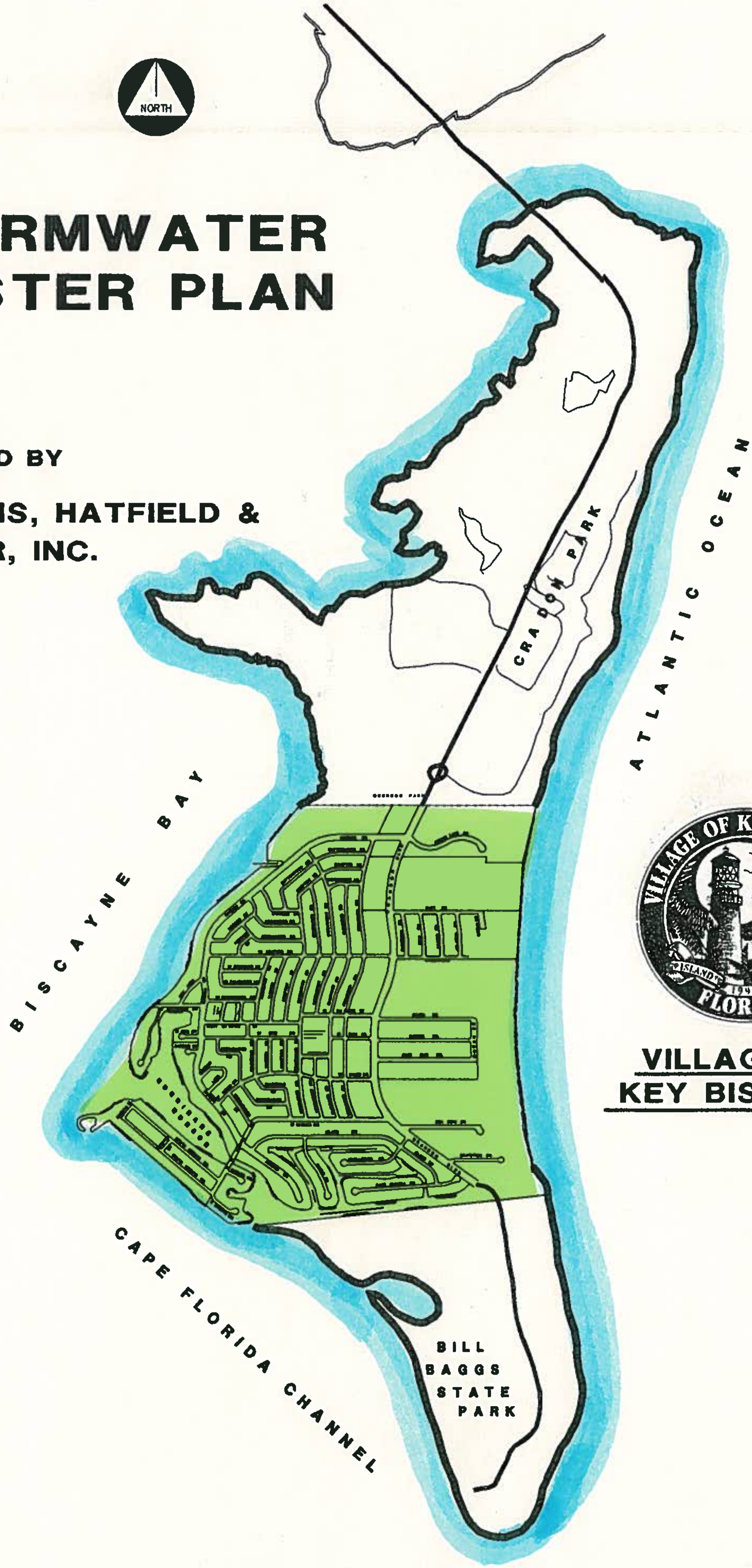
STORMWATER MASTER PLAN

PREPARED BY

WILLIAMS, HATFIELD & STONER, INC.



VILLAGE OF KEY BISCAYNE

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Village Stormwater Management Master Plan

for the

Village of Key Biscayne

September, 1993

Prepared by:

Williams, Hatfield & Stoner, Inc.
Engineers • Planners • Surveyors
3191 Coral Way, Suite 804
Miami, Florida 33145

VILLAGE OF KEY BISCAYNE
STORMWATER MASTER PLAN

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VILLAGE OF KEY BISCAYNE
STORMWATER MASTER PLAN

Executive Summary

ES.1 Introduction

The Village of Key Biscayne contracted with Williams, Hatfield and Stoner, Inc. in April 1993 to prepare a Stormwater Master Plan for the public rights-of-way in the area generally west of Crandon Boulevard. The need for this planning effort was, in part, stimulated by the requirements of the relatively recent Federal regulation known as the National Pollution Discharge Elimination System (NPDES). This legislation requires municipalities to adopt capital improvement plans for stormwater management and a dedicated funding source to implement those plans.

The purpose of this study, therefore, is to develop a capital improvements plan that will reduce the incidence of flooding and improve the quality of stormwater discharged from the study area within the Village. The improvements recommended in this plan will primarily be funded with the revenues generated through the Village's Stormwater Management Utility (SMU). Those funds may be supplemented with other sources such as grants.

The scope of this study includes an analysis of existing conditions, stormwater calculations to determine stormwater management needs, and an evaluation of alternatives for serving the projected volumes of stormwater runoff.

ES.2 Existing Conditions

The existing stormwater management systems on Key Biscayne are a combination of positive drainage systems and seepage (exfiltration) facilities. These systems were installed on a piecemeal basis to address localized flooding problems.

Details of the existing stormwater management system were obtained through field survey and other available information and a database was created (using LOTUS 123 release 3.0 software) to record this information. This database should be updated by the Village as the stormwater management systems are improved.

The elevational characteristics of the study area limit the effectiveness of the existing positive drainage systems. The high water table and low "head" (difference in elevation between surface and water table elevations) result in the catch basins filling up with water and draining very slowly. This is due to the lack of elevational change that is necessary to force water to drain.

The soil characteristics in the study area also limit the effectiveness of exfiltration systems. Soils are very silty to a depth of approximately 25 feet and have very slow percolation rates (.00001 cubic feet per second per square foot per foot of head). Though the auger wells and french drains in the study area can provide storage and slow exfiltration during relative light rain events, they are less productive in heavier rains due to the slow percolation rate.

ES.3 Needs Analysis

Current regulations administered by Dade County's Department of Environmental Resource Management (DERM) require that the municipality's stormwater management system handle the rain intensity of a 5-year storm and provide retention and pretreatment for the first inch of runoff. The existing system in the study area was evaluated based on these water quantity and quality criteria and professional engineering judgement and was found to be inadequate.

A base map of the Village was developed and drainage basins defined as the basis for calculating the demands on the future stormwater management system. The Village was divided into nine drainage basins based on elevational characteristics. The study area includes eight of these nine basins.

The areas, impervious/pervious percentages, and swale storage volumes were calculated for each drainage basin. Using the Rational Method, the volumes of runoff that must be managed in each basin were calculated. (For drainage calculations for each basin see Appendix E.)

An evaluation of alternatives to manage the calculated runoff volumes and provide retention and pretreatment of the first inch of runoff was prepared based on the analysis of existing conditions and results of the needs analysis.

ES.4 Alternatives Evaluation

The five alternatives evaluated are listed below:

- On-site retention or detention
- Exfiltration or seepage systems
- Positive drainage systems with direct outfall
- Positive drainage with pump stations, injection or gravity wells, and emergency outfalls
- Positive drainage system with drainage wells and emergency outfalls

The alternatives considered feasible enough to warrant a detailed analysis were the latter two which both utilize drainage wells. The primary difference between the two alternatives is that one utilizes pumps to force water into the wells and the other relies on gravity for drainage.

After a detailed cost analysis for both alternatives, the development of a positive drainage system with drainage wells that do not rely on pump stations was recommended due to the high cost and maintenance requirements associated with the use of pump stations.

The cost of providing this stormwater management alternative for each basin is provided in Chapter 3, Exhibit 3.7. The costs per basins range from $184,000 to $1.2 million. The total system cost is estimated at $4.9 million.

ES.5 Recommendations and Implementation Guidelines

The Village may choose to construct these facilities over a period of years based on available revenue or all of the facilities could be provided in one to two years if some sort of debt financing is utilized.

If the pay-as-you-go funding method is chosen, the Village will need to prioritize the drainage basins to determine which facilities to construct first with available revenues. To assist in this task, an initial attempt to prioritize the basins based on historical flooding and the potential to maximize short-term water quality improvements is provided in Chapter 4, Exhibit 4.1.

The debt financing techniques available to the Village, revenue bond financing or bank financing, are also described in Chapter 4. If either of these financing methods are chosen, the need to prioritize basin improvements would be eliminated and the improvements to the stormwater management system in the entire study area could be completed in a relatively short period of time.

Other recommendations related to implementing a stormwater management program are included in Chapter 4. These recommendations are divided into the three tasks typically associated with a stormwater management program; administration, operations and maintenance and capital improvements.

VILLAGE OF KEY BISCAYNE
STORMWATER MASTER PLAN

Chapter 1
Existing Conditions

1.0 Introduction

The preparation of this Stormwater Master Plan is not the first effort to improve stormwater management on Key Biscayne. In 1969 the Key Biscayne Storm Drainage Improvement Special Taxing District was established by Dade County Resolution R-1301-69 to provide drainage improvements including catch basins, collection pipes and outfalls. Between 1968 and 1969, the Crandon Boulevard drainage system was also constructed. Several other public and private drainage systems have been installed since these efforts in the late 60's.

The Village, which was previously within unincorporated Dade County, incorporated in 1991. The Village established a Stormwater Management Utility (SMU) in 1993 as a means to improve stormwater management conditions within the Village and to meet National Pollution Discharge Elimination System (NPDES) requirements[1]. The purpose of the SMU is to establish a dedicated source of revenue to make stormwater management improvements in the public rights-of-way that address both water quantity (flooding) and water quality (pollution) problems.

1.1 Scope of the Stormwater Master Planning Study

The Village contracted with Williams, Hatfield and Stoner, Inc. (WHS) in April 1993 to prepare a Stormwater Master Plan for the public rights-of-way within a portion of the Village. The purpose of this plan is to set out a financially feasible capital improvements program for stormwater management within these rights-of-way that can be funded primarily with the revenues generated by the Village's SMU and supplemented with other revenue sources such as grants.

This Stormwater Master Plan contains the following information:

- a description of the existing conditions related to the stormwater management system;
- an analysis of existing deficiencies and future needs;
- an evaluation of alternatives to meet those needs;

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[1] The Federal regulation (40 CFR Parts 122,123, 124) regulating the quality of stormwater runoff entering waters of the United States.

- and recommendations, priorities and a phased implementation schedule for stormwater management improvements.

1.2 Description of the Study Area

The entire Village is included in the project area, though the study area for purposes of master plan recommendations does not encompass the entire Village. The study area is described below along with the characteristics that affect stormwater management planning.

1.2.1 Regional Location

The Village of Key Biscayne is in Dade County, Florida. The Village is located in the center of an island (Key Biscayne) which is approximately 5.5 miles east of Downtown Miami. Access to the Village is by the Rickenbacker Causeway. The regional location of the Village is shown on Exhibit 1.1.

1.2.2 General Location

The Village is approximately 850 acres bounded on the east by the Atlantic Ocean, the west by Biscayne Bay, the north by Crandon Park and the south by Bill Baggs State Park. The general location of the Village is shown on Exhibit 1.2.

1.2.3 The Study Area

The study area, for purposes of master plan recommendations, is that area of the Village generally west of Crandon Boulevard excluding those streets served by the Crandon Boulevard drainage system. The study area is approximately 370 acres.

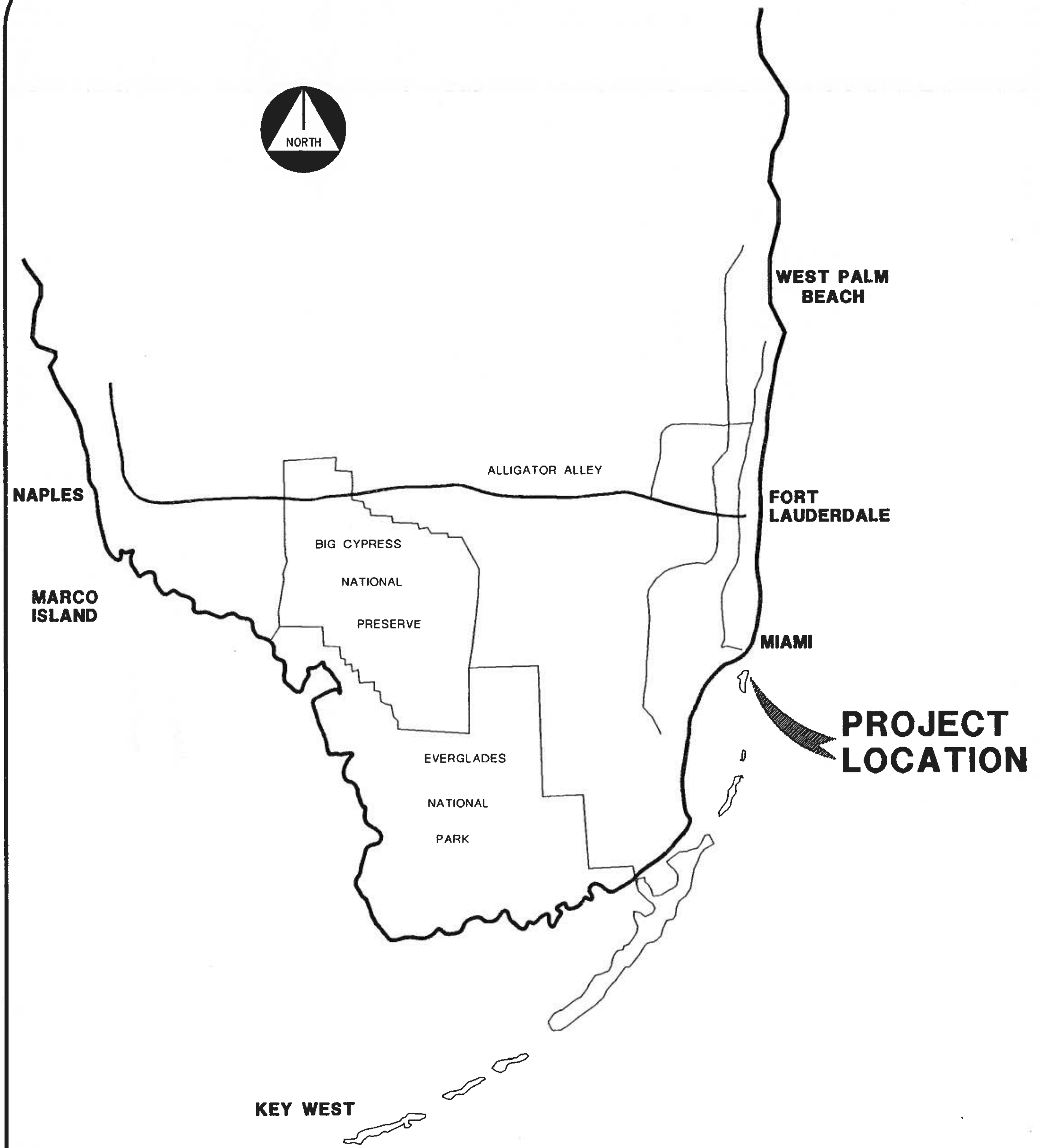
The streets east of Crandon Boulevard, while part of the City's street system, either have drainage improvement projects currently under design or are connected to the Crandon Boulevard System and are being addressed by others.

The Village and the study area are shown on Exhibit 1.3.

1.2.4 Land Use

The future land uses in the Village are shown on Exhibit 1.4. The study area is predominately single family homes, with an elementary school centrally located within the neighborhood and commercial development along Crandon Boulevard.

Currently, there is one vacant tract of land in the study area. It is approximately 10 acres and is adjacent to and west of Crandon Boulevard. It is designated to become a recreational land use in the future and thus should remain predominately pervious.



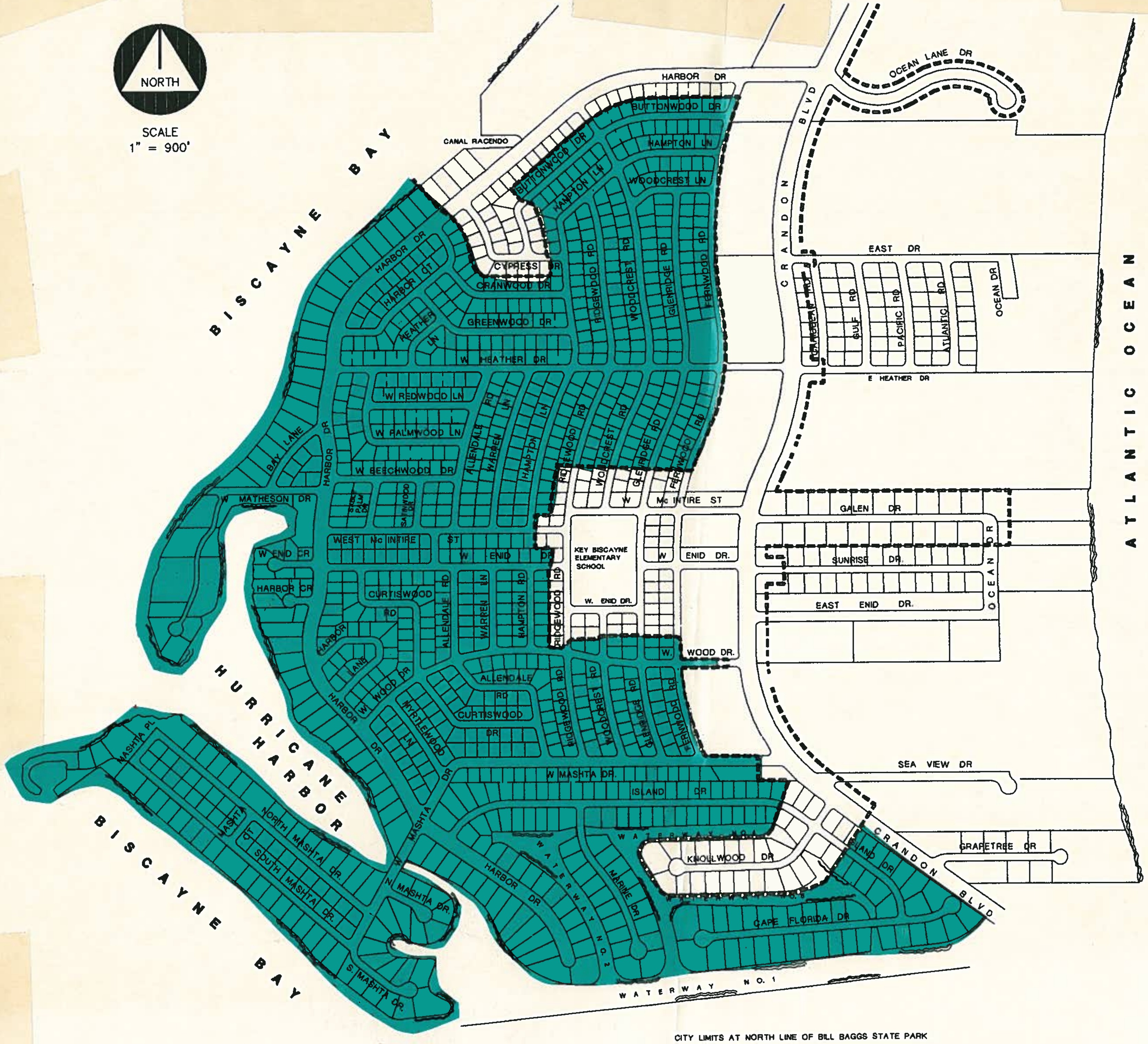
WILLIAMS, HATFIELD & STONER, INC.

REGIONAL LOCATION
EXHIBIT 1.1

VILLAGE OF KEY BISCAYNE

WILLIAMS, HATFIELD & STONER, INC.

GENERAL LOCATION EXHIBIT 1.2

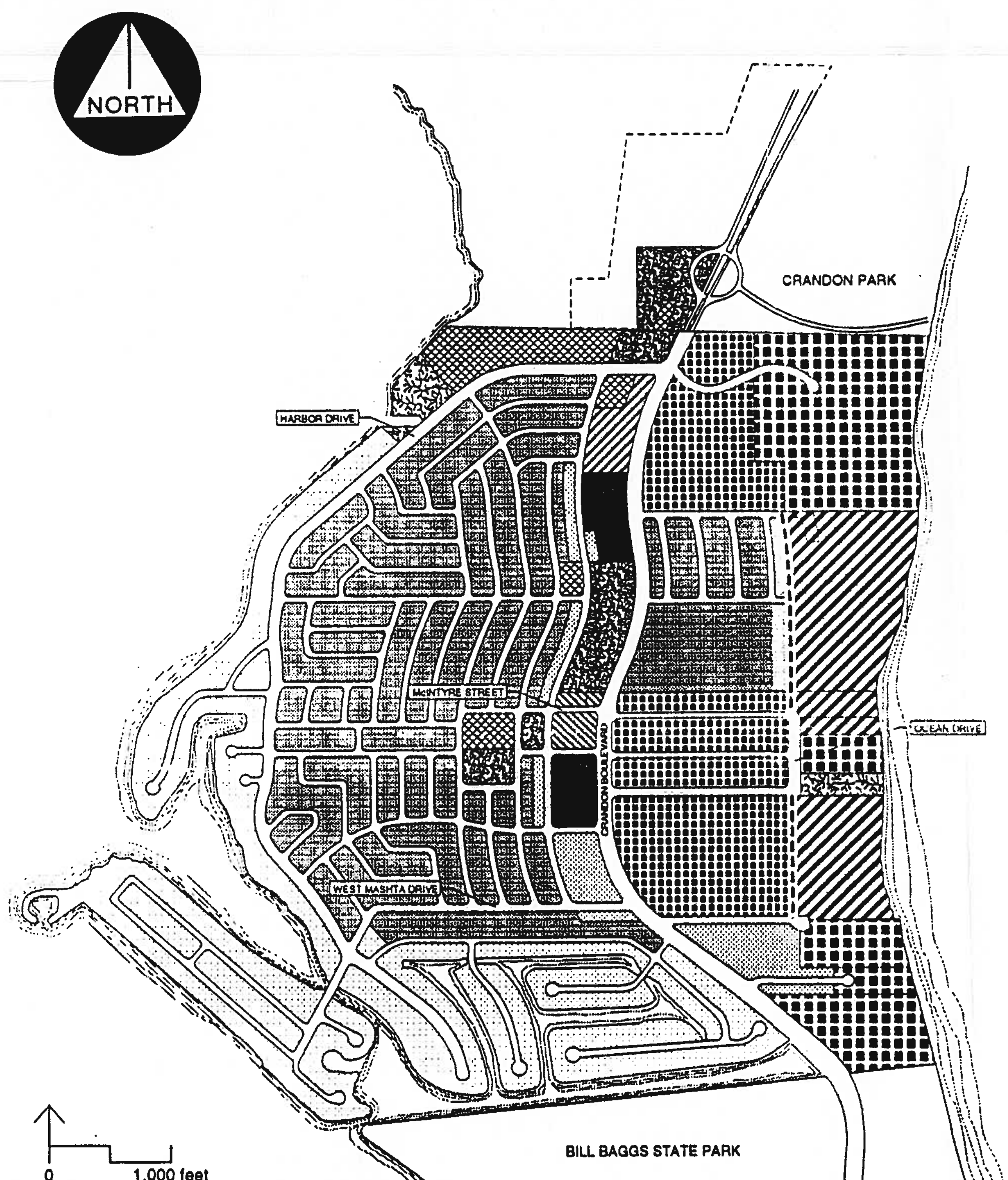


DENOTES PROJECT STUDY AREA

VILLAGE OF KEY BISCAYNE FLORIDA

PROJECT STUDY AREA
EXHIBIT 1.3

WILLIAMS, HATFIELD & STONER, INC.



VILLAGE OF KEY BISCAYNE

Source: Robert K. Swarthout, Incorporated April 1993

Preliminary
FUTURE LAND USE MAP

- **Low Density Single Family Residential** — 15,000 sq. ft. minimum lot size
- **Medium Density Single Family Residential** — 7,500 sq. ft. minimum lot size
- **Townhouse Residential** — Up to 10 units per acre maximum
- **Medium Density Multifamily Residential** — Up to 16 units per acre maximum
- **High Density Multifamily Residential** — Up to 30 units per acre maximum
- **Retail Commercial** — 2 story maximum height and 35% maximum lot coverage by buildings
- **Office Commercial** — 2 story maximum height and 35% maximum lot coverage by buildings
- **Village Center Retail** — 2 story maximum height and 35% maximum lot coverage by buildings
- **Ocean Resort Hotel** — 9 story maximum height and 30% maximum lot coverage by buildings
- **Public and Institutional** — 2 story maximum height and 30% maximum lot coverage by buildings
- **Semi Public Waterfront Recreation and Open Space** — 2 story maximum height and 15% maximum lot coverage by buildings
- **Public Recreation and Open Space** — 1 story maximum height and 15% maximum lot coverage by buildings

VILLAGE OF KEY BISCAYNE FLORIDA

FUTURE LAND USE
EXHIBIT 1.4

WILLIAMS, HATFIELD & STONER, INC.

The area east of Crandon Boulevard that is outside the study area is a mixture of single family homes, hotels and highrise residential development. Currently, one large parcel east of Crandon Boulevard, which is part of the Sheraton Royal Biscayne Hotel property, is vacant. Another large parcel in this area is currently under development.

It should be noted that examining the land use in the study area is for descriptive purposes only. This study pertains only to the land area encompassed by the public rights-of-way (plus an additional 15 feet on either side). Land uses and the associated impervious/pervious characteristics were, therefore, not considered in the stormwater calculations described in Chapter 2.

1.3 Factors that Affect Stormwater Management Planning

Many factors affect the methods that can be used for stormwater management in a given area. These include topography, water table elevations, soil infiltration rates, rainfall intensity and regulatory requirements. These factors and how they affect stormwater management planning on Key Biscayne are explained below.

1.3.1 Topography

As part of this study, the public rights-of-way in the study area were surveyed and spot elevations were taken every 100 feet along the roadway centerline profile. These elevations are shown on the Stormwater Master Plan which is provided in Appendix A. General land contours were generated from the spot elevations and are shown on the Stormwater Master Plan. The contours reflect the general slope of the roadways. The raised house pads and landscape features were not considered in the contour modelling.

The topography on Key Biscayne is very flat. In general, the elevations of the roadways are approximately 3.5 to nearly 6 feet above mean sea level (msl). This is generally only 1.5 to 4 feet above the average high tide elevation (2 feet above msl).

The low elevations are significant because the closer the outfall water elevation is to the land surface, the fewer options there are for stormwater management. If the land elevation and the outfall water elevation are already nearly the same, the water will pool on the land or flow off very slowly. The difference in elevation between water on the surface of the land and the outfall water elevation is referred to as "head". This concept is central to stormwater management as it takes a certain difference in elevation, or head, to force water to drain or run off the land surface.

1.3.2 Water Table Characteristics

The elevation of the water table below the land surface is critical to stormwater management planning. The zone between the water table and the land surface is the area that can be used for soil storage of exfiltrated water and storage for retention/detention basins. The elevation of the water table also controls the available head to force stormwater to drain into drainage wells.

The water table below Key Biscayne is totally influenced by tidal waters. Mean high water of two feet above msl was used as the basis for future stormwater management planning in this study. Given the high water table elevation and the elevations taken on the public rights-of-way within the study area, there is, on average, only 1 to 3 feet of head typically available in the study area to force stormwater to drain.

1.3.3 Infiltration Rates

The soil infiltration rate, (the rate at which water will be absorbed by the ground), is very important for stormwater management planning. If water is absorbed quickly, there is less surface water runoff and more water can be removed from the land in a smaller amount of time. If water is absorbed slowly, there is more surface water runoff and larger amounts of land are necessary for stormwater retention purposes.

The soils on Key Biscayne are very silty, which means the soil particles are very small. These small particles do not allow water to soak into them very quickly.

Water that does eventually infiltrate into the ground is stored in the soil above the water table until it is gradually drained. When the soil becomes saturated, infiltration is greatly reduced thus increasing the amount of surface water runoff from the remainder of the storm.

Existing geotechnical reports (from Law Engineering Inc. and Ardaman & Associates), which provided soil boring data and recent percolation tests were reviewed to determine exfiltration rates (exfiltration rate is the time it takes for water to be absorbed by the ground from a drainge pipe in a trench or well). The geotechnical test information is provided in Appendix B. This data shows that the silty soils in the Village occur as deep as 25 feet below ground and the percolation rate of the soil is only .00001 cubic feet per second (per ft^2 per foot of head), which is very slow.

1.3.4 Rainfall Information

The amount of rainfall affecting an area and the correlation between rain events and flooding is a good indicator of the amount of rain that the existing stormwater management system is designed to handle. The amount of rain in the storm that can be handled by the stormwater system is correlated to its probability of exceedance in years (i.e., one time in two years, one time in five years, etc). This storm is then referred to as the "design storm" or "level of service" for which the stormwater system can be expected to function properly. A storm with greater amounts of rainfall than the design storm will generate more runoff than the stormwater management system is designed to remove and some flooding may result depending on the specific storm's intensity and duration.

Unfortunately, no rainfall data is available for Key Biscayne specifically. The closest rain gauge is located at Miami International Airport. Dade County standard rainfall intensity curves for the five year storm, therefore, was used to calculate the amount of runoff that should be anticipated by the future stormwater management systems in the study area.

1.3.5 Stormwater Management Regulations

Stormwater management regulations relating to both water quality (pollution) and water quantity (flooding) have become more stringent at all levels of government, Federal, State and County. Agencies regulating the quality of stormwater discharge include the Federal Environmental Protection Agency (EPA), the South Florida Water Management District (SFWMD), The Florida Department of Environmental Protection (DEP - formerly DER), and Dade County Department of Environmental Resource Management (DERM).

The two agencies that affect activities on Key Biscayne the most are the EPA administering National Pollution Discharge Elimination System (NPDES) regulations and DERM with their water quality and water quantity standards for facility design.

1.3.5.1 National Pollution Discharge Elimination System (NPDES)

DERM requirements must be followed for new construction and NPDES requires retrofitting of existing systems to bring them up to acceptable standards in regard to the quality of stormwater discharged.

The EPA administers NPDES regulations. An NPDES permit application (known as Part II) must be submitted by municipalities to EPA within the time frames specified in the law. The permit application contains capital improvement plans and describes stormwater management practices to be applied to improve the quality of stormwater discharge and must identify a dedicated funding source to pay for these improvements. If EPA finds these plans acceptable, a 5-year NPDES permit is granted that allows the jurisdiction to discharge stormwater into "waters of the United States". The improvement plans are attached as conditions to this permit.

1.3.5.2 Dade County DERM Stormwater Management Regulations

Dade County DERM has established standards that stormwater management systems must comply with to be permitted. These regulations are described in detail in Appendix C and the key aspects of these regulations that affect the drainage alternatives to be considered for the Village are summarized below.

The Design Storm - Water Quality Requirements

DERM has established design storm frequencies and flood limits for various street cross-sections. For two lane roads in residential and commercial areas, such as those in the study area, the street drainage system must be able to remove the runoff from a storm with a 5-year return frequency.

The use of the design storm is one of the critical elements in determining what type of drainage system can be used in the study area in regard to the quantity of water that must be managed.

Retention, Pretreatment - Water Quality Requirements

DERM regulations state that where full on site retention can not be provided, an emergency overflow may be permitted if there are facilities in place that will provide retention for the first inch of runoff. Permits are required for emergency overflow into any water body in Dade County.

The purpose of providing retention and pretreatment for the first inch of runoff is that this first flush of water is most likely to contain the heaviest concentration of pollutants.

Pretreatment of runoff must be provided prior to discharge into the seepage or other exfiltration facility. This pretreatment is performed by a variety of methods such as swale retention or pollution control devises that serve as grease and oil separators as well as settling chambers.

1.4 Existing Stormwater Management Systems

The drainage systems currently in place in the Village are a combination of positive drainage systems and seepage systems. A positive drainage system refers to one in which water is transported directly from the land to a continuous outfall to the bay or ocean. A seepage system is one that utilizes the permeability of the soil for both retention (temporary storage) and cleansing of a portion of the stormwater. Once the soil is saturated in a seepage system, the remainder of the water to be drained becomes runoff and is transported by the positive drainage system to the outfall.

The information on the existing drainage system was gathered from various sources. These include:

- Field survey;
- Crandon Boulevard widening construction plans - FDOT Project Number 87052-3622;

- Dade County Environmental Resource Management (DERM) Stormwater Monitoring and Evaluation Section;
- Recorded DERM outfall permits;
- Plans from C.A.P. Engineering Consultants, Inc., project #30E305.

The Village's existing stormwater management system is shown on Exhibit 1.5. Though the individual details are not discernable on Exhibit 1.5 due to its small size, the exhibit does show the general location of facilities and where no drainage infrastructure is in place. The specifics of the existing system are clearly shown on the Stormwater Master Plan in Appendix A.

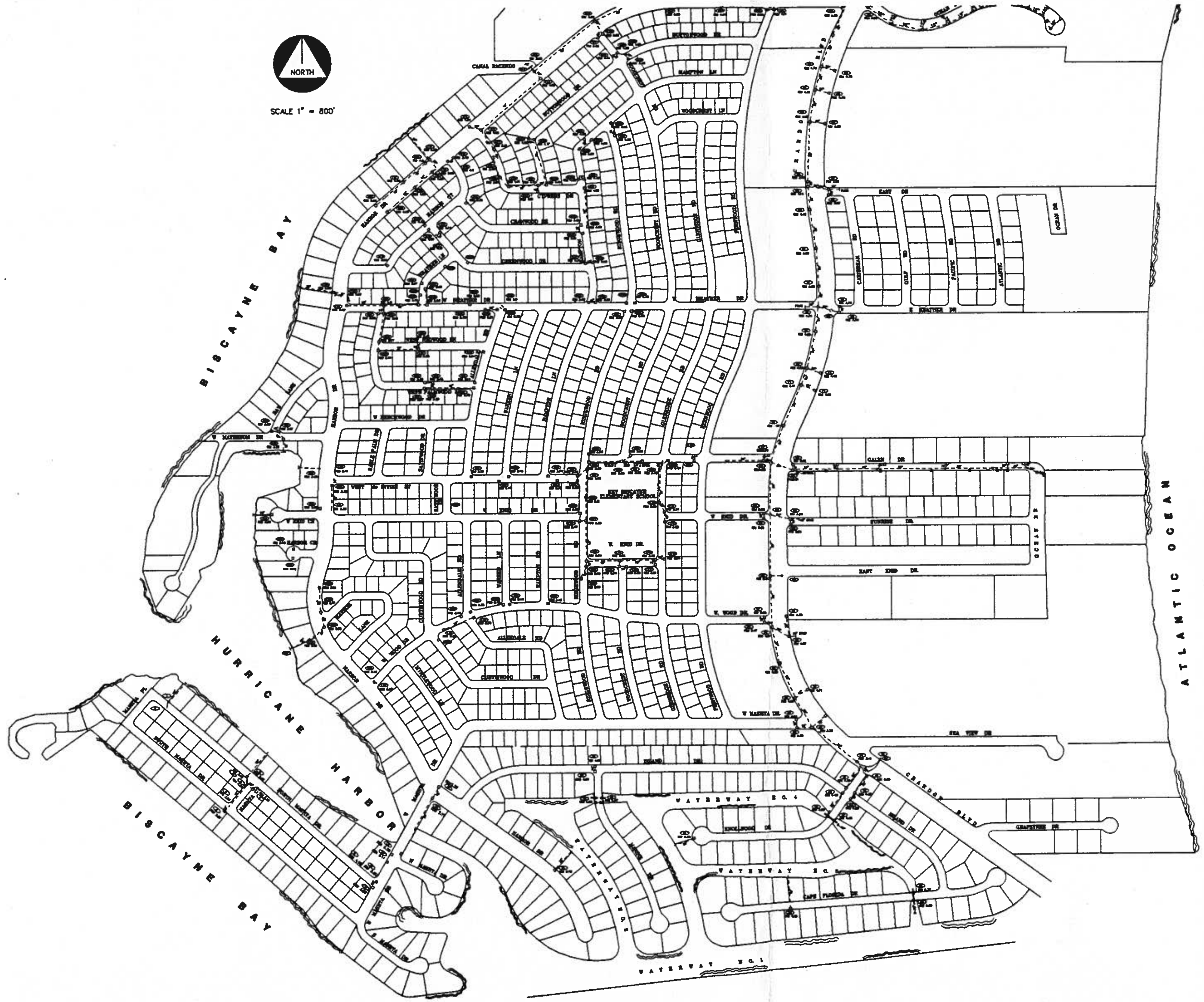
1.4.1 Positive Drainage System Inventory

Catch Basins - Rim elevations, inverts, pipe size, pipe direction and visual condition of the catch basins were evaluated through field survey. It was assumed that those catch basins that did not have pipes connected to them were actually auger wells which are part of the Village's exfiltration system. Once installed, catch basins and auger wells look similar when filled with water and debris so a more definitive determination could not be made.

Exhibit 1.6 contains the database of information on each documented catch basin. This information was obtain through field survey and the best available information. Some existing catch basins may have been covered by grass or other vegetation and were, therefore, not recorded.

The inventory in Exhibit 1.6 was recorded in a database software (Lotus 123 release 3.0) and is meant to serve as a tool for the Village to use to keep updated and accurate records of maintenance activities and additions to the system. As more information is collected during the final design and construction phases of the stormwater program, it should be added to the database.

Outfalls - There are 23 outfalls from individual drainage systems permitted by DERM in the Village (See Appendix D). The outfalls range from 8" to 48" in size and were permitted and installed between 1969 and 1992. Many of the outfalls were constructed between two residential lots which limits access to them. It could not be determined, therefore, if all of these outfalls are open and functioning. Some may be silted over or otherwise inoperable. Available information on the outfalls is included in the database shown in Exhibit 1.6.



VILLAGE OF KEY BISCAYNE
ISLAND PARADISE
1991
FLORIDA

VILLAGE OF
KEY BISCAYNE
FLORIDA

LEGEND

125
RIM 3.34
15"
EXISTING INLET W/PIPE SIZE ,INLET NO & RIM ELEV.

EXISTING STORMWATER MANAGEMENT SYSTEMS
EXHIBIT 1.5

WILLIAMS, HATFIELD & STONER, INC.

VILLAGE STORMWATER MANAGEMENT MASTER PLAN
EXISTING DRAINAGE STRUCTURE INVENTORY

EXHIBIT 1.6

JOB NO: 3225.00
FIELD BOOKS: L–13, L–16
FILE: 3225TMFA.WK3
DATE: 8–16–93

(1) STRUCTURE TYPE:
CB = CATCH BASIN
MH = MANHOLE
HW = HEADWALL

(2) PIPE TYPE:
C = CONCRETE
CMP = CORR. METAL PIPE

(3) PROPOSED REHABILITATION TYPE:
1 = ADD BAFFLE
2 = ADD PAV'T & BAFFLE
3 = REPAIR FRAME & GRATE OR TOP SLAB, ADD BAFFLE
4 = CLEAN, REPAIR STRUCT. &/OR ADD PIPES
5 = REMOVE AND REPLACE STRUCTURE

WHS STRUCT NO.	STRUCT TYPE (1)	LOCATION HOUSE No. or INTERSECTING ST.	STREET NAME	STR RIM ELEV	PIPE INVERTS, SIZE, TYPE (2) N	PIPE SIZE/ TYPE	S	PIPE SIZE/ TYPE	E	PIPE SIZE/ TYPE	W	PIPE SIZE/ TYPE	PROP REHAB TYPE (3)	VISUAL CONDITION OF STRUCTURE OR DATE OF LAST MAINT
1	CB	730	N MASHTA DR	3.80					–0.16	12"C	–0.10	12"C	3	LOW RIM
2	CB	735	N MASHTA DR	3.70					–0.05	12"C			3	LOW RIM
3	CB	621	S MASHTA DR	3.67					1.33	12"C			1	3/93 OK
4	CB	650	S MASHTA DR	3.88							0.98	12"C	4	OK
5	CB	640	N MASHTA DR	4.23			1.03	12"C	2.13	12"C			1	OK
6	CB	620	N MASHTA DR	3.70	1.20								1	OK
7	CB	640	N MASHTA DR	3.90			SW1.75	12"C	1.20	12"C			1	OK
8	CB	631	N MASHTA DR	3.42					0.92	12"C	1.02	12"C	4	WELL 1 LOCATION
9	CB	501	N MASHTA DR	4.10									5	FULL OF DIRT
10	CB	501	N MASHTA DR	3.83							–1.77	15"C	5	OK
11	CB	500	N MASHTA DR	3.87					–0.20	15"C			5	FILLED IN
12	CB	501	N MASHTA DR	4.11									5	FULL OF DIRT
13	CB	501	N MASHTA DR	3.35									5	WELL 2 LOCATION
14	CB	HARBOR DR	W MASHTA	3.11					–3.19	18"C	–3.21	24"C	4	OK
15	CB	HARBOR DR	W MASHTA	3.32							–3	18"C	4	OK
16	CB	911	HARBOR DRIVE	3.72					–2.06	15"C	–2.04	10"C	2	OK
17	CB	930	HARBOR DR	4.54										ELECTRICAL BOX
18	CB	WATER WAY 4	MARINE DR	4.23							–1.77		2	OK
19	CB	WATER WAY 4	MARINE DR	4.27					–1.63				2	OK
20	HW	WATER WAY 4	MARINE DR	4.65					–1.9	36"C			5	OUTFALL PLUGGED?
21	HW	WATER WAY 4	MARINE DR	4.63							–1.57	36"C	5	OUTFALL PLUGGED?
22	HW	WATER WAY 4	MARINE DR	4.63							–1.57	36"C	5	WEIR
23	HW	WATER WAY 4	MARINE DR	4.65					–1.75	36"C			5	WEIR
24	CB		ISLAND DRIVE	4.06	–0.74	15"							4	OK
25	CB	301	ISLAND DRIVE	4.55			–0.35	15"C					4	OK
26	CB	250	KNOLLWOOD	4.53							0.13	18"C	2	OUTFALL
27	CB	90	KNOLLWOOD	4.25					–1.75				2	OK
28	CB	100	KNOLLWOOD	4.35							–1.45		4	OK
29	HW	WATER WAY 4	KNOLLWOOD	4.82					–1.68	36"C				OUTFALL
30	HW	WATER WAY 4	KNOLLWOOD	4.82					–1.68	36"C				OUTFALL

VILLAGE STORMWATER MANAGEMENT MASTER PLAN
EXISTING DRAINAGE STRUCTURE INVENTORY

EXHIBIT 1.6

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FIELD BOOKS: L–13, L–16
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WHS STRUCT NO.	STRUCT TYPE (1)	LOCATION: HOUSE No. or INTERSECTING ST.	LOCATION: STREET NAME	STR RIM ELEV	PIPE INVERTS, SIZE, TYPE (2): N	PIPE SIZE/ TYPE	S	PIPE SIZE/ TYPE	E	PIPE SIZE/ TYPE	W	PIPE SIZE/ TYPE	PROP REHAB TYPE (3)	VISUAL CONDITION OF STRUCTURE OR DATE OF LAST MAINT
31	HW	WATER WAY 4	KNOLLWOOD	4.82							–1.68	36"C	2	OUTFALL
32	HW	WATER WAY 4	KNOLLWOOD	4.82							–1.68	36"C		OUTFALL
33	CB	WATER WAY 4	CAPE FLORIDA	4.15	0.6	15"C							4	OUTFALL
34	CB	200	CAPE FLORIDA	4.85			0.05	36"C					1	OK
35	CB	WATER WAY 5	CAPE FLORIDA	4.77	–1.53	36"C							4	WELL 5 LOCATION
36	HW	WATER WAY 5	CAPE FLORIDA	5.50			–1.1	36"C					1	OUTFALL
37	HW	WATER WAY 5	CAPE FLORIDA	5.50			–1.1	36"C					1	OUTFALL
38	HW	WATER WAY 5	CAPE FLORIDA	5.57	–1.63	36"C							1	OUTFALL
39	HW	WATER WAY 5	CAPE FLORIDA	5.57	–1.63	36"C							1	OUTFALL
40	CB	ISLAND DRIVE	KNOLLWOOD	4.40					0.7	30"C	0.3	30"C	1	OK
41	CB	ISLAND DRIVE	KNOLLWOOD	4.30					0		0.1	30"C	1	OK
42	CB	ISLAND DRIVE	KNOLLWOOD	4.35	0.35	15"C							2	OK
43	CB	ISLAND DRIVE	KNOLLWOOD	4.33	1.13	15"C							3	OK
44	CB		CRANDON	4.81	–2.29		–2.29	36"C						OK
45	CB		CRANDON	5.28	–2.92									OK
46	CB		CRANDON	4.69										CURB INLET
47	CB		CRANDON	5.74					0.12	36"C	0.09	30"C		OK
48	CB	CRANDON	MASHTA	3.73			–2.34	36"C			–2.82		1	OK
49	CB	CRANDON	MASHTA	3.64			0.34	18"C					1	OK
50	CB	CRANDON	MASHTA	3.55	0.6	18"C							1	OK
51	CB		CRANDON	4.71							1.21	16"C		OK
52	CB		CRANDON	4.51					1.21	18"C	–2.29	36"C		OK
53	CB		CRANDON	4.25	–2.40	36"C	–2.35	36"C						OK
54	CB		CRANDON	4.08			–2.12	36"C	–2.22	18"C	–1.02	15"C		OK
55	CB		CRANDON	4.27	–1.33	18"C					–1.73	18"C		OK
56	CB		CRANDON	3.47										CURB INLET
57	CB		CRANDON	3.64										CURB INLET
58	CB		CRANDON	4.65										FILLED IN
59	CB		CRANDON	5.00	–2.15	30"C	–2.12	36"C	–2.35	24"C				OK
60	CB		CRANDON	4.68										?

VILLAGE STORMWATER MANAGEMENT MASTER PLAN
EXISTING DRAINAGE STRUCTURE INVENTORY

EXHIBIT 1.6

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JOB NO: 3225.00
FIELD BOOKS: L−13, L−16
FILE: 3225TMFA.WK3
DATE: 8−16−93

WHS STRUCT NO.	STRUCT TYPE (1)	LOCATION		STR RIM ELEV	PIPE INVERTS, SIZE, TYPE (2)								PROP REHAB TYPE (3)	VISUAL CONDITION OF STRUCTURE OR DATE OF LAST MAINT
		HOUSE No. or INTERSECTING ST.	STREET NAME		N	PIPE SIZE/ TYPE	S	PIPE SIZE/ TYPE	E	PIPE SIZE/ TYPE	W	PIPE SIZE/ TYPE		
61	CB		CRANDON	3.51										
62	CB		CRANDON	3.63										CURB INLET
63	CB		CRANDON	3.90										CURB INLET
64	CB		CRANDON	3.82										CURB INLET
65	CB		CRANDON	4.52										CURB INLET
66	CB		CRANDON	4.02	−0.73	24"C	−2.25	24"C	−2.28	24"C	−2.28	24"C		
67	CB		CRANDON	3.54										CURB INLET
68	CB		CRANDON	3.82										CURB INLET
69	CB		CRANDON	3.81										CURB INLET
70	CB		CRANDON	4.87	−0.76	24"C	−0.68	24"C						OK
71	CB		CRANDON	4.17	−0.78	24"C	−0.78	24"C	0.67	18"C				OK
72	CB		CRANDON	4.50	−0.7	24"C	−0.7	24"C	1	18"C				OK
73	CB		CRANDON	4.42							0.92	18"C		OK
74	CB		CRANDON	4.10					1.25	18"C				OK
75	CB		CRANDON	4.63	−0.7	24"C	−1.09	24"C						OK
76	CB		CRANDON	4.24			−0.74	24"C	−0.76	24"C				OK
77	CB		CRANDON	4.57	−0.76	25"C	−0.6	24"C						OK
78	CB		CRANDON	3.74										CURB INLET
79	CB		CRANDON	3.58										CURB INLET
80	CB		CRANDON	4.18					−1.92					CONFLICT OK
81	CB		CRANDON	5.24	−0.76	30"C	−0.86	30"C						
82	CB		CRANDON	4.45	−0.65	30"C	−0.75	30"C						
83	CB		CRANDON	4.14					−1.46	24"C				
84	CB		CRANDON	4.46					−1.24					
85	CB		CRANDON	3.90										CURB INLET
86	CB		CRANDON	3.97										CURB INLET
87	CB		CRANDON	4.86	−1.24	36"C	−1.34	36"C	1.46	18"C				OK
88	CB		CRANDON	4.86							1.56	18"C		OK
89	CB		CRANDON	4.35							1.35	16"C		OK
90	CB		CRANDON	4.26	−1.24	26"C	−1.29	36"C	1.16	18"C				OK

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		HOUSE No. or INTERSECTING ST.	STREET NAME		N	PIPE SIZE/ TYPE	S	PIPE SIZE/ TYPE	E	PIPE SIZE/ TYPE	W	PIPE SIZE/ TYPE		
91	CB		CRANDON	4.70	–1.1	36"C	–1.25	36"C	0.3	16"C				OK
92	CB		CRANDON	4.73							1.53	16"C		OK
93	CB		HARBOR DR	3.54										CURB INLET
94	CB		HARBOR DR	3.90										CURB INLET
95	CB		HARBOR DR	4.10			0.2	24"C	1.5	15"C				OK
96	CB		HARBOR DR	4.24							1.39	15"C		OK
97	CB		HARBOR DR	3.43			0.28	15"C						
98	CB		HARBOR DR	3.53										
99	CB	CHURCH	HARBOR DR	3.70					–2.2	48"C	–2.4	48"C		OK
100	CB	101	HARBOR DR	3.47					–2.53	48"C	–2.43	48"C	3	OK
101	CB	CRANDON	HARBOR DR	4.11							1.41	15"CMP	2	OK
102	CB	CRANDON	HARBOR DR	4.24					2.04	15"CMP			1	OK
103	CB	119	HARBOR DR	4.75										
104	CB		HARBOR DR	3.23										
105	CB		HARBOR DR	4.34	–0.86	15"C							2	
106	CB	141 (OPPOSITE)	HARBOR DR	3.40					–2.25	48"C	–2.2	48"C	1	RES. S CAN'T DO
107	CB	141	HARBOR DR	4.20	1.5	15"C							1	OK
108	CB	CHURCH	HARBOR DR	4.00					–1.45	48"C	–2.3	48"C	2	OK
109	CB	CHURCH	HARBOR DR	4.02	–2.28	48"C	–2.38	48"C					5	SETTLEMENT PROBLEM
110	CB	157	HARBOR DR	3.85	1.85	15"C			0.95	15"C	1.05	15"C	4	PUMP STAT 8 LOCATION
111	CB	161	HARBOR DR	3.62			1.62	15"C					1	OK
112	CB	201 (OPPOSITE)	HARBOR DR	3.62	–3.18	48"CMP			–0.38	48"CMP	–2.98	48"CMP	1	OK
113	CB	201	HARBOR DR	4.03			0.83	15"CMP			0.33	48"CMP	1	OK
114	HW	RACENDO CANAL	HARBOR DR	4.73					–3.27	48"CMP				OK – CRANDON OUTFALL
115	CB	200	HARBOR DR	4.04					1.44	15"C			1	OK
116	CB	245	HARBOR DR	4.08	0.68	18"C	1.48	15"C	–0.22	18"C			2	OK
117	CB	260	HARBOR DR	3.90			1.73	18"CMP	1.1	12"CMP	0.8	20"CMP	2	GRASS AROUND CB
118	CB	275	HARBOR DR	3.63			1.33	18"CMP			1.13	12"CMP	2	GRASS AROUND CB
119	CB	275	HARBOR DR	4.20	0.4	18"CMP	0.3	15"CMP					4	WELL 9A LOCATION
120	CB	260	HARBOR DR	4.00	0.7	18"CMP	0.4	18"CMP					1	OK

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FILE: 3225TMFA.WK3
DATE: 8–16–93

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		HOUSE No. or INTERSECTING ST.	STREET NAME		N	PIPE SIZE/ TYPE	S	PIPE SIZE/ TYPE	E	PIPE SIZE/ TYPE	W	PIPE SIZE/ TYPE		
121	CB	282	HARBOR DR	4.20	0.5	18"CMP	0.5	18"CMP					1	OK
122	CB	295	HARBOR DR	4.50			0.1	18"CMP					1	OK
123	CB	300	HARBOR DR	3.89	–0.01	18"CMP							1	OK
124	CB	315	HARBOR DR	4.20	0.2	18"CMP							4	OK
125	CB	398	HARBOR DR	3.06					1.06	15"CMP	1.06	18"CMP	5	OUTFALL
126	CB	375	HARBOR DR	2.87							1.17	15"CMP	5	WELL 9B LOCATION
127	CB	375	HARBOR DR	2.98	0.58	18"CMP			0.58	18"CMP			4	OK
128	CB	W McINTIRE	HARBOR DR	3.41					–3.49				5	PUMP STAT 7 LOCATION
129	CB		HARBOR DR	3.42									5	FULL OF DIRT
130	CB	W McINTIRE	HARBOR DR	3.38	0.28	15"CMP	–0.02	18"CMP					4	OK
131	CB	599	HARBOR DR	3.25	–0.25								4	FRENCH DRAIN
132	CB	580	HARBOR DR	2.55							–1.95		4	
133	CB	680 (OPPOSITE)	HARBOR DR	3.81			–1.19	18"CMP					3	
134	CB	HARBOR LANE	HARBOR DR	3.17	–1.33	18" CMP	–1.13	15"CMP					2	
135	CB	701	HARBOR DR	3.50	–2.4	15"CMP					–2.4	30"W	4	
136	CB	710	HARBOR DR	3.10					–2	30"W	0.5	18"W	5	WELL 3 LOCATION
137	HW		HARBOR DR	4.40							0.4	18"W	1	OUTFALL
138	CB	755	HARBOR DR	3.20	–1.3	18"CMP					–1.4	18"CMP	5	
139	CB	741	HARBOR DR	3.15					–0.65	18"CMP	–0.35	18"CMP	5	
140	CB	BAY LANE	W MATHESON	3.03					1.33	12" C			4	
141	CB	BAY LANE	W MATHESON	3.17			1.27	12" C			1.37	12" C	4	
142	CB	460	W MATHESON	3.23	0.83	12" C	1.33	12"C					4	
143	CB	640	W ENID CR	3.00							0.7	15" C	1	OK – OUTFALL
144	CB	620	HARBOR CR	3.00							–4		4	
145	CB	635	HARBOR CR	2.72							–4.28		4	FULL
146	CB	705	CURTISWOOD	3.37					0.67	18" C			4	
146A	CB	705	CURTISWOOD										4	OK
147	CB	276	W WOOD DR	2.50					–4.5				4	FRENCH DRAIN
148	CB	685	ALLENDALE	2.69							–4.31		4	FRENCH DRAIN
149	CB	690	ALLENDALE	3.15							–3.85		4	FRENCH DRAIN

VILLAGE STORMWATER MANAGEMENT MASTER PLAN
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		HOUSE No. or INTERSECTING ST.	STREET NAME		N	PIPE SIZE/ TYPE	S	PIPE SIZE/ TYPE	E	PIPE SIZE/ TYPE	W	PIPE SIZE/ TYPE		
150	CB	690	WARREN LANE	3.45	−3.55								3	FRENCH DRAIN
151	CB	691	WARREN LANE	3.40	−3.6								4	FRENCH DRAIN
152	CB	691	HAMPTON RD	3.16	−3.84								4	FR DRAIN – FULL OF DIRT
153	CB	WEST ENID DR	RIDGEWOOD	2.94	−0.46	12" C	0.44	15" C	−0.36	12" C			1	
154	CB	WEST ENID DR	RIDGEWOOD	2.99	0.29	15" C	0.49	15" C					1	
155	CB	676	RIDGEWOOD	2.95	0.75								1	
156	CB	610	RIDGEWOOD	2.47							−4.73		3	
157		SCHOOL	RIDGEWOOD	3.32									1	CURB
158	CB	191	WEST ENID DR	3.20							−2.3		2	
159		SCHOOL	RIDGEWOOD	3.31									1	CURB
160	CB	200	W McINTIRE	2.69							−3.31		4	FULL OF MUD
161	CB	570	RIDGEWOOD	2.30							−4.2		4	FULL OF MUD
162		SCHOOL	RIDGEWOOD	3.05									1	
163		SCHOOL	RIDGEWOOD	3.04									1	
164	CB	165	W McINTIRE	2.65					−3.85				4	FULL OF MUD
165		SCHOOL	W McINTIRE	3.55									1	CURB
166	CB	119	W McINTIRE	3.62									2	
167		SCHOOL	W McINTIRE	3.52			1.52	15" CMP					1	.5" PIPE IN CB – DRAIN ?
168	CB	571	GLENRIDGE RD	3.55			0.35	15" C					2	
169	CB	SCHOOL	GLENRIDGE RD	3.32	0.82	15" C	0.72	15" C					1	
170	CB	SCHOOL	GLENRIDGE RD	3.24	1.44	15" C	1.64	12" CMP					1	
171	CB	SCHOOL	GLENRIDGE RD	3.34	1.34	12" CMP	1.24	15" CMP					1	
172	CB	605	GLENRIDGE RD	3.22	1.52	15" CMP							3	
173	CB	653	GLENRIDGE RD	3.54							1.34	15" CMP	1	
174	CB	SCHOOL	W ENID	3.12			1.12	15" CMP	1.22	15" CMP			2	
175	CB		W ENID	3.31	1.61	15" CMP							1	
176	CB	663	WOODCREST RD	3.09							1.29	15" CMP	1	
177	CB		W ENID	2.96									4	FULL OF ROCKS
178	CB	SCHOOL	W ENID	3.05			1.35	15" CMP	1.35	15" CMP	1.25	15" CMP	2	
179	CB	534	FERNWOOD RD	???	?−4.90	18" C	?−4.85	18" C					3	

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180	CB	570	FERNWOOD RD	???	?-4.60	18" C							2	
181	CB	573	ALLENDALE	3.10	-3.9								4	FRENCH DRAIN
181A		299	WEST ENID										5	TOTALLY COVERED
182	CB	260	McINTYRE	2.76			-4.24						4	FRENCH DRAIN
183	CB	573	WARREN LANE	2.96	-4.04								4	FRENCH DRAIN
184	CB	573	HAMPTON LANE	2.74	-4.26								4	3/93 FRENCH DRAIN
185	CB	220	McINTYRE ST	2.75			-4.25						4	FRENCH DRAIN
186	CB	301	PALMWOOD LN	3.14	-2.96	15" CMP							1	3/93
187	CB	300	PALMWOOD LN	2.73							-1.57	15" CMP	4	3/93
188	CB	340	PALMWOOD LN	3.39							-0.61	18" C	1	3/93
189	CB	341	PALMWOOD LN	3.43							-0.47	18" C	1	3/93
190	CB	351	PALMWOOD LN	3.30							-4.2		2	3/93 FRENCH DRAIN
191	CB	340	PALMWOOD LN	2.97									5	3/93 FR DRAIN - FILLED IN
192	CB	W REDWOOD	PALMWOOD LN	3.19	1.23	15" C			1.03	15" C			1	OK
193	CB	375	W REDWOOD LN	3.17	1.27	15" C	1.27	15" C					1	OK
194	CB	360	PALMWOOD LN	3.10	-0.4	15" C	1.2	15" C			1.25	15" C	2	OK
195	CB	371	HEATHER DR	4.00			-0.6	15" C	0.7	15" C	0.8	15" C	4	OK
196	CB	VACANT	PALMWOOD LN	3.20					1.2	15" C			1	OK
197	CB	340	REDWOOD LN	3.20	1.4	15" C					1.4	15" C	1	OK
198	CB	361	REDWOOD LAND	3.10			1.6	15" C					2	
199	CB	300	REDWOOD LN	2.64									5	FILLED IN
200	CB	300	HEATHER DR	2.21			-2.49	15" C					4	3/93
201	CB	401	ALLENDALE RD	2.72			-1.88	15" C					4	
202	MH	401	W HEATHER DR	3.00									4	FRENCH DRAIN
203	CB	300	W HEATHER DR	2.78					-1.52	15" C			4	3/93
204	CB	285	W HEATHER DR	2.83					-1.47	15" C			4	3/93
205	CB	385	W HEATHER DR	2.93	0.93	15" C					0.93	15" C	4	
206	CB	370	W HEATHER DR	3.57									5	FULL
207	CB		HEATHER LN	3.60									5	FILLED IN
207A	CB	365	HEATHER LN										1	OK

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208	CB	390	HEATHER LN	3.12					1.12	15" C	0.52	15" C	1	
208A	CB	390	HEATHER LN										4	OK
209	CB	340	HARBOR CT	4.02	–3.28								4	FRENCH DRAIN
210	CB	345	HARBOR CT	4.00			–3.3						4	3/93 FRENCH DRAIN
211	CB	335	GREENWOOD DR	4.14	0.44	18" C							1	3/93
212	CB	345	GREENWOOD DR	4.10			0.6	18" C					4	3/93
212A	CB	301	GREENWOOD DR										1	3/93 OK
213	CB	380	HARBOR CT	3.69	–3.81								5	FRENCH DRAIN
214	CB	300	HARBOR CT	3.36	–3.94								4	FRENCH DRAIN
215	CB	255	HARBOR CT	3.70			1.5	12" C					2	
216	CB	265	HARBOR CT	4.00	1.9	12" C							4	
217	CB	335	CYPRESS DR	3.91			–0.39	15" C	–0.39	18" C			3	
218	CB	310	CYPRESS DR	3.95	–0.35	18" C	–0.55	18" C					1	
219	CB	270	CYPRESS DR	3.94	–0.56	18" C	–0.46	18" C					1	
220	CB	315	CYPRESS DR	4.19			–0.11	18" C			–0.01	18" C	1	
221	CB	285	BUTTONWOOD	4.17			2.17	15" C	0.67	15" C	0.67	18" C	1	
222	CB	230	CYPRESS DR	4.21	2.32	15" C							1	
223	CB	300	BUTTONWOOD	4.12	1.92	15" C					3.37	15" C	1	
224	CB	175	BUTTONWOOD	3.85	1.75	12" C							4	
225	CB	190	BUTTONWOOD	3.96			1.86	12" C					3	
226	CB	175	BUTTONWOOD	4.05			1.85	12" C					4	3/93
227	CB	201	BUTTONWOOD	4.14	1.94	12" C							1	3/93
228	CB	250	BUTTONWOOD	4.17			2.17	12" C			2.47	15" C	4	3/93
229	CB	259	BUTTONWOOD	4.22					2.62	15" C			1	3/93
230	CB	235	HAMPTON LN	4.03			–0.17	15" C					4	
231	CB	235	RIDGEWOOD	4.32							0.12	15" C	4	
232	CB	255	HAMPTON LN	4.04							0.04	18" C	4	
233	CB	255	HAMPTON LN	3.30					–0.2	18" C			1	
234	CB	246	HAMPTON LN	4.23					–0.17	18" C			1	
235	CB	280	HAMPTON LN	4.08					1.68	12" C			3	

VILLAGE STORMWATER MANAGEMENT MASTER PLAN
EXISTING DRAINAGE STRUCTURE INVENTORY

EXHIBIT 1.6

(1) STRUCTURE TYPE:
CB = CATCH BASIN
MH = MANHOLE
HW = HEADWALL

(2) PIPE TYPE:
C = CONCRETE
CMP = CORR. METAL PIPE

(3) PROPOSED REHABILITATION TYPE:
1 = ADD BAFFLE
2 = ADD PAV'T & BAFFLE
3 = REPAIR FRAME & GRATE OR TOP SLAB, ADD BAFFLE
4 = CLEAN, REPAIR STRUCT. &/OR ADD PIPES
5 = REMOVE AND REPLACE STRUCTURE

JOB NO: 3225.00
FIELD BOOKS: L-13, L-16
FILE: 3225TMFA.WK3
DATE: 8-16-93

WHS STRUCT NO.	STRUCT TYPE (1)	LOCATION		STR RIM ELEV	PIPE INVERTS, SIZE, TYPE (2)								PROP REHAB TYPE (3)	VISUAL CONDITION OF STRUCTURE OR DATE OF LAST MAINT
		HOUSE No. or INTERSECTING ST.	STREET NAME		N	PIPE SIZE/ TYPE	S	PIPE SIZE/ TYPE	E	PIPE SIZE/ TYPE	W	PIPE SIZE/ TYPE		
236	CB	275	HAMPTON LN	4.45							1.95	12" C	1	
237	CB	285	HAMPTON LN	4.25			0.95	15" C					1	
238	CB	325	HAMPTON LN	4.00	0.6	15" C							4	
239	CB	201	CRANWOOD DR	3.61									4	FULL OF MUD & WATER
240	CB	200	CRANWOOD DR	3.91									4	FULL OF MUD & WATER
241	CB	201	HAMPTON LN	4.21					2.01	12" C			1	
242	CB	355	HAMPTON LN	4.08							1.88	12" C	4	
243	CB	385	HAMPTON LN	3.50							1.2	12" C	4	
244	CB	201	W HEATHER	3.92					1.52	12" C			4	
245	CB	385	RIDGEWOOD	2.75	-3.75								4	3/93 FRENCH DRAIN
245A	CB	380	RIDGEWOOD										4	FULL OF MUD & WATER
246	CB	401	RIDGEWOOD	2.86			-4.14						4	FRENCH DRAIN
247	CB	400	RIDGEWOOD	2.88			-3.92						4	FRENCH DRAIN

1.4.2 Exfiltration Systems

Auger Wells - One primary component of the Village's exfiltration (seepage) system are 15" auger wells installed in gravel lined holes, 10 feet deep. These wells consist of a catch basin with a perforated corrugated aluminum pipe in the bottom. These wells are installed in many locations along the public rights-of-way in the Village. Exhibit 1.7 shows a typical cross section of one of these wells.

Once in an auger well, the water seeps through the holes in the pipe, filters through the gravel around the pipe (to help remove pollutants) and infiltrates into the soil around the well. Unfortunately, the soils in the Village at 10 feet of depth are very silty and thus the water infiltrates very slowly.

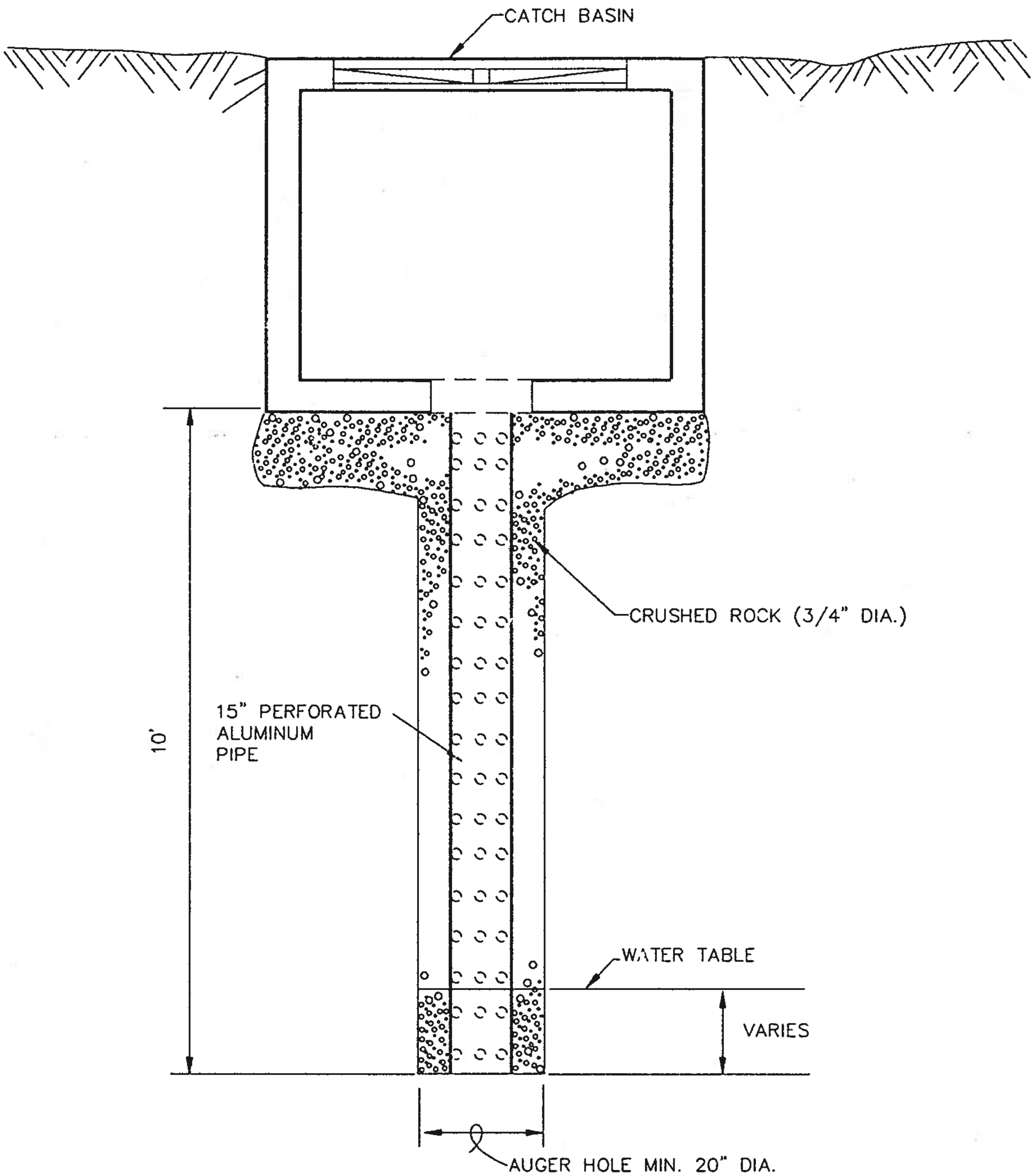
In addition, these wells are not connected by underground piping to any other parts of the drainage system. This minimizes the long term effectiveness of these wells because the water standing in the wells has no outlet, other than very slow exfiltration, so additional water in the area needing to be drained must either be accommodated by the positive drainage system or it puddles on the land.

French Drains - Recently some french drains have been installed in the Village. A french drain is a perforated pipe laid in a trench 10 to 15 feet deep and is surrounded by gravel and a filter material (see Exhibit 1.8). These drains function much like the auger wells with the primary difference being they are laid horizontally rather than vertically and have a greater surface area to facilitate exfiltration.

These exfiltration trenches or french drains provide some water storage in minor storm events but will be less productive during heavy and prolonged rainfalls. This is again due to the low permeability of the Village's soils at such shallow depths.

Swales - Typically, swales (a shallow roadside ditch, often "V" shaped and sloped to convey stormwater to a drainage facility) along the public rights-of-way serve four functions. They provide storage for stormwater running off the streets and residential lots, they allow for some exfiltration of water into the soil, they convey water to a drainage facility and they reduce the levels of some pollutants. Exhibit 1.9 shows a typical cross-section for a drainage swale.

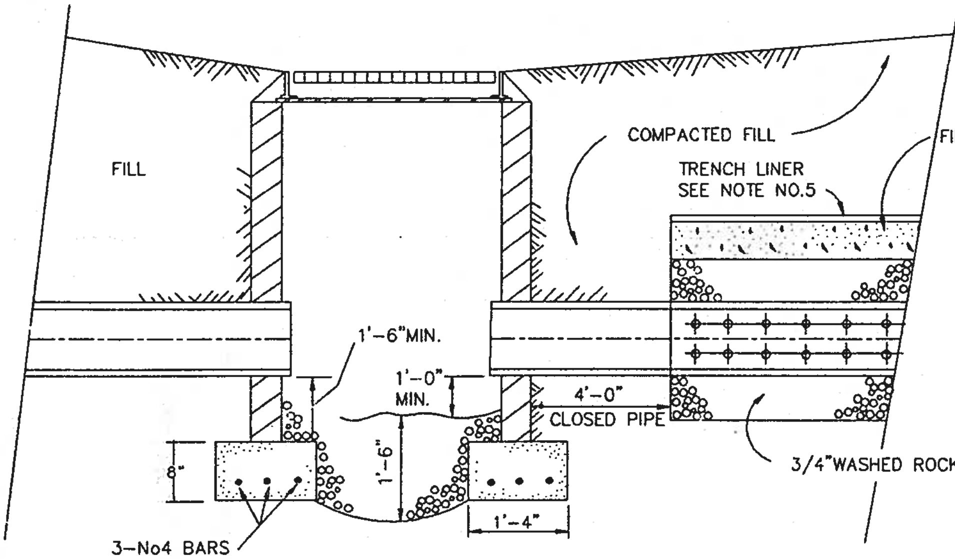
As water flows over landscaped areas to the swales, it picks up fertilizers which settle out and accumulate in the swale. This makes the vegetation in the swales grow faster and thicker than in other areas and eventually the swale fills in which reduces the capacity for water storage and eliminates the slope meant to transport the water to the associated drainage facility. Swale maintenance, therefore, is very important for a drainage system that relies on these facilities.



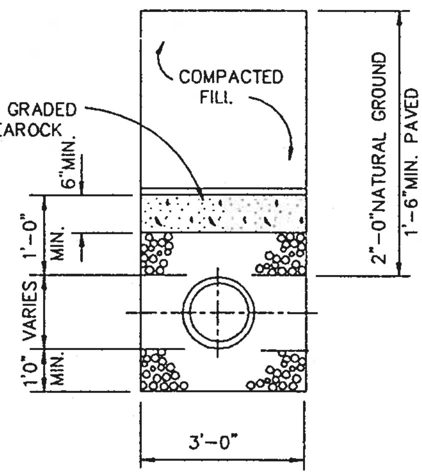
CROSS SECTION

WILLIAMS, HATFIELD & STONER, INC.

TYPICAL AUGER WELL
EXHIBIT 1.7



SECTION



END VIEW OF TRENCH

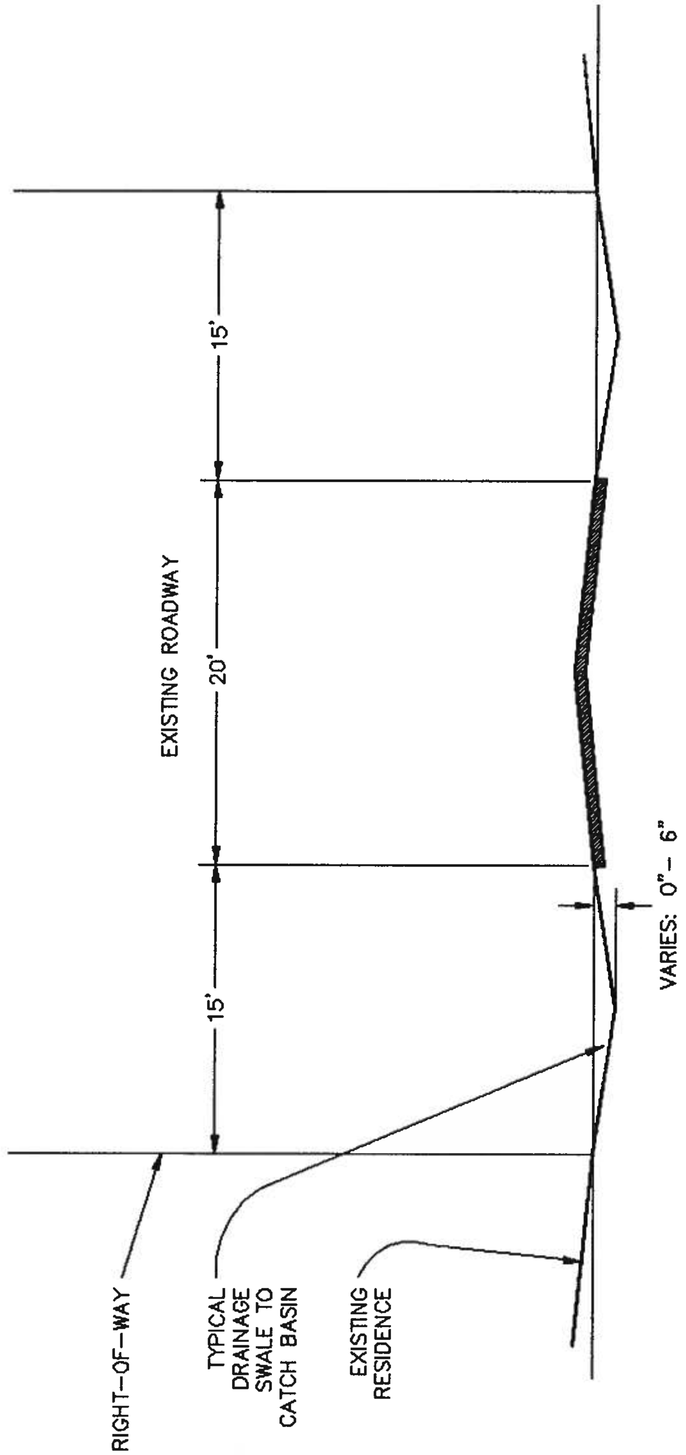
NOTES

1 DRAIN FIELD MAY BE OF SLOTTED CONCRETE PIPE OR PERFORATED METAL PIPE.
2. PIPES SHALL TERMINATE 2 FEET FROM END OF TRENCH OR CONNECT TO ADDITIONAL CATCH BASINS AS REQUIRED.
3. COVER PIPE ENDS WITH NO.10 GALVANIZED OR ALUMINUM SCREEN. OPENING SHALL BE NO LARGER THAN 1/2" x 1/2".
4. BALLAST ROCK SHALL BE FROM FRESH WATER WASHED FREE OF DELETERIOUS MATTER.
5. SIDES AND TOP OF TRENCH SHALL BE LINED WITH A PLASTIC BLANKET (GEOTEXTILE FABRIC) AND SAHLL COMPLY WITH F.D.O.T. "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" AND SECTION 985, 1986 EDITION

EXFILTRATION TRENCH

WILLIAMS, HATFIELD & STONER, INC.

TYPICAL FRENCH DRAIN EXHIBIT 1.8



TYPICAL SWALE CROSS-SECTION

DATE: 8/4/93	DRAWN: TMAF	CHECKED: LMB	DATE:	REVISION	BY
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FILE NAME: SWALE.DWG

Swale maintenance, if not done on a regular schedule, can be difficult. In the Village, for example, most of the residential streets have been constructed with 20 feet of asphalt within a 50 foot right-of-way leaving 15 feet on either side of the street for swales. Many of these swale areas have been heavily landscaped and/or bermed. These conditions result in areas where replacement of the swales is impossible without severely impacting the neighborhood. In some areas, swale replacement or installation of new drainage pipes would disturb decorative concrete driveways, destroy established trees, and cause an undue hardship on residents. These factors have been considered in the evaluation of alternatives that include the use of swales or new roadside drainage pipes.

The swale study prepared by CAP Engineering Consultants, Inc. in April 1993 was reviewed and incorporated into the various drainage alternatives.

1.4.3 The Crandon Boulevard System

The Crandon Boulevard system contains approximately 1.5 miles of 24 to 48 inch drainage pipe and two 48 inch outfalls. The system was constructed in 1968-69 when Crandon Boulevard was widened to four lanes.

The system extends west along a segment of Harbor Drive. Ocean Drive, east of Crandon Boulevard, was added to the system by Dade County later. The roadways surrounding Key Biscayne Elementary School are also tied into Crandon Boulevard.

The drainage system was constructed by the Florida Department of Transportation (FDOT) and was turned over to Dade County for operation and maintenance. Since the area currently served by the Crandon Boulevard drainage system is maintained by Dade County it was excluded from the study area.

Chapter 2
Needs Analysis

2.0 Introduction

The stormwater management system in the Village was built on a piecemeal basis primarily in response to localized flooding problems. These "fixes" have provided localized improvement of conditions in the areas targeted, but they have not improved conditions in the rest of the community.

This study is the first to analyze the entire study area and determine the deficiencies in the drainage system as a whole.

2.1 Existing System

The existing system was analyzed through field observation, analysis of survey data, base mapping and drainage basin evaluation. The results of these analyses are described below.

2.1.1 Field Observation

The project engineers field inspected the drainage facilities in the study area to access their current condition. It was noted that most of the catch basins were filled with water. This is because the water table elevations are very high.

Many of the catch basins could benefit from various maintenance activities including cleaning, repairs to the grates or top slabs, correction of settlement problems, and in some cases, replacement. The Village currently has a maintenance contractor that provides routine maintenance of catch basins on an as needed basis. Regular maintenance activities currently being practiced should continue. Specific maintenance activities are recommended for each catch basin in Chapter 3.

Standing water in the streets was observed in several locations in low lying areas where the catch basins were full and/or drainage facilities were completely lacking.

Based on discussions with Village personnel and local residents, areas particularly known for localized flooding were identified. These include areas such as North and South Mashta Drive, the Allendale Road area and others. New exfiltration facilities are currently being installed along West Enid Drive to mitigate the flooding in that area.

The few areas that do drain reasonably well are those with street elevations above 5 feet msl (Cape Florida Drive for example).

2.1.2 The Village Base Map

A detailed base map of the Village was developed as part of this analytical effort to record the information being collected on the existing stormwater management system. A general street map developed from the base map information is provided for discussion purposes in Exhibit 2.1.

The base map was computer generated (using AutoCAD software) and developed through the use of a grid system to locate recorded plat boundaries using coordinate geometry when available. Lot lines and other plat details were digitized when geometric information was not available.

The resulting base map is relatively accurate but is limited to use for conceptual planning purposes only. It is not intended for use as a final design or survey base map.

2.1.3 Survey Data

As previously noted, survey data was collected in the field and was recorded on the base map for use in evaluating the existing system and future drainage needs. (The survey data for each catch basin is summarized on Exhibit 1.6 which was presented in Chapter 1 and is shown on the Stormwater Master Plan in Appendix A.)

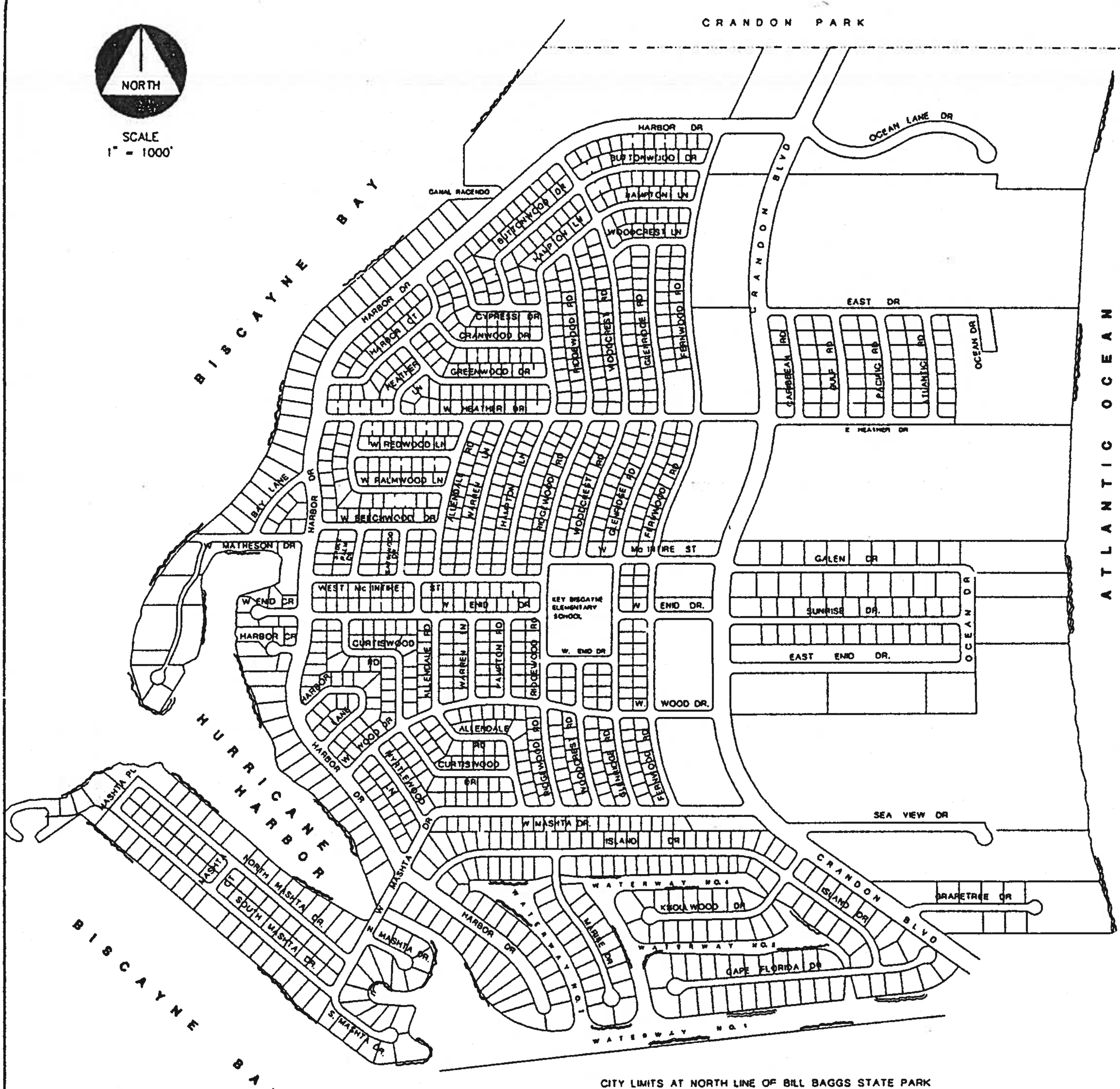
Street elevations were taken every 100 feet along the centerline of the roads in the study area. These were mapped, along with the drainage structure information, and provided the basis for determining drainage basins that were used for further analysis of existing conditions and future needs.

2.1.4 Drainage Basins

With the survey data recorded on the base map, drainage basins based primarily on topographic characteristics could be developed and analyzed.

The Village was divided into 9 drainage basins, 8 of which are within the study area. The proposed drainage basins are shown on Exhibit 2.2.

The pervious/impervious percentages were calculated for each drainage basin. Pervious area is not paved and provides an opportunity for some exfiltration. Impervious area is paved or otherwise modified from its natural condition in a manner that precludes exfiltration. This percentage, therefore, is very important when calculating the amount of water that must be retained (the first inch of runoff) to address water quality issues and otherwise handled by the drainage system during the design storm (the 5-year storm).



VILLAGE OF KEY BISCAYNE, FLORIDA

WILLIAMS, HATFIELD & STONER, INC.

STREET MAP
EXHIBIT 2.1

The characteristics of the study area's drainage basins including their area (based on road right-of-way plus 15 feet on either side), percent impervious, and average storage volume of swales (assuming restoration in some areas), are summarized on Exhibit 2.3.

2.1.5 Existing System Deficiencies

Typically, rainfall events are correlated to incidents of flooding to determine the capacity, or level of service, provided by the existing drainage system. Since this data is not available for Key Biscayne specifically, engineering judgement, in conjunction with the data collected from the various activities described above, was applied to evaluate the existing system. It was concluded that the current drainage system is inadequate in regard to both water quantity (generated by the 5-year design storm) and water quality (retention and pretreatment of the first inch of runoff) goals.

The existing systems do provide for some retention and pretreatment in the seepage facilities (swales, french drains and auger wells). Due to the extremely slow soil percolation rates, however, this retention is minimal. Settlement of the water in the sump of the catch basins also provides some pretreatment of water entering these structures but, due to the low head in the system, the movement of water through these facilities is very slow and thus the amount of water pretreated is minimal.

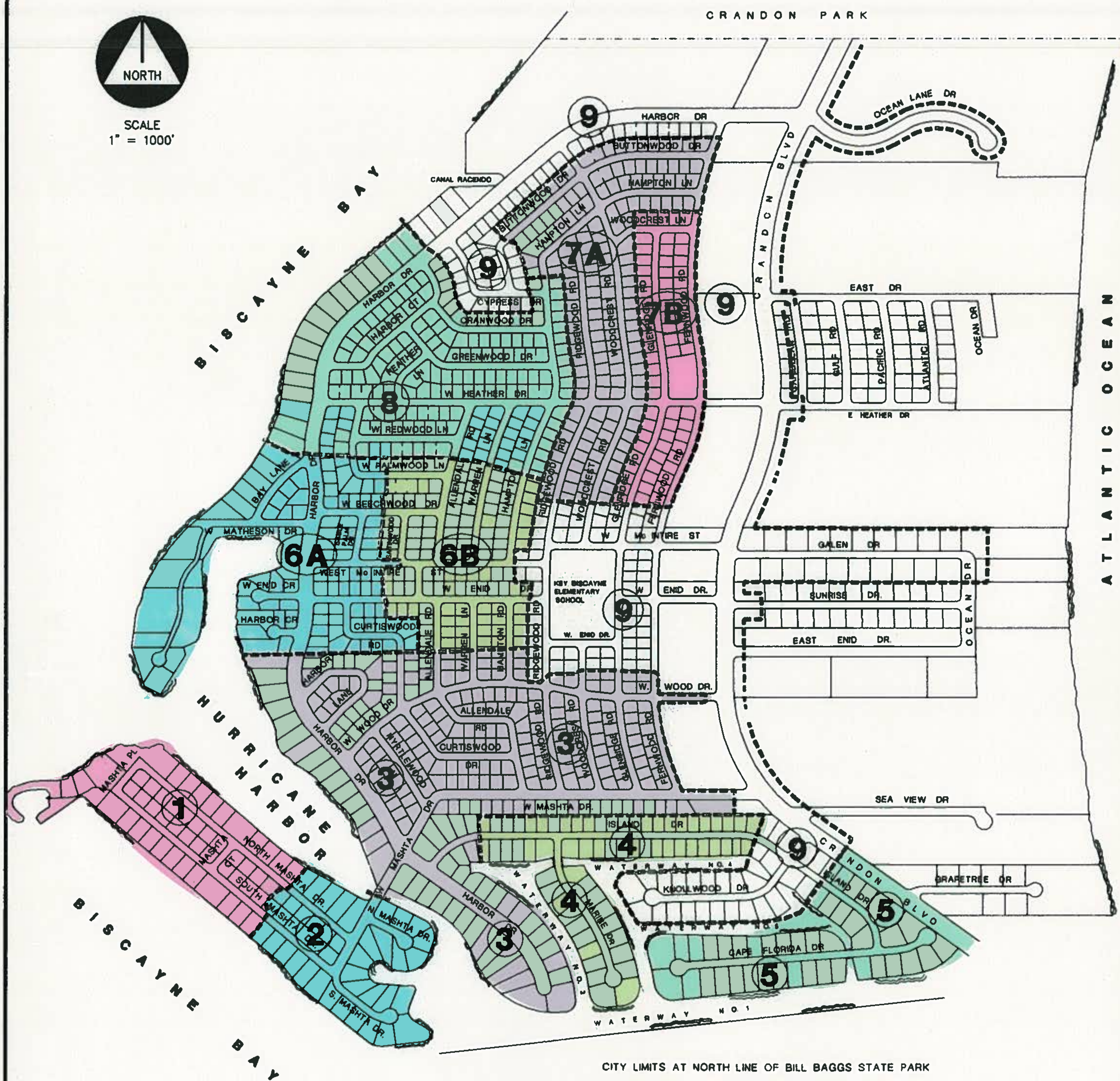
In analyzing the volume of water that additional facilities would need to handle to make the proposed system function adequately, it was assumed that improvements would be made to the existing facilities to maximize their capacities.

2.2 Future System Needs

The volumes of water that would have to be collected, retained, pretreated and served by the drainage system in the future were calculated using the Rational Method. Detailed drainage calculations for each basin are provided in Appendix E.

The existing swale storage volumes for each basin, as well as the other basin characteristics previously described on Exhibit 2.3 were factored into the analysis.

The evaluation of alternatives to meet drainage needs within each basin are presented in Chapter 3.



VILLAGE OF KEY BISCAYNE, FLORIDA

WILLIAMS, HATFIELD & STONER, INC.

PROPOSED DRAINAGE BASINS
EXHIBIT 2.2

DRAINAGE BASIN CHARACTERISTICS

Worksheet 1

EXHIBIT 2.3

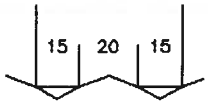
STORMWATER MASTER PLAN
VILLAGE OF KEY BISCAYNE

WHS NO: 3225.OO
FILE: DRCALC1.WK3
BY: LMB
DATE: 8-23-93
REV:_________

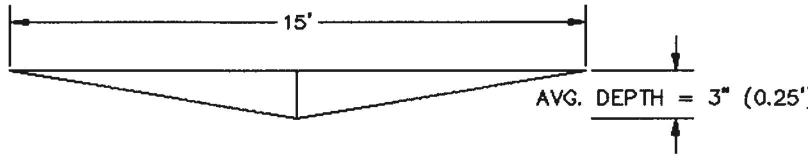
	DRAINAGE AREA			SWALE STORAGE		
BASIN NO.	LENGTH LF	WIDTH LF	AREA ACRES	LENGTH LF	AREA SF	VOLUME CF
1	3100	80	5.7	5450	1.875	10219
2	1900	80		3750	1.875	
	700	100	5.1	900	2.875	9619
3	3050	80		6100	1.875	
	950	100		1450	2.875	
	3000	130		5900	4	
	5700	80		11400	1.875	
	1750	100	31.2	2600	4.75	72931
4	3050	80	5.6	5600	1.875	10500
5	2400	80	4.4	4750	1.875	8906
6	10300	80		20600	1.875	
	1350	130	22.9	2400	4.75	50025
7	13000	80	23.9	26200	1.875	49125
8	7700	80		15200	1.875	
	1700	130	19.2	3300	4.75	44175
	TOTALS:		118.1			255500

NOTE: THIS TABLE REPRESENTS AN ESTIMATE OF AREAS AND VOLUMES ONLY.
RECALCULATIONS ARE REQUIRED DURING FINAL DESIGN.

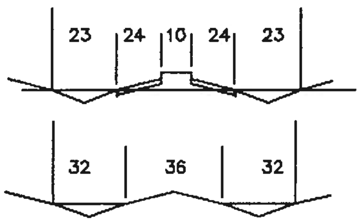
SWALE STORAGE CALCULATIONS



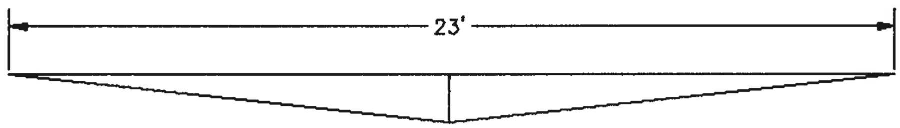
70' R/W



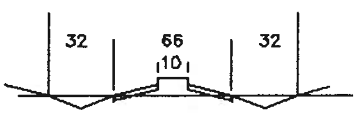
STORAGE AREA = (0.25' * 15') / 2 = 1.875 SF.



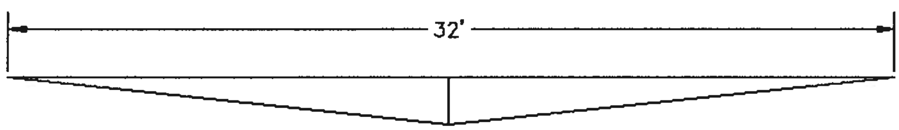
100' R/W



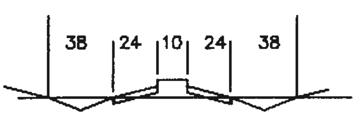
STORAGE AREA = (0.25' * 23') / 2 = 2.875 SF.



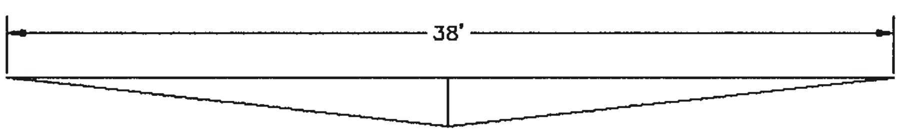
130' R/W



STORAGE AREA = (0.25' * 32') / 2 = 4.000 SF.



130' R/W



STORAGE AREA = (0.25' * 38') / 2 = 4.750 SF.

DRAINAGE BASIN CHARACTERISTICS

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FILE NAME: BAS-CHAR.DWG

Chapter 3
Alternative Evaluation

3.1 Design Alternatives

To address the future stormwater management needs in the study area, five design alternatives were considered. Several could be eliminated as possibilities without a detailed analysis. The reason for their elimination is explained briefly.

Both of the alternatives considered feasible include the use of drainage wells. The primary difference in the two alternatives is that one includes the use of pump stations and fewer wells while the other eliminates the pump stations and instead calls for additional wells. These alternatives were analyzed in detail and the preferred alternative was identified.

It should be noted that improvements to maximize the effectiveness of the existing system, including swale restoration and various types of catch basin maintenance, must also be accomplished in addition to the provision of new facilities. The recommended improvements to the existing system are described in section 3.2.

3.1.1 On-Site Retention or Detention

Stormwater retention or detention, in lakes or ponds, is one method commonly used for stormwater management. This method is not viable for Key Biscayne. The low elevation of the land in relation to the water table would result in only one foot(+/-) of storage capacity for any proposed water storage area. This shallow depth means that a very large land area would be required to retain or detain the amount of water that must be removed from the study area in the design storm event. This makes water retention or detention methods impractical because developed lots would have to be demolished and cleared to create retention/detention basins of sufficient size, even if this alternative was implemented in conjunction with other methods. The cost for this alternative, therefore, is prohibitive and it was, therefore, not seriously considered for use in any of the drainage basins in the study area.

3.1.2 Exfiltration Systems

Exfiltration systems that utilize a trench, such as french drains, are another method commonly examined for stormwater management purposes. The Dade County Public Works Manual recommends seepage systems as preferable to other types of systems in areas where they can be used.

The high silt content of the study area's soils up to 25 feet in depth and the resulting slow exfiltration rates reduces the effectiveness of this type of system except for use as temporary water storage. If an exfiltration system was to be used, the water would have to be distributed over a very large land area to compensate for the slow percolation rate. Due to the high water table, the soil would become saturated quickly which means these facilities would only work well for short duration storms. In addition, both sides of the streets would have to be excavated and french drains installed over the entire study area. This would not only be very disruptive to the neighborhoods and residents, it would also be so expensive to be cost prohibitive, even if used in conjuction with other methods. The exfiltration alternative that relies on trenchs or shallow wells (less than 25 feet deep) was not considered in further detail.

3.1.3 Positive Drainage Systems with Direct Outfall

Positive drainage refers to stormwater management systems that are basically made up of catch basins and drainage pipes connected to outfalls in the ocean. The most effective portions of the Village's existing system in regard to drainage (water quantity) are these types of facilities.

This type of system, without retention or detention facilities and the pretreatment of the first inch of runoff, is not permitted any longer by current regulations because of the recent studies on the negative water quality impacts of untreated stormwater entering the bay or ocean waters. This stormwater master plan provides alternatives to improve the quality of stormwater discharged from the existing system.

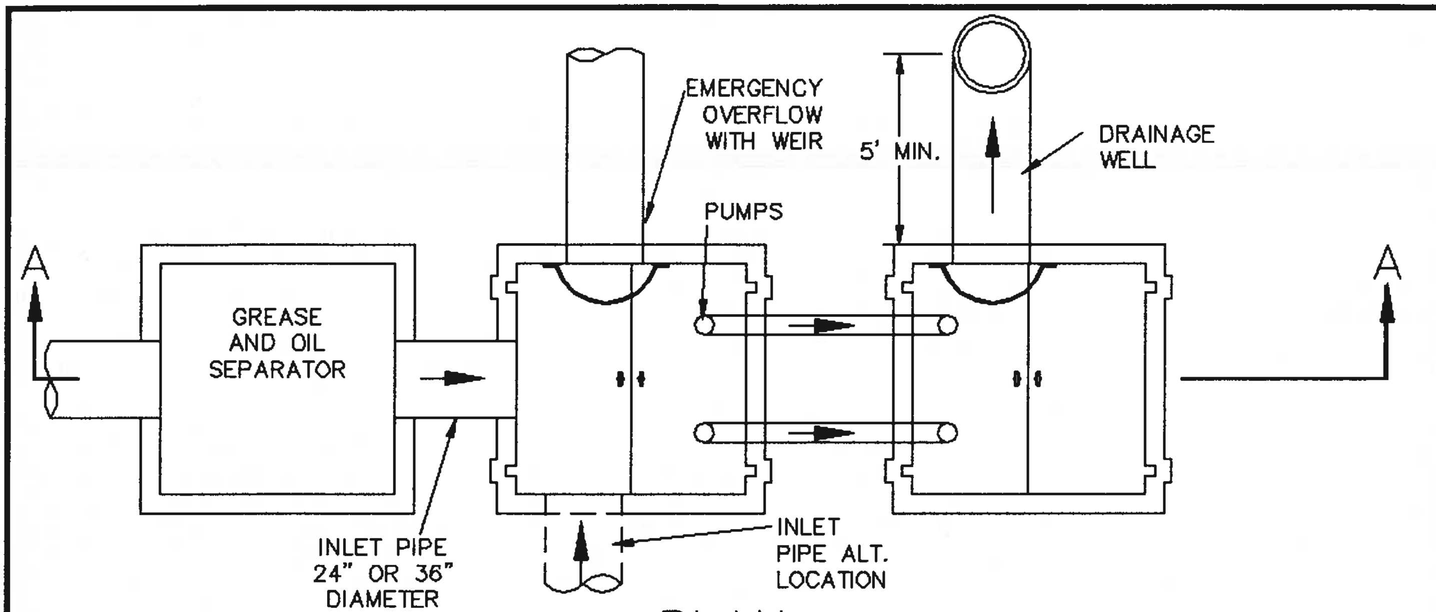
3.1.4 Positive Drainage with Pump Stations, Injection or Gravity Wells, and Emergency Outfalls

Basins 3, 6, 7, and 8 are very low in elevation and thus have very little head to force water to drain. There are basically two ways to address drainage in these areas using drainage wells. A series of wells can be clustered in an area and connected so when one fills up, the overflow will enter the next and so forth. The other option includes the use of pump stations as a means to reduce the number of wells necessary to manage design storm runoff volumes within these basins.

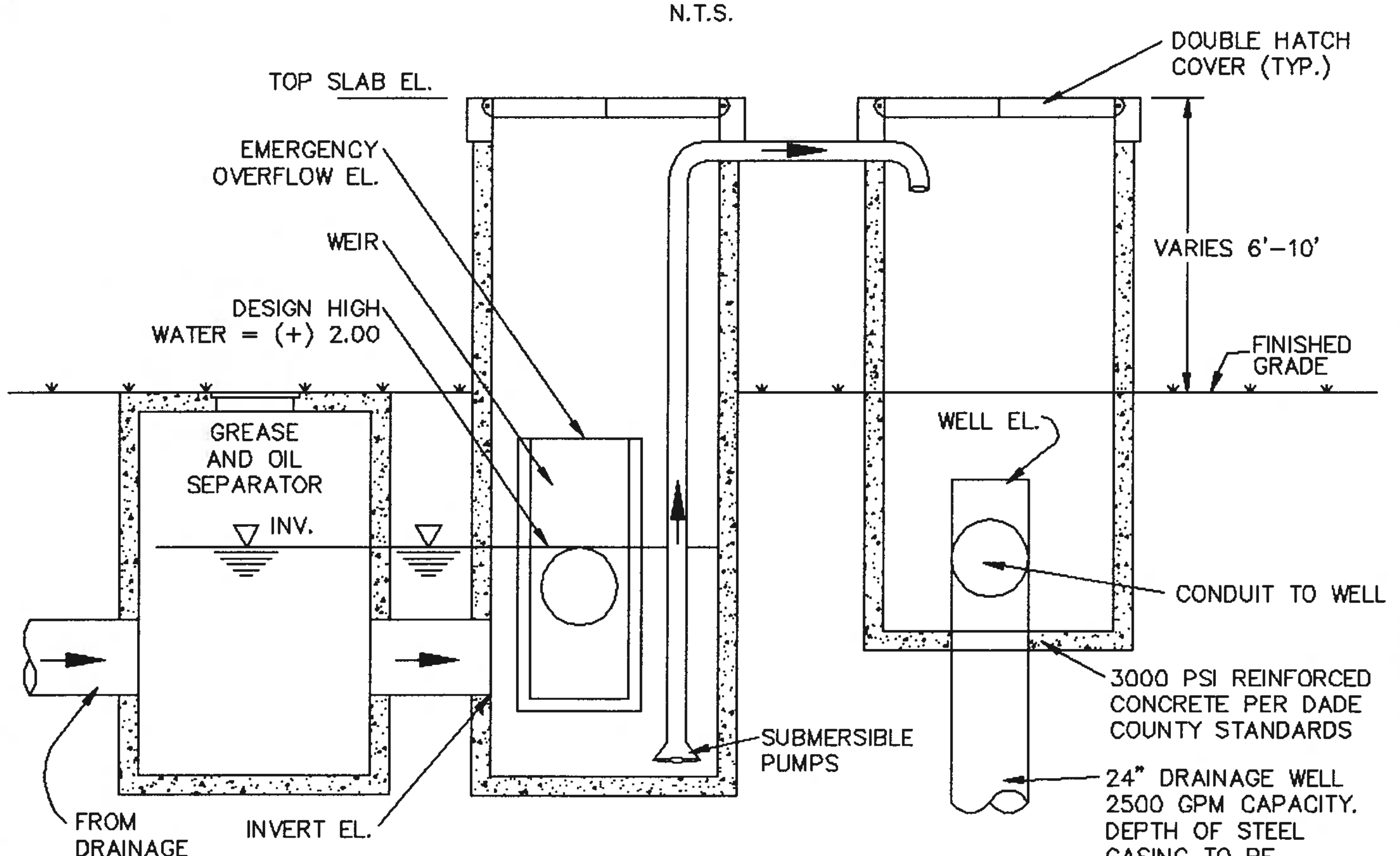
One type of pump station would collect the runoff in a wet well at the low elevation and then pump or lift the water to a storage tank of higher elevation. The water would then flow by gravity into the drainage well for disposal. A cross-section of this type of pump station and gravity will is provided on Exhibit 3.1. Because of the relatively large differential in elevation of the water (greater head) with this system, the flow into the well is greater than it would be under natural conditions.

The advantage of this system is that areas of very low elevation near sea level may be drained into a well. This provides a relatively dry drainage system.

The disadvantage is the high cost of the pumps and the large above ground structures which are often 7 to 10 feet high. These pumps and structures would require landscaping, maintenance, constant electricity and a suitable location either in a roadway median or swale area. There is also yearly maintenance which tends to increase with the age of the pumps. Constant maintenance is required on a weekly



PLAN
N.T.S.



SECTION A–A

PUMPING STATION WITH GRAVITY WELLS AND GREASE & OIL SEPARATOR

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FILE NAME: PUMP_STA.DWG

or monthly schedule. Trained staff would be necessary to perform these maintenance activities or a maintenance contract with a qualified lift station maintenance company would have to be established and administered.

Another type of pump station would collect the runoff in a wet well and then "inject" or force the water into the well with pressure. A cross-section of a this type of system with a typical pump station and injection well is shown on Exhibit 3.2. The advantage of this type of system is the same for the above pumps with gravity wells. An additional advantage is that these systems are constructed completely underground. Only a concrete slab and control panel is visible to the observer.

The disadvantage of injection wells is the high cost of the larger pumps required and the large underground concrete structures. This type of pump station with injection wells is currently being constructed in Surfside by FDOT at a cost of $600,000 per pump station, not including the cost of the well. Analysis of the Key Biscayne basins resulted in an estimated need for smaller pumps and pump stations which would cost approximately $200,000 each.

This alternative was analyzed in detail because it would have the capacity to handle pretreatment of the first inch of runoff generated by the design storm, would reduce the incidence of flooding, and would improve the quality of stormwater discharged.

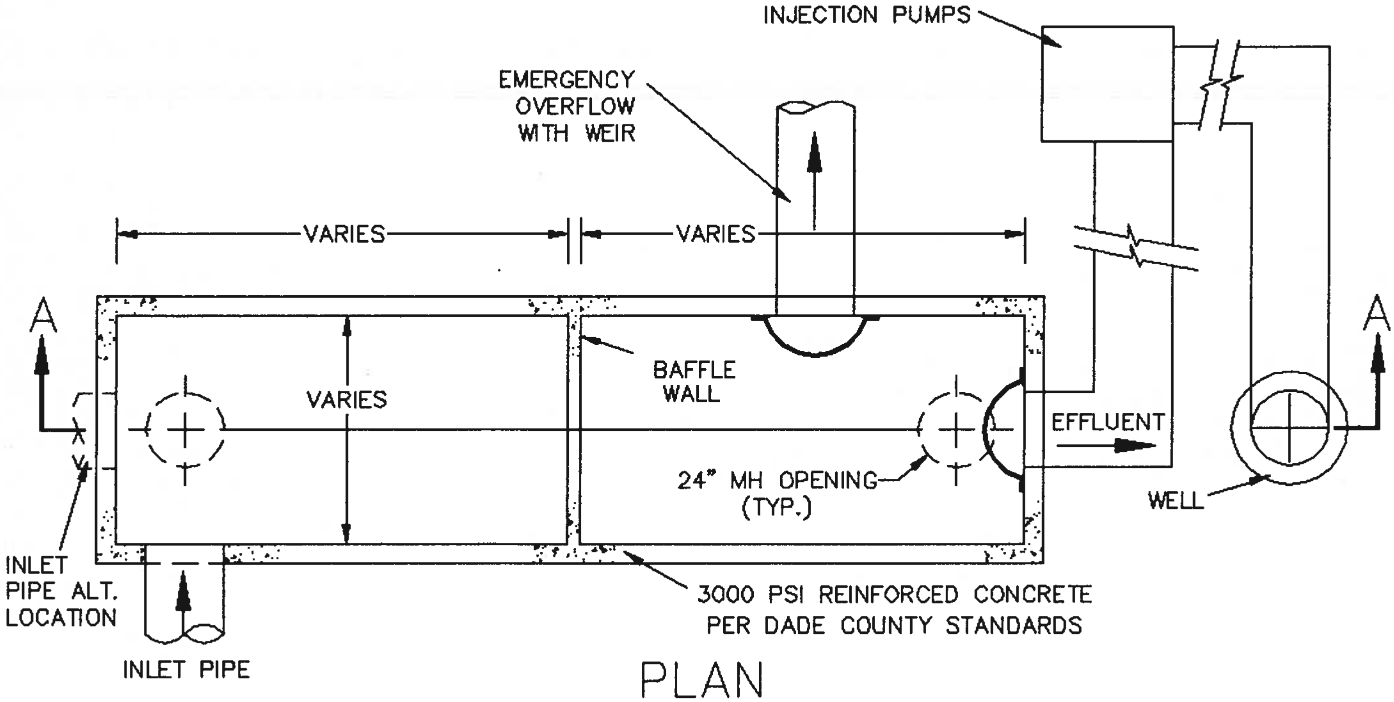
The use of pump stations was eliminated from consideration due to their high cost (see cost estimate in Appendix F) and the long term maintenance required to keep these stations operational.

3.1.5 Positive Drainage System with Drainage Wells and Emergency Outfall

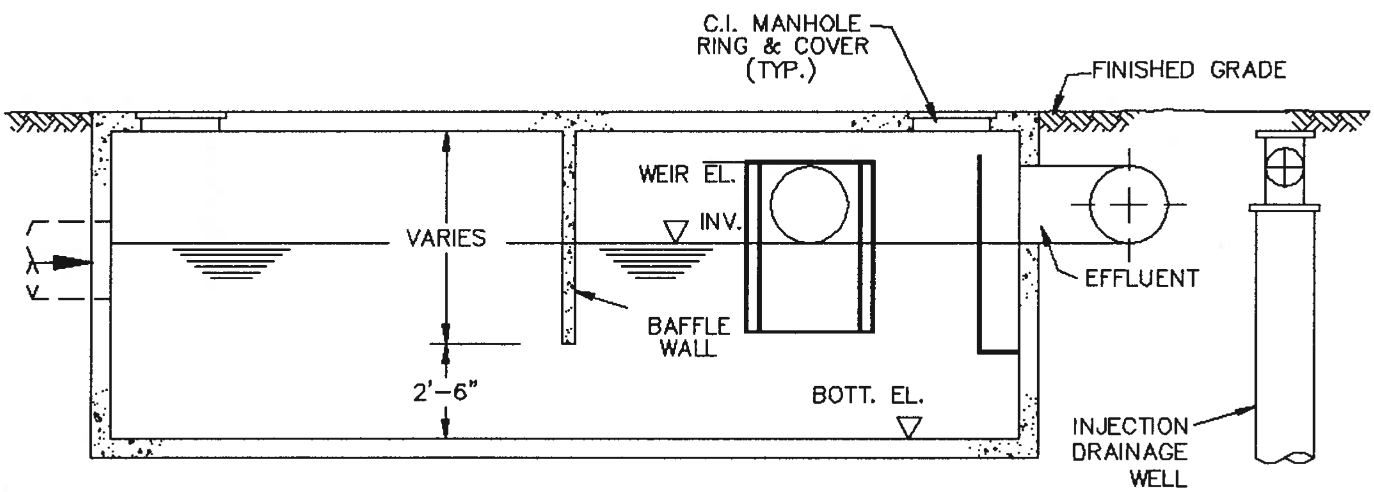
This alternative was analyzed in detail because it too would have the capacity to handle pretreatment of the first inch of runoff generated by the design storm, would reduce the incidence of flooding, and would improve the quality of stormwater discharged.

This type of system uses a series of drainage wells to retain or capture the first inch of runoff. A pollution control structure (grease and oil separator) is used in conjunction with the wells to provide additional pretreatment and to facilitate maintenance activities.

This system is similar to the pump stations described above, but the gravity from the elevation or head of the water is the only force used to push water into the well. A cross-section of a drainage well is provided as Exhibit 3.3.



PLAN
N.T.S.



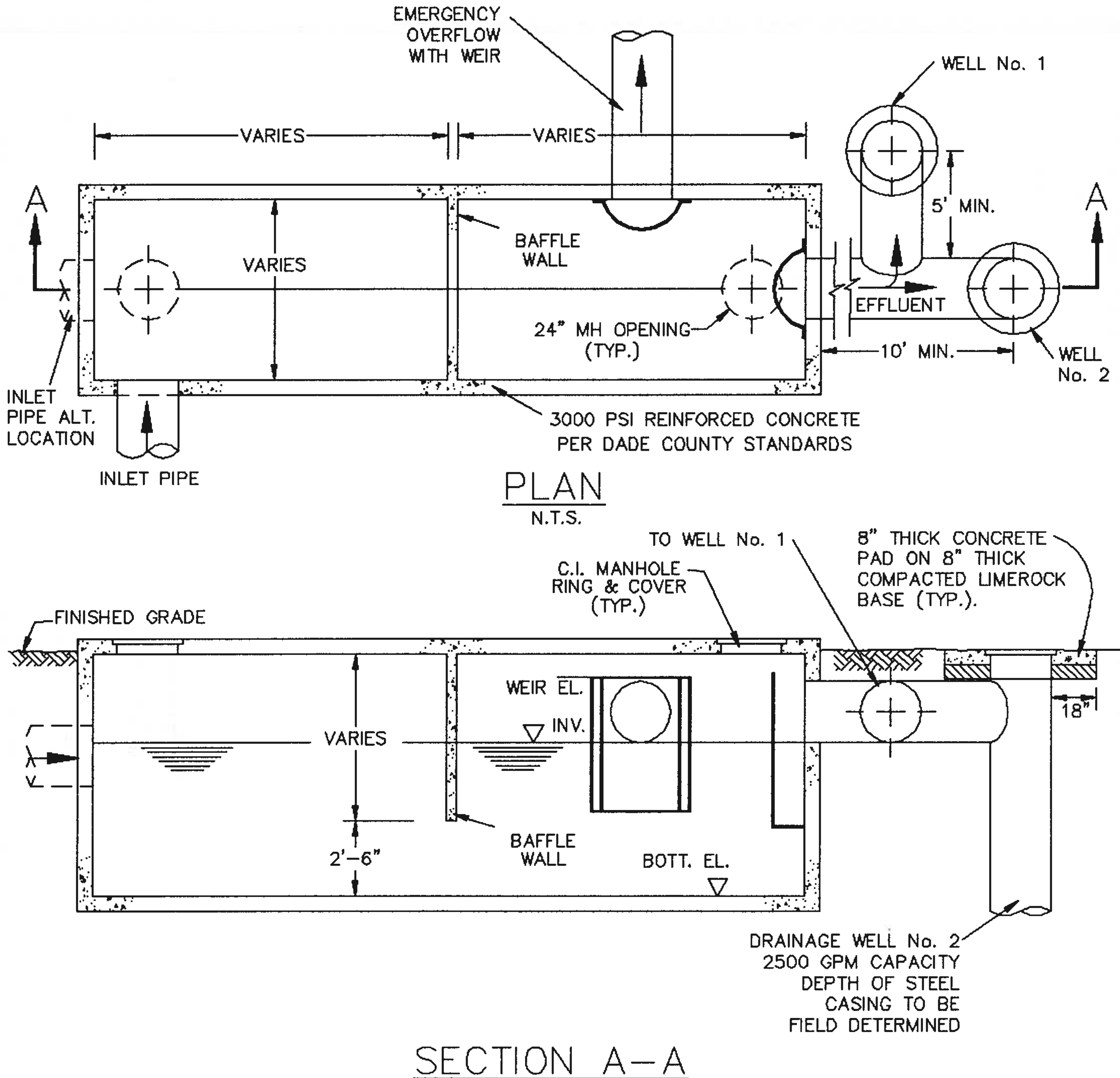
SECTION A–A

PUMPING STATION WITH INJECTION WELL AND GREASE & OIL INTERCEPTOR

NOTE: STRUCTURE TO BE SIZED TO MEET RETENTION TIME OF 1.5 MIN. BEFORE DISCHARGE
TOP SLAB TO MEET HS 20 LOADING

DATE: 8/4/93	DRAWN: TMAF	CHECKED: LMB	DATE:	REVISION	BY
WILLIAMS, HATFIELD & STONER, INC. CONSULTING ENGINEERS • PLANNERS • SURVEYORS			VILLAGE OF KEY BISCAYNE STORMWATER MASTER PLAN DRAINAGE DETAILS		PROJECT No: 3225.00 EXHIBIT: 3.2 PAGE:

FILE NAME: DRN–WELL.DWG



DRAINAGE WELLS WITH GREASE & OIL INTERCEPTOR

NOTE: STRUCTURE TO BE SIZED TO MEET RETENTION TIME OF 1.5 MIN. BEFORE DISCHARGE
TOP SLAB TO MEET HS 20 LOADING

DATE: 8/4/93	DRAWN: TMAF	CHECKED: LMB	DATE:	REVISION	BY

WILLIAMS, HATFIELD & STONER. INC.

CONSULTING ENGINEERS • PLANNERS • SURVEYORS

VILLAGE OF KEY BISCAYNE
STORMWATER MASTER PLAN
DRAINAGE DETAILS

PROJECT No: 3225.00
EXHIBIT: 3.3
PAGE:

FILE NAME: DR-WL-B.DWG

It is common practice in this area of Dade County to use 24 inch wells approximately 100 feet deep. With two feet of head, this well will provide a flow capacity of approximately 2,500 gallons per minute (gpm). A conservative value of 1,500 gpm was used in this analysis to estimate the number of wells required to accommodate the first inch of runoff in the various basins.

It was assumed that the elevation differential or head will be increased in each basin as drainage and roadway rehabilitation is completed in a manner that raises the lower inlets. This will increase the flow potential of the wells and provide a greater amount of retention in the future (see section 4.4.2. for related recommendations).

This alternative appears to be the most cost effective approach to handling the stormwater management needs in the study area. A detailed analysis of the cost estimates for this alternative is presented in section 3.3.

3.2 Recommended Improvements to the Existing System

The maintenance, rehabilitation and improvements recommended for the existing system include the following:

Swale Restoration - swales should be regraded and sodded during restoration after the recommended drainage facilities have been installed in each basin. This will increase storage capacity and improve the quality of stormwater runoff by providing additional treatment thus minimizing maintenance problems with the wells and pollution control structures. The determination of which side of the street will be affected by the installation of new drainage facilities and eventual swale restoration should be made on a street by street basis with the objective being to minimize disruption.

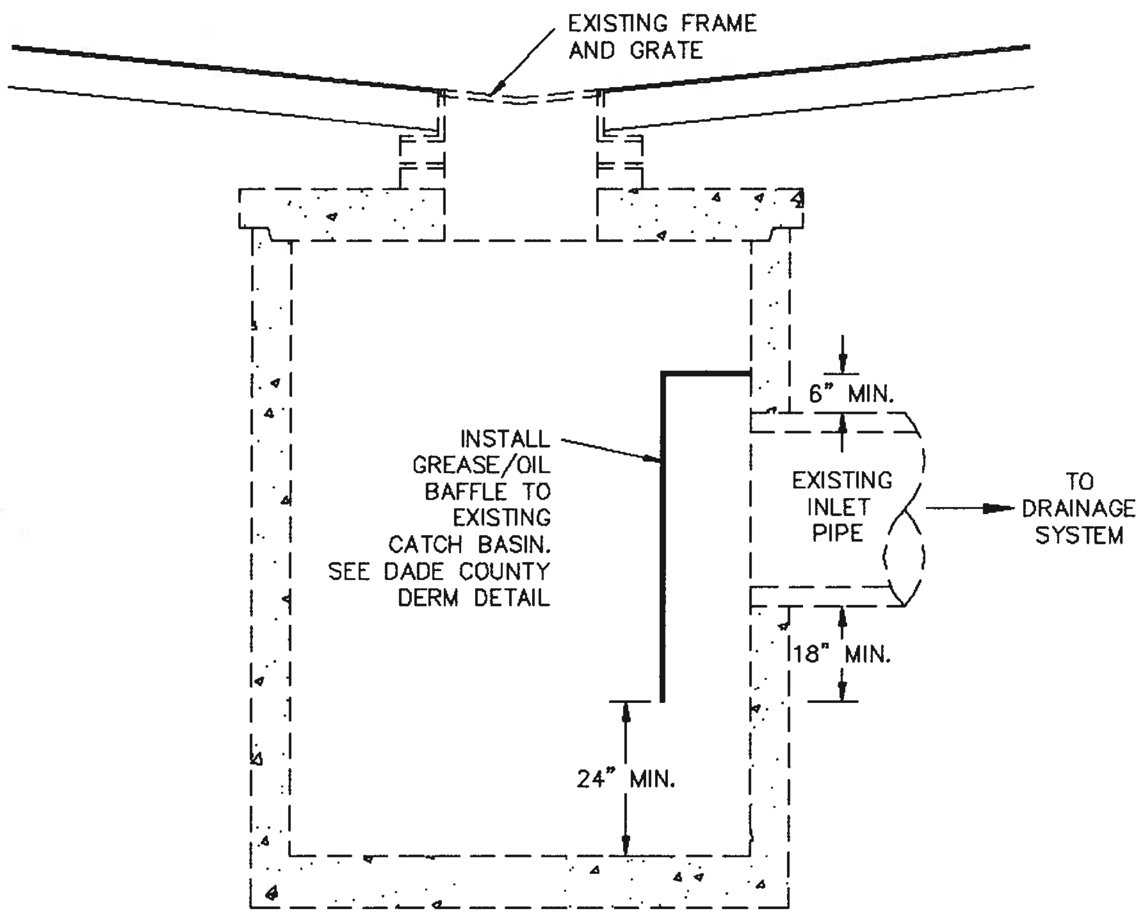
Catch Basin Rehabilitation - there are 5 types of catch basin rehabilitation recommended based on the existing condition of the catch basin (see existing system inventory in Exhibit 1.6 for recommended rehabilitation type for each basin).

- *Type 1 rehabilitation*: add baffle to existing catch basins when large enough to accommodate these required pollution control devises (grease and oil separators). Exhibit 3.4 shows a cross-section of this type of catch basin rehabilitation.

- *Type 2 rehabilitation*: add pavement around catch basin and baffle, see Exhibit 3.5.

- *Type 3 rehabilitation*: repair frame and top grate or top slab and add baffle.

- *Type 4 rehabilitation*: clean, repair structure and/or add pipes to connect structure more efficiently to other components of the drainage system.



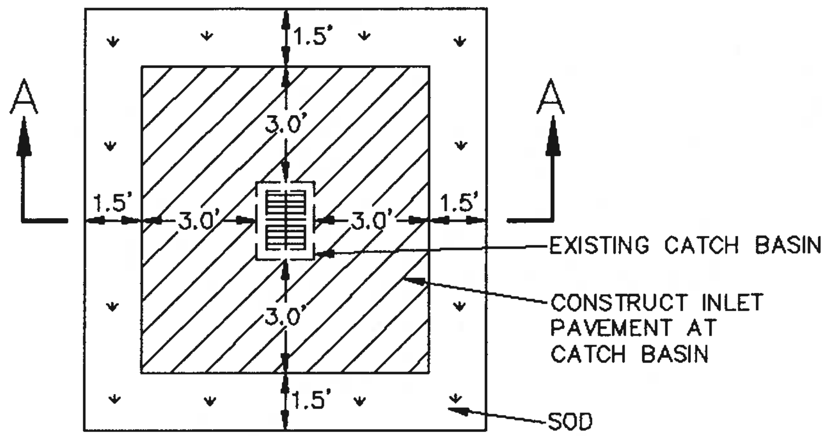
CATCH BASIN REHABILITATION

TYPE 1 - BAFFLE

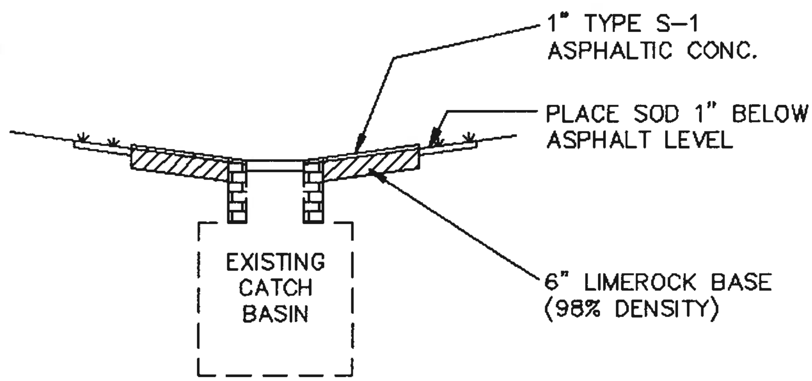
N.T.S

DATE: 8/4/93	DRAWN: TMAF	CHECKED: LMB			
			DATE:	REVISION	BY
WILLIAMS, HATFIELD & STONER. INC. CONSULTING ENGINEERS • PLANNERS • SURVEYORS			VILLAGE OF KEY BISCAYNE STORMWATER MASTER PLAN DRAINAGE DETAILS		PROJECT No: 3225.00 EXHIBIT: 3.4 PAGE:

FILE NAME: CB-TY1.DWG



PLAN
N.T.S.



SECTION A-A

CATCH BASIN REHABILITATION
TYPE 2 - PAVEMENT

DATE:	DRAWN:	CHECKED:	DATE:	REVISION	BY
8/4/93	TMAF	LMB			
WILLIAMS, HATFIELD & STONER. INC. CONSULTING ENGINEERS • PLANNERS • SURVEYORS			VILLAGE OF KEY BISCAYNE STORMWATER MASTER PLAN DRAINAGE DETAILS		PROJECT No: 3225.00 EXHIBIT: 3.5 PAGE:

FILE NAME: CB-TY2.DWG

- *Type 5 rehabilitation*: remove and replace entire catch basin.

3.3 Preliminary Construction Cost Estimate for Alternative 3.1.6

The preliminary construction cost estimate for the recommended positive drainage system with gravity fed drainage wells and emergency outfall were calculated for each basin. These cost estimates include costs for improvements to the exiting system (see catch basin rehabilitation types explained above) as well as the following components:

- **New Catch Basin with Baffle** - The recommended catch basins with pollution control structures are those specified by Dade County (or are a DERM approved equal) which are generally less than 10 feet deep and have one or more grease and oil separators (for Dade County Standard Detail SD 2.9, see Exhibit 3.6.)

- **Drainage Well with Grease and Oil Separator** - the cost estimate is for a 24-inch steel encased drainage well placed 60-100 feet deep to discharge stormwater. Prior to entering the well, stormwater will flow through a pollution control devise (grease and oil separator) which includes a weir to hold back the surface runoff and prevent contamination from entering the well.

- **Emergency Overflow Structure** - costs for this structure, which will be constructed at the canal or bay and will discharge only in emergency conditions (i.e., when the storm event generates more than one inch of runoff), are included in the cost estimate for each basin. It is assumed that this structure will be connected to the existing outfalls which are in working condition.

- **Pavement/Swale Restoration** - all pavement restoration costs included in the estimate are based on Dade County Standard Details R21.1. Full lane restoration was assumed for longitudinal cuts. The cost to restore swales along one side of the street affected by construction is also included in the cost estimates.

- **Drainage Pipe** - the cost estimate for drainage pipe is based on an average unit cost. The Village may choose to use concrete, corrugated metal pipe (CMP), corrugated aluminum pipe (CAP), polyvinyl chloride (PVC), or an equivalent for the actual construction. Concrete pipe is hydraulically smoother and therefore better for transporting water but it is also more expensive.

- **Administration, Engineering, Financing, and Contingency** - the cost estimate was increased by 35% to account for these "soft" costs to implement the recommended capital improvement program.

The resulting costs for each basin are shown on Exhibit 3.7. Costs per basin range from approximately $184,000 to $1.2 million. The total approximated cost for the recommended improvements is $4.9 million.

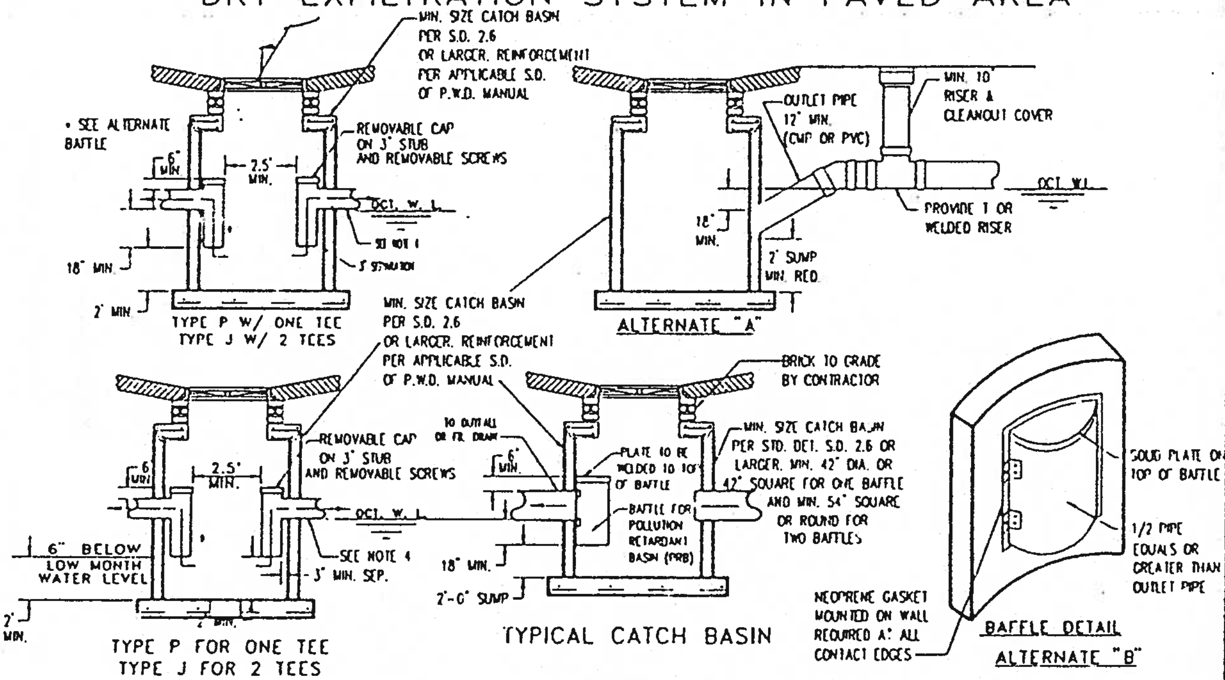
METRO DADE

METROPOLITAN DADE COUNTY, FLORIDA
ENVIRONMENTAL RESOURCES MANAGEMENT
111 NW 1st STREET
SUITE 1310
MIAMI, FLORIDA 33128-1971
(305) 375-DERM

ENVIRONMENTAL REVIEW OF DRAINAGE SYSTEM

- ☐ REVIEW FOR COMPLIANCE TO DADE COUNTY AQUIFER PROTECTION REQUIREMENTS.
- ☐ PROVIDE OIL & GREASE INTERCEPTOR @ ALL CATCH BASINS PRECEDING FRENCH DRAIN AS PER ATTACHED STD. DET. BELOW.
- ☐ PROVIDE OIL & GREASE INTERCEPTORS AT STRUCTURE NO. ______________________________
- ☐ ALL FRENCH DRAINS TO HAVE INVERT OF PERFORATED PIPE MIN. ELEVATION OF OCTOBER GROUND WATER LEVEL OF ________ NGVD. OR HIGHER.
- ☐ REVIEW FOR COMPLIANCE W/SECTION 24-12.1 OF THE METRO DADE COUNTY CODE.
- ☐ COMMENTS: ______________________________

DRY EXFILTRATION SYSTEM IN PAVED AREA



CATCH BASIN
GREASE & OIL SEPARATOR
(WITH SEEPAGE HOLE AT BOTTOM)
PRECEDING FRENCH DRAIN

TWO (2) TEES AS SHOWN IF F.D. AT BOTH SIDES OF STRUCTURE

NOTES:

1 – ABOVE STRUCTURE TYPE "P" S.D. 2.6 IS RECOMMENDED FOR SMALL DRAINAGE AREAS LESS THAN 0.20 ACRE PER CATCH BASIN.

2 – FOR DRAINAGE AREAS EQUAL TO OR GREATER THAN 0.20 BUT NOT EXCEEDING .3 ACRE PROVIDE TYPE "J" AS PER S.D. 2.6 STRUCTURES.

3 – ALL INVERTS OF PERFORATED PIPES TO BE AT OCTOBER WATER TABLE.

4 – WHEN PRETREATMENT IS REQUIRED IN A DRY EXFILTRATION SYSTEM, IF GRADE CONDITION ON SITE IS SUCH THAT THE INVERT OF THE NON PERFOFATED PIPE LEAVING THE CATCH BASIN IS BELOW THE OCTOBER GROUND WATER LEVEL; A TRANSITION IS REQUIRED FROM THIS INVERT ELEVATION TO THE INVERT OF THE PERFORATED PIPE.

5 – ALL OTHER ALTERNATIVES TO THE ABOVE OIL & GREASE INTERCEPTORS MUST BE REVIEWED AND APPROVED BY D.E.R.M. PRIOR TO ISSUANCE OF A CONSTRUCTION PERMIT

TYPICAL CATCH BASIN
EXHIBIT 3.6

KEY BISCAYNE STORMWATER MASTER PLAN
PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS

EXHIBIT 3.7

JOB NO: 3225.00

FILE: COSTEST1.WK3

DATE: 9–7–93

ITEM NO	DESCRIPTION	UNIT	EST UNIT COST	BASIN 1		BASIN 2		BASIN 3		BASIN 4		BASIN 5		BASIN 6A		BASIN 6B		BASIN 7A		BASIN 7B		BASIN 8	
				QUANTITY	EST COST	QUANTITY	EST COST	QUANTITY	EST COST	QUANTITY	EST COST	QUANTITY	EST COST	QUANTITY	EST COST	QUANTITY	EST COST	QUANTITY	EST COST	QUANTITY	EST COST	QUANTITY	EST COST
1	NEW CATCH BASIN W/ BAFFLES	EA	$2,000	8	$16,000	6	$12,000	10	$20,000	4	$8,000	5	$10,000	23	$46,000	30	$60,000	37	$74,000	27	$54,000	18	$36,000
2	18" DRAINAGE PIPE	LF	$28	1900	$53,200	1250	$35,000	4900	$137,200	1050	$29,400	1200	$33,600	2600	$72,800	4820	$134,960	3980	$111,440	4600	$128,800	5200	$145,600
3	24" DRAINAGE PIPE	LF	$35		$0		$0	2250	$78,750		$0		$0	1180	$41,300		$0	2700	$94,500	450	$15,750	350	$12,250
4	30" DRAINAGE PIPE	LF	$45		$0		$0		$0		$0		$0	350	$15,750		$0		$0		$0		$0
5	DRAINAGE WELL	EA	$18,000	1	$18,000	1	$18,000	4	$72,000	1	$18,000	1	$18,000	4	$72,000		$0	4	$72,000		$0	3	$54,000
6	POLLUTION CONTROL STRUCTURE	EA	$16,000	1	$16,000	1	$16,000	1	$16,000	1	$16,000	1	$16,000	1	$16,000		$0	1	$16,000		$0	1	$16,000
7	OUTFALL WEIR W/STRUCTURE	EA	$10,000	1	$10,000	1	$10,000	1	$10,000	1	$10,000	1	$10,000	1	$10,000		$0	1	$10,000		$0	1	$10,000
8	REHAB 1 – ADD BAFFLE	EA	$500		$0		$0		$0		$0		$0		$0	3	$1,500		$0		$0	15	$7,500
9	REHAB 2 – ADD PAVT & BAFFLE	EA	$1,000		$0		$0	2	$2,000		$0		$0		$0	1	$1,000		$0		$0	5	$5,000
10	REHAB 3 – REPAIR F&G, TOP SLAB & ADD BAFFLE	EA	$1,500	2	$3,000		$0	1	$1,500		$0		$0		$0		$0		$0		$0	1	$1,500
11	REHAB 4 – ADD PIPES, REPAIR STRUCT	EA	$1,500	2	$3,000		$0	8	$12,000	2	$3,000	2	$3,000	8	$12,000	5	$7,500	7	$10,500		$0	23	$34,500
12	REMOVE & REPLACE CATCH BASIN	EA	$2,500	7	$17,500	5	$12,500	3	$7,500		$0	1	$2,500		$0	1	$2,500	2	$5,000		$0	7	$17,500
13	SWALE RESTORATION	LF	$5	3100	$15,500	2600	$13,000	14450	$72,250	3050	$15,250	2400	$12,000	5800	$29,000	5800	$29,000	8400	$42,000	4600	$23,000	9400	$47,000
	SUBTOTALS				$152,200		$116,500		$429,200		$99,650		$105,100		$314,850		$236,460		$435,440		$221,550		$386,850
	ADMIN, ENG, FINANCING, & CONTINGENCY	EST 35%			$53,270		$40,775		$150,220		$34,878		$36,785		$110,198		$82,761		$152,404		$77,543		$135,398
	DRAINAGE SUBTOTALS				$205,470		$157,275		$579,420		$134,528		$141,885		$425,048		$319,221		$587,844		$299,093		$522,248
14	PAVEMENT RESTORATION – 1" OVERLAY	LF	$12	3100	$37,200	2600	$31,200	14450	$173,400	3050	$36,600	2400	$28,800	5800	$69,600	5800	$69,600	8400	$100,800	4600	$55,200	9400	$112,800
15	ROADWAY GRADE CHANGE	LF	$15	1550	$23,250	1300	$19,500	7225	$108,375	0	$0	0	$0	2900	$43,500	2900	$43,500	4200	$63,000	2300	$34,500	9400	$141,000
	ADMIN, ENG, FINANCING, & CONTINGENCY	EST 35%			$21,158		$17,745		$98,621		$12,810		$10,080		$39,585		$39,585		$57,330		$31,395		$88,830
	PAVEMENT SUBTOTALS				$81,608		$68,445		$380,396		$49,410		$38,880		$152,685		$152,685		$221,130		$121,095		$342,630
	BASIN TOTALS				$287,078		$225,720		$959,816		$183,938		$180,765		$577,733		$471,906		$808,974		$420,188		$864,878

NOTE 1: COMPARISON TO BASINS

WITH PUMP STATIONS (SEE APPENDIX F) $5,281,914 PLUS YEARLY MAINTENANCE COSTS

DRAINAGE IMPROVEMENT TOTAL $3,372,030

ROADWAY IMPROVEMENT TOTALS $1,608,964

BASINS 1–8 TOTAL $4,980,994

The Village may choose to construct all of the recommended improvements in a relatively short time frame by using debt financing or the improvements can be completed over a longer time frame based on available revenues. To assist in making these choices, Chapter 4 contains a discussion of improvement priorities by basin and funding/financing options that may be considered.

Chapter 4
Recommendations and Implementation Guidelines

4.1 Improvement Priorities

To match annual capital improvements with annual revenue available for improvements, priorities must be set for both improvements to the existing system and installation of new facilities within and among the drainage basins.

Priorities for basin improvements are based on the historical incidence of flooding and the potential for immediate and direct improvements to the quality of stormwater discharged.

The basins and associated improvements are prioritized on Exhibit 4.1. It should be noted that these priorities are somewhat subjective and if the Village chooses to deviate from these recommendations it will not have a long-term detrimental affect on the stormwater management system.

4.2 Funding/Financing Alternatives

The Village may consider many methods for using the revenue generated from the Stormwater Management Utility (SMU) to fund or finance the recommended stormwater improvements, three of which are considered in this report.

4.2.1 Pay-As-You-Go

The pay-as-you-go approach refers to the method in which the revenue stream from the SMU is accumulated in a reserve fund. After the reserve fund contains sufficient revenue to pay for improvements, construction of the improvements are included in the next annual budgeting cycle. The pay-as-you-go method is generally perceived as the least cost means of financing capital improvements as the Village would not accrue any interest expenses associated with borrowing funds for construction.

This option is most equitable when a continuous, relatively level stream of improvements are made on an annual basis. In addition, if this option is used for the first two years of the SMU's history, future projects could be financed through revenue bonds without the requirement for bond insurance which lowers the cost of bond financing.

4.2.2 Revenue Bond Financing

Under Florida law, a utility may fund capital improvement projects or purchases by issuing bonds that will be repaid by the revenues from an enterprise operation. With revenue bonds, the utility obtains the funds needed to initiate and complete major improvements and repays them over time with the revenue collected from the SMU.

This method includes interest expenses and expenses associated with the validation and sale of bonds thus it is more costly in the long term than the pay-as-you-go method. It does, however, enable large projects to be completed more quickly. Given the projected annual revenues anticipated from the SMU, all of the recommended improvements could conceivably be completed in one to two years if bond financed. This would, in effect, eliminate the sometimes difficult task of choosing when one basin should be improved before another.

4.2.3 Bank Financing

Bank financing is similar to bond financing, however, it involves a direct bank loan rather than the more costly process of issuing bonds. The interest rate in bank financing is somewhat higher than with revenue bond financing, however, there is a greater degree of flexibility and some of the indirect costs associated with bond financing mentioned above are eliminated.

Bank financing is often preferable to bond financing due to its flexibility and the use of local banks that are sensitive to local conditions. The Village may want to consider this source of financing to implement their stormwater management improvement plan.

4.3 Grants

The Village has applied for grants in the past to help fund stormwater management improvements. It is anticipated that additional such funds will be available from various State agencies (SFWMD, DEP formerly DER) on a competitive basis for municipalities that have created stormwater utilities.

This report has been prepared in a manner conducive to use in conjunction with grant applications for specific projects. It can be used to demonstrate the comprehensive and responsible approach the Village is taking to improving the quality of stormwater discharged into the bay and ocean waters.

4.4 Implementation Recommendations

Implementation of a stormwater management program includes three categories of activity; administration, operations and maintenance and capital improvements. Recommendations for tasks within each of these categories are presented below.

4.4.1 Administration Recommendations

- Include both planned capital expenditures for drainage improvements and maintenance expenses in the annual budgeting process.

- Establish procedures and schedule for updating the facility database and base map when new facilities are installed or additional existing facilities are located.

- Establish procedures and time schedule for updating the facility database to include the dates and types of maintenance activities performed.

4.4.2 Operation and Maintenance Recommendations

The Village should adopt an annual maintenance plan and budget for both existing facilities and the recommended additions to the system. Maintenance suggestions include:

- clean and vacuum debris from catch basins twice per year
- clean drainage wells every two years
- mow and maintain swales regularly and keep clear of debris

4.4.3 Capital Improvements Recommendations

The Stormwater Master Plan is a conceptual plan based on the scope of this study and the information available. Due to its conceptual nature, several issues should be addressed during the final design of the capital improvements.

- Sewer and water lines were not located as part of this study. This should be accomplished and the locations included on the Stormwater Master Plan map prior to completion of the final design phase. The general locations of sewered areas are provided in Appendix G.

- At final design, decisions will have to be made regarding which side of the street is the most appropriate for construction of the new facilities and improved swales.

- The area of each drainage basin should be verified and recalculated using design survey methods at the final design phase.

- The drainage calculations should be verified and recalculated to ensure that the outfalls are properly sized to accommodate the anticipated discharge.

- Only after the drainage and sanitary sewer improvements are constructed, the roads should be repaved and raised 6 to 12 inches. This will increase the available head and the effectiveness of the existing and proposed drainage facilities. This, naturally, will have to be correlated to the first floor elevations of adjacent structures.

- When developing construction schedules for the improvements, construction during the winter months, November through March, should be avoided to minimize the impacts on neighborhood residents.

EXHIBIT 4.1

JOB NO:3225.00
FILE: BSNPRIO.WK3
BY: LMB CHK: AAN
DATE: 8-24-93
REV:________

KEY BISCAYNE STORMWATER MASTER PLAN
DRAINAGE BASIN IMPROVEMENT PRIORITIES

SUGGESTED PRIORITY NUMBER	DRAINAGE BASIN NUMBER	PRELIMINARY ESTIMATE OF COSTS (from Exhibit 3.7)
1	6A	$443,340
2	6B	$338,850
3	1	$218,700
4	2	$169,763
5	3	$641,925
6	8	$562,275
7	7A	$610,200
8	7B	$308,475
9	4	$150,863
10	5	$153,225

BASIN 1-8 TOTAL $3,597,616

NOTE: These priorities are preliminary. The Village may deviate from these recommendations without any long-term detrimental affect on the Stormwater Management System.

Appendix A

Stormwater Master Plan

Appendix B

Soil Information

Est. 1959
FLORIDA TESTING & ENGINEERING, INC.

August 16, 1993

Attn: Ms. Linda Bell
Williams Hatfield and Stoner
3191 Coral Way, Suite 804
Miami, FL 33145

Reference: Key Biscayne Stormwater Master Plan
Key Biscayne, Fl

Dear Ms. Bell:

This office has conducted a s subsoil investigation for the above referenced project. The purpose of this investigation was to define the current subsurface conditions and to determine the hydraulic conductivity of the soil at the sites for the Key Biscayne Stormwater Master Plan.

The testing consisted of 5 (five) hand auger borings, taken to a depth of 20 feet deep and 5 usual condition open hole percolation tests. The auger boring and percolation test locations are as indicated on the boring logs and exfiltration test result sheets and also in Figure 1 enclosed with this report. The borings show that the soil in the locations tested consists mostly of tan, gray to brown sand with shell.

Enclosed please find the results of our field testing as shown in the table shown below. Five Usual Condition Open Hole Percolation Tests were performed. Calculation of hydraulic conductivity yielded the following:

TEST NUMBER	HYDRAULIC CONDUCTIVITY (K) cfs/ft^2-ft Head
P-1	0.49994×10^{-4}
P-2	0.86750×10^{-5}
P-3	0.30299×10^{-4}
P-4	0.53781×10^{-4}
P-5	0.64339×10^{-4}

877 N.W. 61 Street • Fort Lauderdale, Florida 33309 • (305) 938-4400 • FAX (305) 938-8900

The above values for the hydraulic conductivity show that the soil can be defined as pervious.

If you have any questions please feel free to contact this office.

Sincerely Yours,

Abdul Moudud.
Staff Geotech. Engr.

Dr. Makbul Hossain, P.E.
Senior Engineer
Fla Registration No. 46834

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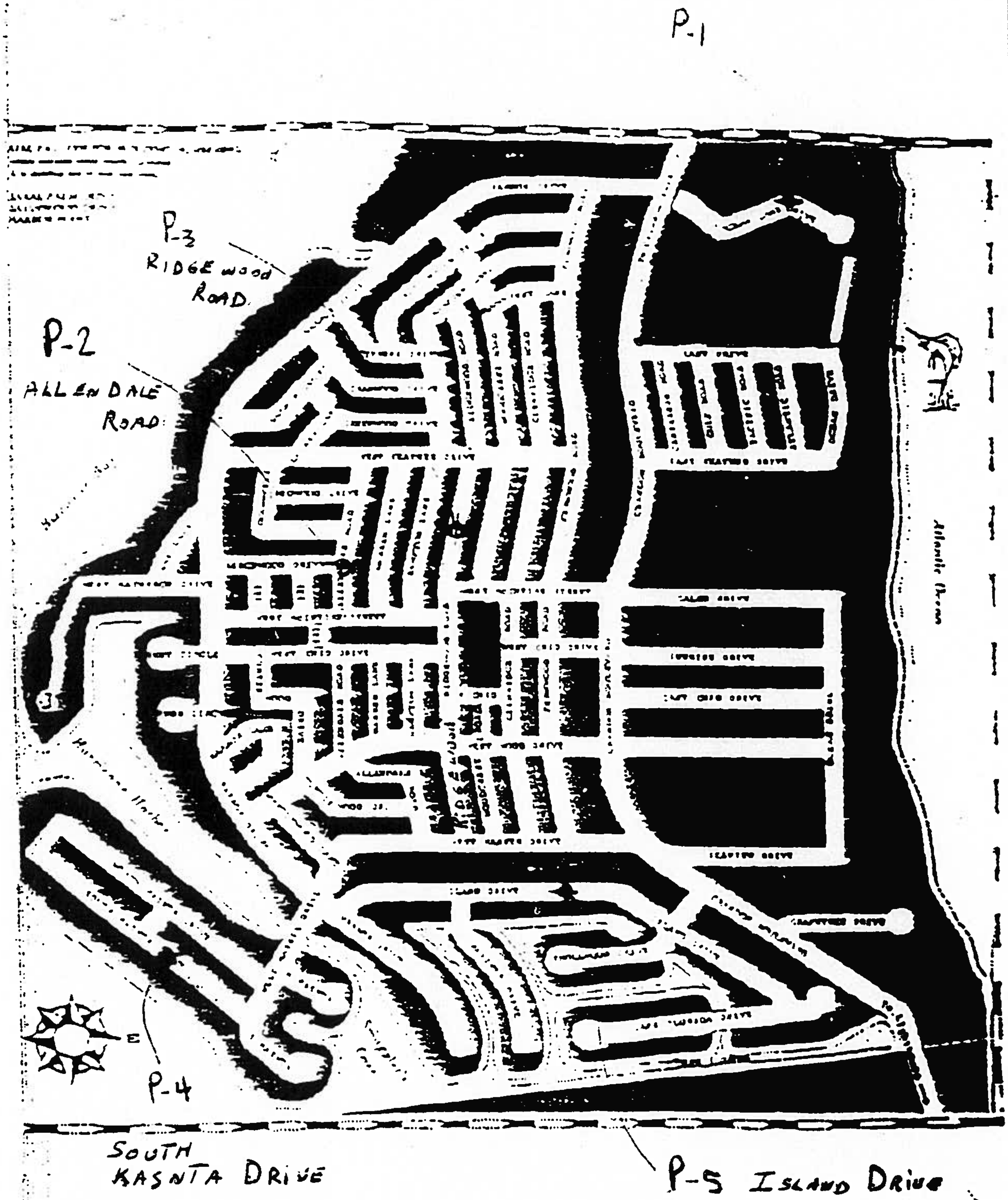

P-1
P-3
RIDGEWOOD ROAD
P-2
ALLENDALE ROAD
E
P-4
SOUTH KASNTA DRIVE
P-5 ISLAND DRIVE

Figure 1

Est. 1959

FLORIDA TESTING & ENGINEERING, INC.

TEST BORING REPORT

CLIENT:	Williams, Hatfield and Stoner	ORDER NUMBER:	930666
PROJECT:	Key Biscayne Storm Wtr. M.P.	BORING NUMBER:	1
:	Key Biscayne, FL	DRILLER:	Bruce Hill
LOCATION:	North Side of 150 Harbor Drive	WATER LEVEL:	3.5 Feet at 5:05 P.M.
:		S.P.T.: 140 lb HAMMER; 30 INCH DROP;	
DATE:	8/11/93	S.P.T.: 2 ft SPLIT SPOON SAMPLER	

DEPTH ft	VISUAL CLASSIFICATION	LAYER THICKNESS ft	HAMMER BLOWS on SAMPLER	HAMMER BLOWS on CASING	ELEVATION Unknown ft. M.S.L.
1	Tan Sand and Limerock.	1.0		Hollow Auger	
2	Brown Medium Fine Silica Sand with trace of Shell.				
3					
4		3.0			
5	Grey Medium Fine Silica Sand with Shell.				
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20		16.0			

PAGE 1 OF 1

TEST TERMINATED AT 20.0 FEET

The above test boring was conducted in accordance with A.S.T.M. designation D-1586

877 N.W. 61 Street • Fort Lauderdale, Florida 33309
Phone: (305) 938-4400 • Fax: (305) 938-8900

FTE Est. 1959

FLORIDA TESTING & ENGINEERING, INC.

TEST BORING REPORT

CLIENT:	Williams, Hatfield and Stoner	ORDER NUMBER:	930666
PROJECT:	Key Biscayne Storm Wtr. M.P.	BORING NUMBER:	2
:	Key Biscayne, FL	DRILLER:	Bruce Hill
LOCATION:	East Side of 525 Allen Dale Road	WATER LEVEL:	3.0 Feet at 2:30 P.M.
:		S.P.T.: 140 lb HAMMER; 30 INCH DROP;	
DATE:	8/11/93	S.P.T.: 2 ft SPLIT SPOON SAMPLER	

DEPTH ft	VISUAL CLASSIFICATION	LAYER THICKNESS ft	HAMMER BLOWS on SAMPLER	HAMMER BLOWS on CASING	ELEVATION Unknown ft. M.S.L.
1	Tan Medium Fine Silica Sand with Silt.			Hollow Auger	
2					
3		3.0			
4	Grey Medium Fine Silica Sand with Shell.				
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20		17.0			

PAGE 1 OF 1 TEST TERMINATED AT 20.0 FEET

The above test boring was conducted in accordance with A.S.T.M. designation D-1586

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Phone: (305) 938-4400 • Fax: (305) 938-8900

FTE Est. 1959

FLORIDA TESTING & ENGINEERING, INC.

TEST BORING REPORT

CLIENT:	Williams, Hatfield and Stoner	ORDER NUMBER:	930666
PROJECT:	Key Biscayne Storm Wtr. M.P.	BORING NUMBER:	3
:	Key Biscayne, FL	DRILLER:	Bruce Hill
LOCATION:	462 Ridgewood Road	WATER LEVEL:	3.5 Feet
:		S.P.T.: 140 lb HAMMER; 30 INCH DROP;	
DATE:	8/11/93	S.P.T.: 2 ft SPLIT SPOON SAMPLER	

DEPTH ft	VISUAL CLASSIFICATION	LAYER THICKNESS ft	HAMMER BLOWS on SAMPLER	HAMMER BLOWS on CASING	ELEVATION Unknown ft. M.S.L.
1	Brown and Tan Medium Fine Silica Sand.			Hollow Auger	
2					
3					
4					
5		5.0			
6	Tan Medium Fine Silica Sand.				
7					
8					
9		4.0			
10	Grey Medium Fine Silica Sand.				
11					
12					
13					
14					
15					
16					
17					
18					
19					
20		11.0			

PAGE 1 OF 1 TEST TERMINATED AT 20.0 FEET

The above test boring was conducted in accordance with A.S.T.M. designation D-1586

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TEST BORING REPORT

CLIENT:	Williams, Hatfield and Stoner	ORDER NUMBER:	930666
PROJECT:	Key Biscayne Storm Wtr. M.P.	BORING NUMBER:	4
:	Key Biscayne, FL	DRILLER:	Bruce Hill
LOCATION:	East Side of 630 South Masnata Drive	WATER LEVEL:	3.5 Feet at 12:25 P.M.
:		S.P.T.: 140 lb HAMMER; 30 INCH DROP;	
DATE:	8/11/93	S.P.T.: 2 ft SPLIT SPOON SAMPLER	

DEPTH ft	VISUAL CLASSIFICATION	LAYER THICKNESS ft	HAMMER BLOWS on SAMPLER	HAMMER BLOWS on CASING	ELEVATION Unknown ft. M.S.L.
1	Tan Medium Fine Silica Sand with trace of Silt.			Hollow Auger	
2					
3					
4					
5		5.0			
6	Brown Medium Fine Silica Sand with trace of Marl.				
7					
8		3.0			
9	Tan Medium Fine Silica Sand with Shell.				
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20		12.0			

TEST TERMINATED AT 20.0 FEET

The above test boring was conducted in accordance with A.S.T.M. designation D-1586

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FLORIDA TESTING & ENGINEERING, INC.

TEST BORING REPORT

CLIENT:	Williams, Hatfield and Stoner	ORDER NUMBER:	930666
PROJECT:	Key Biscayne Storm Wtr. M.P.	BORING NUMBER:	5
:	Key Biscayne, FL	DRILLER:	Bruce Hill
LOCATION:	190 Island Drive, South Side of Road.	WATER LEVEL:	6.0 Feet at 10:35 A.M.
:		S.P.T.:	140 lb HAMMER; 30 INCH DROP;
DATE:	8/11/93	S.P.T.:	2 ft SPLIT SPOON SAMPLER

DEPTH ft	VISUAL CLASSIFICATION	LAYER THICKNESS ft	HAMMER BLOWS on SAMPLER	HAMMER BLOWS on CASING	ELEVATION Unknown ft. M.S.L.
1	Brown Medium Fine Silica Sand.			Hollow Auger	
2					
3					
4		4.0			
5	Grey Medium Fine Silica Sand with Shell.				
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20		16.0			

TEST TERMINATED AT 20.0 FEET

The above test boring was conducted in accordance with A.S.T.M. designation D-1586

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Phone: (305) 938-4400 • Fax: (305) 938-8900

Report of Usual Condition Open Hole Percolation Test

Project Name	KEY BISCAYNE S.W.M.P.	Test Number	P-1
Client:	WILLIAMS, HATFIELD & STONER	Project Number:	930666
Project Location:	KEY BISCAYNE, FL	Tested By	BRUCE HILL
Test Location:	NORTH SIDE OF 150 HARBOR DR	Date Tested	AUGUST 11, 1993

Soil Description:

0 - 1'	TAN SAND AND LIMEROCK
1 - 4'	BROWN MEDIUM FINE SILICA SAND WITH TRACE OF ORGANIC
4 - 15'	GREY MEDIUM FINE SILICA SAND WITH SHELL

Remarks:

1. Water Table below existing grade 3.5 Ft
2. Test Depth 15 Ft
3. Diameter of Tube is 6 inches.

Time (min)	Water Input (gal)	Time (min)	Water Input (gal)	Time (min)	Water Input (gal)
1	5.00	11	2.25	21	2.00
2	4.00	12	2.25	22	1.75
3	3.25	13	2.25	23	1.75
4	3.00	14	2.25	24	1.75
5	3.00	15	2.25	25	1.75
6	3.00	16	2.00	26	1.50
7	3.00	17	2.00	27	1.50
8	2.75	18	2.00	28	1.50
9	2.50	19	2.00	29	1.50
10	2.25	20	2.00	30	1.50

Stabilized Flow (gal) 1.65

Hydraulic Conductivity (K) **0.049994×10^{-3} CFS/FT^2-FT HEAD**

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FTE Est. 1959
FLORIDA TESTING & ENGINEERING, INC.

Report of Usual Condition Open Hole Percolation Test

Project Name	KEY BISCAYNE S.W.M.P.	Test Number	P-2
Client:	WILLIAMS, HATFIELD & STONER	Project Number:	930666
Project Location:	KEY BISCAYNE, FL	Tested By	BRUCE HILL
Test Location:	EAST SIDE OF 525 ALLEN DALE ROAD	Date Tested	AUGUST 11, 1993

Soil Description:

0 - 3' TAN MEDIUM FINE SILICA SAND WITH SILT

3 - 15' GREY MEDIUM FINE SILICA SAND WITH SHELL

Remarks:

1. Water Table below existing grade 3 Ft
2. Test Depth 15 Ft
3. Diameter of Tube is 6 inches.

Time (min)	Water Input (gal)	Time (min)	Water Input (gal)	Time (min)	Water Input (gal)
1	4.00	11	0.50	21	0.25
2	2.25	12	0.50	22	0.25
3	1.50	13	0.50	23	0.25
4	1.00	14	0.50	24	0.25
5	1.00	15	0.50	25	0.25
6	0.75	16	0.25	26	0.25
7	0.75	17	0.25	27	0.25
8	0.75	18	0.25	28	0.25
9	0.50	19	0.25	29	0.25
10	0.50	20	0.25	30	0.25

Stabilized Flow (gal) 0.25

Hydraulic Conductivity (K) **0.008675 x 10^{-3} CFS/FT^2-FT HEAD**

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FTE Est. 1959
FLORIDA TESTING & ENGINEERING, INC.

Report of Usual Condition Open Hole Percolation Test

Project Name	KEY BISCAYNE S.W.M.P.	Test Number	P-3
Client:	WILLIAMS, HATFIELD & STONER	Project Number:	930666
Project Location:	KEY BISCAYNE, FL	Tested By	AVERY YATES
Test Location:	462 RIDGEWOOD ROAD	Date Tested	AUGUST 12, 1993

Soil Description:

0 - 5'	BROWN AND TAN MEDIUM FINE SILICA SAND
5 - 9'	TAN MEDIUM FINE SILICA SAND
9 - 20'	GREY MEDIUM FINE SILICA SAND

Remarks:

1. Water Table below existing grade 3.5 Ft
2. Test Depth 15 Ft
3. Diameter of Tube is 6 inches.

Time (min)	Water Input (gal)	Time (min)	Water Input (gal)	Time (min)	Water Input (gal)
1	2.00	11	1.25	21	1.00
2	2.00	12	1.25	22	1.00
3	2.00	13	1.25	23	1.00
4	1.75	14	1.25	24	1.00
5	1.75	15	1.25	25	1.00
6	1.75	16	1.00	26	1.00
7	1.50	17	1.00	27	1.00
8	1.50	18	1.00	28	1.00
9	1.50	19	1.00	29	1.00
10	1.50	20	1.00	30	1.00

Stabilized Flow (gal) 1.00

Hydraulic Conductivity (K) **0.030299×10^{-3} CFS/FT^2-FT HEAD**

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FTE Est. 1959
FLORIDA TESTING & ENGINEERING, INC.

Report of Usual Condition Open Hole Percolation Test

Project Name	KEY BISCAYNE S.W.M.P.	Test Number	P-4
Client:	WILLIAMS, HATFIELD & STONER	Project Number:	930666
Project Location:	KEY BISCAYNE, FL	Tested By	BRUCE HILL
Test Location:	EAST SIDE 630 SOUTH MASNATA DRIVE	Date Tested	AUGUST 11, 1993

Soil Description:

0 - 5'	TAN MEDIUM FINE SILICA SAND WITH TRACE OF SILT
5 - 8'	BROWN MEDIUM FINE SILICA SAND WITH TRACE OF MARL
8 - 15'	TAN MEDIUM FINE SILICA SAND WITH SHELL

Remarks:

1. Water Table below existing grade 3.5 Ft
2. Test Depth 15 Ft
3. Diameter of Tube is 6 inches.

Time (min)	Water Input (gal)	Time (min)	Water Input (gal)	Time (min)	Water Input (gal)
1	5.50	11	3.25	21	2.00
2	5.00	12	3.00	22	2.00
3	5.00	13	3.00	23	2.00
4	5.00	14	3.00	24	2.00
5	4.50	15	2.75	25	2.00
6	4.00	16	2.50	26	1.75
7	3.75	17	2.50	27	1.50
8	3.75	18	2.50	28	1.50
9	3.50	19	2.25	29	1.50
10	3.00	20	2.25	30	1.50

Stabilized Flow (gal) 1.78

Hydraulic Conductivity (K) **0.053781 x 10^{-3} CFS/FT^2-FT HEAD**

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FTE Est. 1959
FLORIDA TESTING & ENGINEERING, INC.

Report of Usual Condition Open Hole Percolation Test

Project Name	KEY BISCAYNE S.W.M.P.	Test Number	P-5
Client:	WILLIAMS, HATFIELD & STONER	Project Number:	930666
Project Location:	KEY BISCAYNE, FL	Tested By	BRUCE HILL
Test Location:	190 ISLAND DRIVE - APPROX. 15' SOUTH OF ROAD	Date Tested	AUGUST 11, 1993

Soil Description:

0 - 4'	BROWN MEDIUM FINE SILICA SAND
4 - 15'	GREY MEDIUM FINE SILICA SAND WITH SHELL

Remarks:

1. Water Table below existing grade 6 Ft
2. Test Depth 15 Ft
3. Diameter of Tube is 6 inches.

Time (min)	Water Input (gal)	Time (min)	Water Input (gal)	Time (min)	Water Input (gal)
1	8.00	11	3.75	21	3.50
2	7.00	12	3.75	22	3.50
3	5.50	13	3.50	23	3.25
4	4.50	14	3.50	24	3.25
5	4.50	15	3.50	25	3.25
6	4.25	16	3.50	26	3.25
7	4.25	17	3.50	27	3.25
8	4.25	18	3.50	28	3.25
9	4.25	19	3.50	29	3.25
10	4.00	20	3.50	30	3.25

Stabilized Flow (gal) 3.30

Hydraulic Conductivity (K) **0.064339×10^{-3} CFS/FT^2-FT HEAD**

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FTE Est. 1959
FLORIDA TESTING & ENGINEERING, INC.

SUBSURFACE EXPLORATION REPORT
KEY BISCAYNE POLICE STATION
KEY BISCAYNE, FLORIDA

FILE NO.: 93-2385

JULY 21, 1993

Ardaman & Associates, Inc.

OFFICES

Orlando, 8008 S. Orange Avenue, Orlando, Florida 32809, Phone (407) 855-3860
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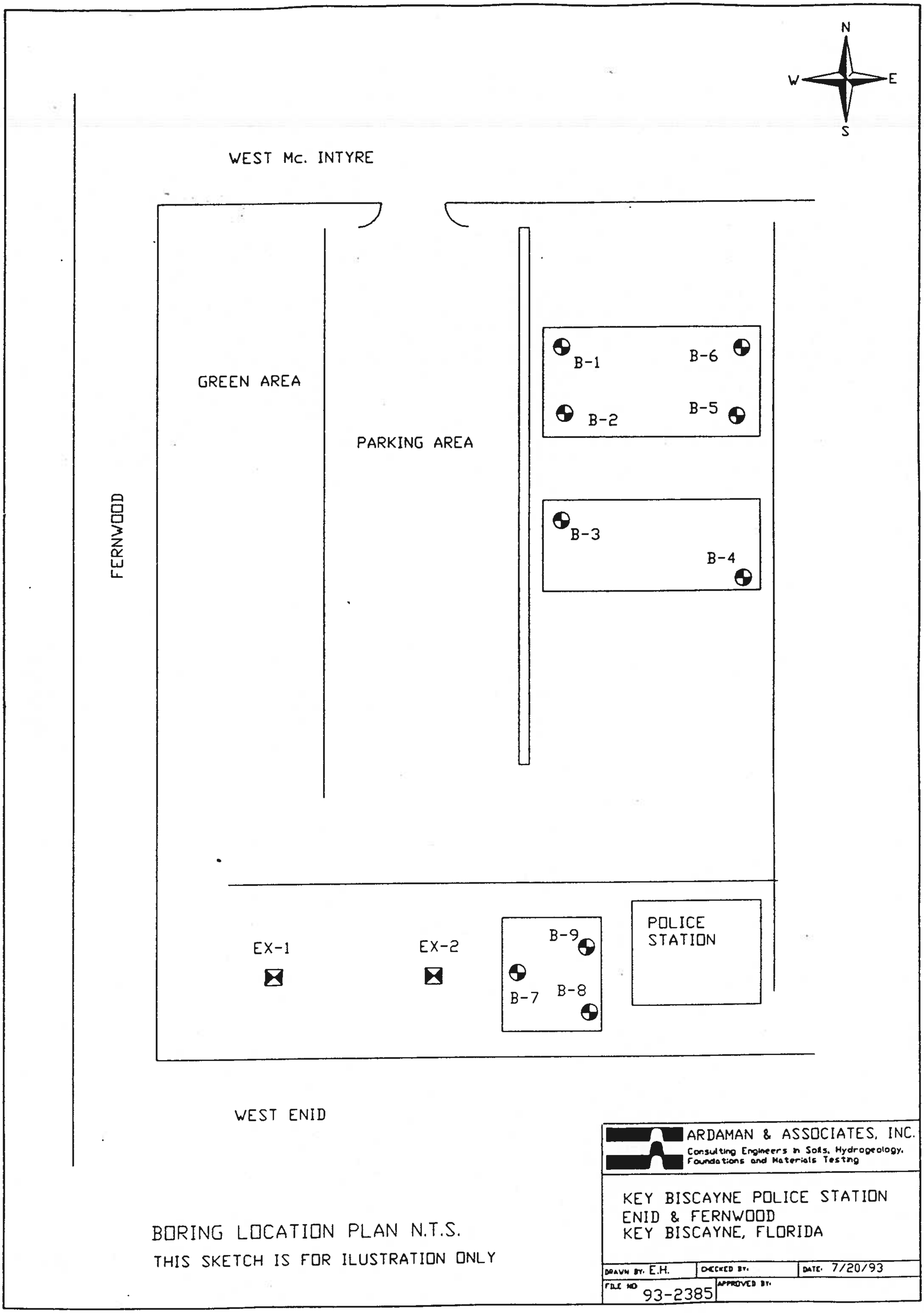


BORING LOCATION PLAN N.T.S.

THIS SKETCH IS FOR ILUSTRATION ONLY

Legend:

Symbol:	Description:
	Fill
	Sandy Limestone
	Hand auger sample
	End of boring
	Sand
7/6 5/6	SPT Sample No. of blows/ Penetration in inches
	Groundwater Table

Notes:

ENGINEERING CLASSIFICATIONS

COHESIONLESS SOILS

DESCRIPTION	SPT "N" VALUE
VERY LOOSE	0 TO 4
LOOSE	5 TO 9
MED. DENSE	10 TO 29
DENSE	30 TO 49
VERY DENSE	> 50

COHESIVE SOILS

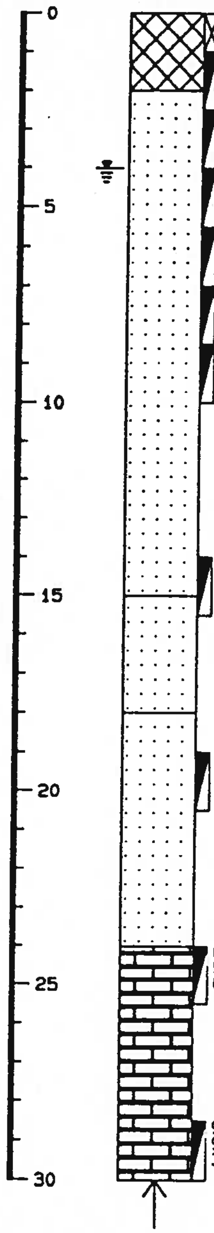
DESCRIPTION	SPT "N" VALUE
VERY SOFT	0 TO 2
SOFT	3 TO 4
MED. STIFF	5 TO 8
STIFF	9 TO 15
VERY STIFF	16 TO 30
HARD	> 30

Project No. 93-2385

SOIL TEST BORING SYMBOLIC LOGS

BORING B-1

Project: KEY BISCAYNE POLICE STATION | File No: 93-2385
Boring No: B-1 | Date: 7-15-93 | Elevation: N/A
Boring Location: SEE PLAN
Casing Depth: N/A
Drill Method: SPT/HSA | Driller: S.G./C.E.
Depth of Watertable: 4.0' | Date Checked: 7-15-93



SOIL SYMBOLS & BLOW COUNTS / INCHES OF PENETRATION	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
	FILL, limerock.		
5/6 6/6 3/6		1	9
	SAND, gray to brown fine to medium grained, some shells.		
1/6 4/6 6/6		2	10
8/6 8/6 12/6		3	20
13/6 8/6 13/6		4	21
13/6 17/6 8/6		5	25
12/6 13/6 12/6		6	25
8/6 13/6 11/6		7	24
	SAND lt gray fine grained, some silt.		
	SAND gray medium grained, some shells.		
12/6 8/6 8/6		8	16
6/6 5/6 6/6	SANDY LIMESTONE lt gray.	9	11
9/6 9/6 32/6		10	41

Water Checked
7-15-93

END OF BORING 30'.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-2

Project: KEY BISCAYNE POLICE STATION

File No: 93-2385

Boring No: B-2

Date: 7-15-93

Elevation: N/A

Boring Location: SEE PLAN

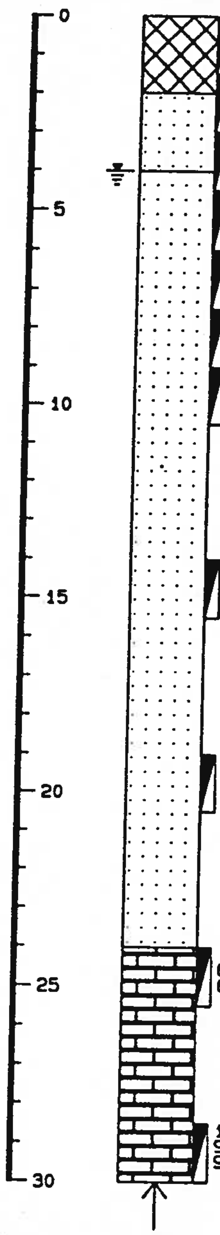
Casing Depth: N/A

Drill Method: SPT/HSA

Driller: S.G./C.E.

Depth of Watertable: 4.0'

Date Checked: 7-15-93



BLOW COUNTS / INCHES OF PENETRATION	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
6/6 11/6 5/6	FILL, limerock.	1	16
8/6 4/6 3/6	SAND lt brown fine grained few organics.	2	7
3/6 5/6 5/6		3	10
9/6 15/6 24/6	SAND gray fine to medium grained some shells.	4	39
20/6 25/6 25/6		5	50
23/6 13/6 14/6		6	27
14/6 18/6 18/6		7	36
8/6 9/6 11/6		8	20
4/6 5/6 10/6		9	15
10/6 6/6 6/6	SANDY LIMESTONE lt gray.	10	12
12/6 9/6 9/6		11	18

Water Checked 7-15-93

END OF BORING 30'.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-3

Project: KEY BISCAYNE POLICE STATION

File No: 93-2385

Boring No: B-3

Date: 7-15-93

Elevation: N/A

Boring Location: SEE PLAN

Casing Depth: N/A

Drill Method: SPT/HSA

Driller: S.G./C.E.

Depth of Watertable: 4.0'

Date Checked: 7-15-93

ELEV / DEPTH	SOIL SYMBOLS & BLOW COUNTS / INCHES OF PENETRATION	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
0	31/6, 21/6, 8/6	FILL, limerock.	1	29
	7/6, 5/6, 6/6	SAND gray to brown fine to medium grained some shells.	2	11
	6/6, 6/6, 6/6		3	12
5	10/6, 13/6, 22/6		4	35
	10/6, 20/6, 20/6		5	40
	23/6, 16/6, 15/6		6	31
10	20/6, 20/6, 20/6		7	40
15	14/6, 6/6, 6/6	SAND lt gray fine grained, some silt.	8	12
		SAND gray medium grained some shells.		
20	4/6, 3/6, 4/6		9	7
25	14/6, 15/6, 11/6	SANDY LIMESTONE lt gray.	10	26
30	7/6, 7/6, 8/6		11	15

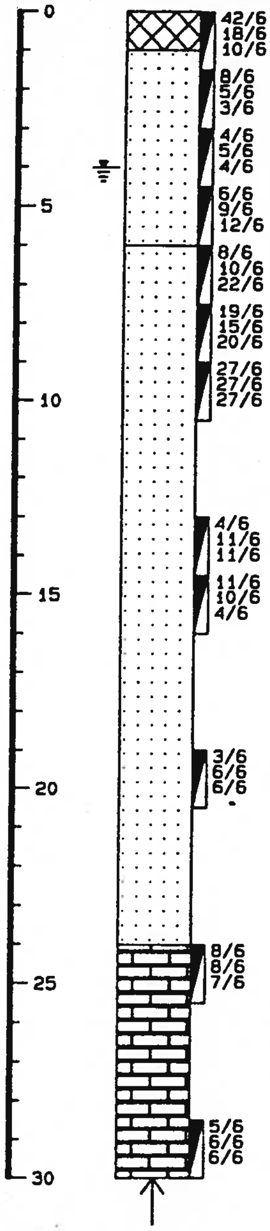
Water Checked 7-15-93

END OF BORING 30'.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-4

Project: KEY BISCAYNE POLICE STATION — File No: 93-2385
Boring No: B-4 — Date: 7-15-93 — Elevation: N/A
Boring Location: SEE PLAN
Casing Depth: N/A
Drill Method: SPT/HSA — Driller: S.G./C.E.
Depth of Watertable: 4.0' — Date Checked: 7-15-93



SOIL SYMBOLS & BLOW COUNTS / INCHES OF PENETRATION	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
42/6, 18/6, 10/6	FILL, limerock.	1	28
8/6, 5/6, 3/6	FILL brown fine to medium grained few organics.	2	8
4/6, 5/6, 4/6		3	9
6/6, 9/6, 12/6		4	21
8/6, 10/6, 22/6	SAND gray fine to medium grained some shells.	5	32
19/6, 15/6, 20/6		6	25
27/6, 27/6, 27/6		7	54
4/6, 11/6, 11/6		8	22
11/6, 10/6, 4/6		9	14
3/6, 6/6, 6/6		10	12
8/6, 8/6, 7/6	SANDY LIMESTONE lt gray to yellow.	11	15
5/6, 6/6, 6/6		12	12

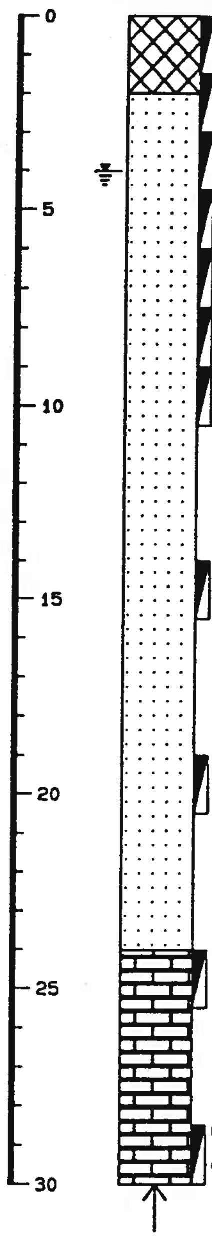
Water Checked 7-15-93

END OF BORING 30'.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-5

Project: KEY BISCAYNE POLICE STATION File No: 93-2385
Boring No: B-5 Date: 7-15-93 Elevation: N/A
Boring Location: SEE PLAN
Casing Depth: N/A
Drill Method: SPT/HSA Driller: S.G./C.E.
Depth of Watertable: 4.0' Date Checked: 7-15-93



ELEV / DEPTH	SOIL SYMBOLS & BLOW COUNTS / INCHES OF PENETRATION	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
0	44/6 23/6 13/6	FILL, limerock.	1	36
	12/6 5/6 3/6	SAND gray fine to medium grained.	2	8
	5/6 5/6 9/6		3	14
5	9/6 12/6 18/6		4	30
	15/6 20/6 15/6		5	35
	20/6 13/6 17/6		6	30
10	17/6 19/6 19/6		7	38
15	2/6 3/6 4/6		8	7
20	5/6 5/6 5/6		9	10
25	4/6 14/6 12/6	SANDY LIMESTONE lt gray to yellow.	10	26
30	6/6 11/6 8/6		11	19

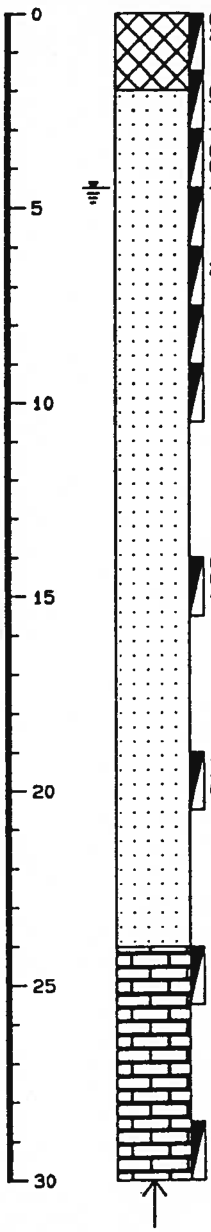
Water Checked
7-15-93

END OF BORING 30'.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-6

Project: KEY BISCAYNE POLICE STATION   File No: 93-2385
Boring No: B-6   Date: 7-15-93   Elevation: N/A
Boring Location: SEE PLAN
Casing Depth: N/A
Drill Method: SPT/HSA   Driller: S.G./C.E.
Depth of Watertable: 4.5'   Date Checked: 7-15-93



ELEV / DEPTH	SOIL SYMBOLS & BLOW COUNTS / INCHES OF PENETRATION	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
0	60/6 21/6 14/6	FILL, limerock.	1	35
2	15/6 6/6 7/6	SAND gray fine to medium grained, few shells.	2	13
	7/6 6/6 6/6		3	12
5	7/6 19/6 17/6		4	36
	10/6 20/6 12/6		5	32
	16/6 12/6 18/6		6	30
10	16/6 12/6 12/6		7	24
15	6/6 6/6 4/6		8	10
20	4/6 4/6 6/6		9	10
24	14/6 11/6 10/6	SANDY LIMESTONE lt gray.	10	21
30	11/6 5/6 8/6		11	13

Water Checked
7-15-93

END OF BORING 30'.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-7

Project: KEY BISCAYNE POLICE STATION
File No: 93-2385
Boring No: B-7
Date: 7-15-93
Elevation: N/A
Boring Location: SEE PLAN
Casing Depth: N/A
Drill Method: SPT/HSA
Driller: S.G./C.E.
Depth of Watertable: 4.0'
Date Checked: 7-15-93

DEPTH	SOIL SYMBOLS & BLOW COUNTS / INCHES OF PENETRATION	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
0	25/6 30/6 29/6	FILL, limerock.	1	59
	17/6 7/6 9/6		2	16
2.5	4/6 6/6 8/6	SILTY SAND brown fine grained, little organics.	3	14
5	8/6 12/6 14/6		4	26
6	5/6 15/6 19/6	SAND gray fine to medium grained, few shells.	5	34
	22/6 16/6 20/6		6	36
10	20/6 22/6 22/6		7	44
15	8/6 12/6 14/6		8	26
20	8/6 8/6 10/6		9	16
24	11/6 13/6 10/6	SANDY LIMESTONE.	10	23
30	4/6 3/6 4/6		11	7

Water Checked
7-15-93

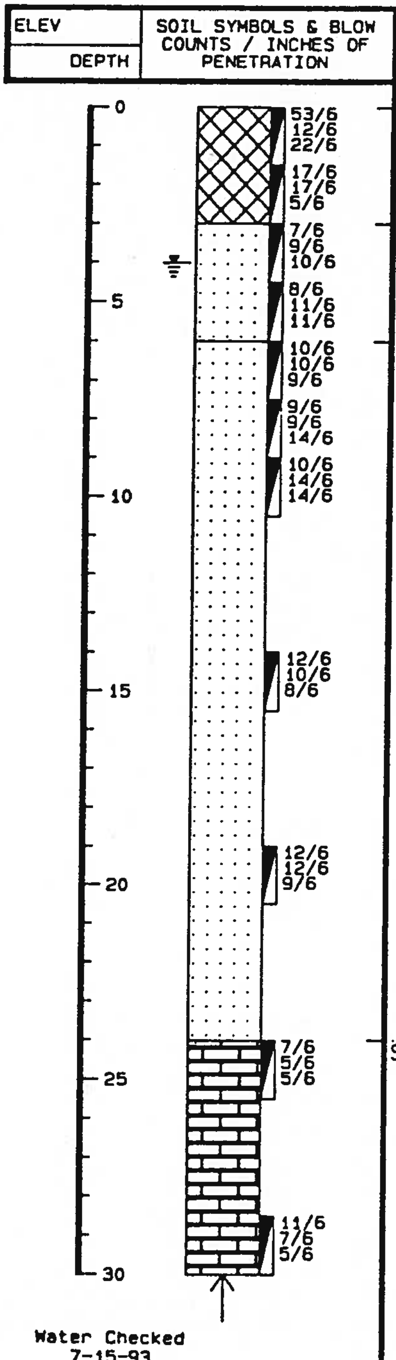
END OF BORING 30'.

Ardaman & Associates, Inc.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-8

Project: KEY BISCAYNE POLICE STATION | File No: 93-2385
Boring No: B-8 | Date: 7-15-93 | Elevation: N/A
Boring Location: SEE PLAN
Casing Depth: N/A
Drill Method: SPT/HSA | Driller: S.G./C.E.
Depth of Watertable: 4.0' | Date Checked: 7-15-93



Blow counts / inches of penetration	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
53/6 12/6 22/6	FILL sand and gravel gray.	1	34
17/6 17/6 5/6		2	22
7/6 9/6 10/6	SILTY SAND mostly organics dark brown.	3	19
8/6 11/6 11/6		4	22
10/6 10/6 9/6	SAND gray fine to medium grained, few shells.	5	19
9/6 9/6 14/6		6	23
10/6 14/6 14/6		7	28
12/6 10/6 8/6		8	18
12/6 12/6 9/6		9	21
7/6 5/6 5/6	SANDY LIMESTONE.	10	10
11/6 7/6 5/6		11	12

END OF BORING 30'.

SOIL TEST BORING SYMBOLIC LOGS

BORING B-9

Project: KEY BISCAYNE POLICE STATION   File No: 93-2385

Boring No: B-9   Date: 7-15-93   Elevation: N/A

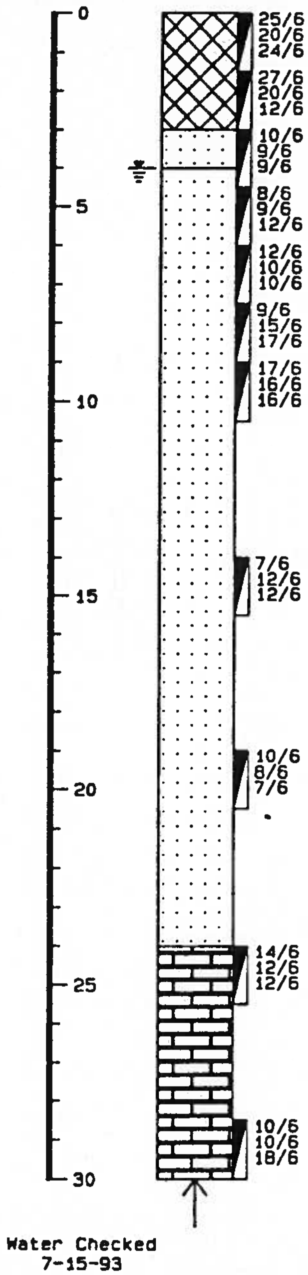
Boring Location: SEE PLAN

Casing Depth: N/A

Drill Method: SPT/HSA   Driller: S.G./C.E.

Depth of Watertable: 4.0'   Date Checked: 7-15-93

ELEV / DEPTH	SOIL SYMBOLS & BLOW COUNTS / INCHES OF PENETRATION	SOIL DESCRIPTION	SAMPLE NO.	SPT "N" VALUE
0	25/6 20/6 24/6	FILL limerock.	1	44
	27/6 20/6 12/6		2	32
	10/6 9/6 9/6	SILTY SAND brown fine grained little organics.	3	18
5	8/6 9/6 12/6	SAND gray fine to medium grained, few shells.	4	21
	12/6 10/6 10/6		5	20
	9/6 15/6 17/6		6	32
10	17/6 16/6 16/6		7	32
15	7/6 12/6 12/6		8	24
20	10/6 8/6 7/6		9	15
25	14/6 12/6 12/6	SANDY LIMESTONE.	10	24
30	10/6 10/6 18/6		11	28

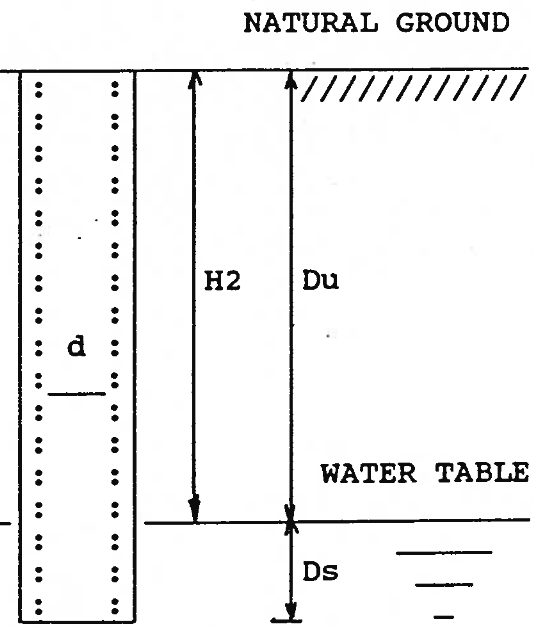


END OF BORING 30'.

July 19, 1993
File No. 93-2385

EXFILTRATION TEST RESULTS
CONSTANT HEAD TEST
TEST NO. 1

DEPTH	SOIL DESCRIPTION
0'-2.5'	FILL, limerock gravel
0.8'-10'	SAND brown to gray fine to medium grained



TEST DATE: 7-16-93
TEST LOCATION: SEE SKETCH

K = HYDRAULIC CONDUCTIVITY = 5.67E-05 (CFS/SQ.FT.- FT. HEAD)

Q = AVERAGE FLOW RATE = 1.92E-03 (CFS)

d = DIAMETER OF TEST HOLE = 0.33 (FT.)

H2 = DEPTH OF WATER TABLE = 4.00 (FT.)

Du = UNSATURATED HOLE DEPTH = 4.00 (FT.)

Ds = SATURATED HOLE DEPTH = 6.00 (FT.)

DEPTH OF HOLE = 10.00 (FT.)

Evelio Horta
7/21/93

Evelio Horta, Ph.D., P.E.
Project Engineer
Fla.Reg.No. 46625

ARDAMAN & ASSOCIATES, INC.
Consulting Engineers in Soils, Hydrogeology, Foundations and Materials Testing

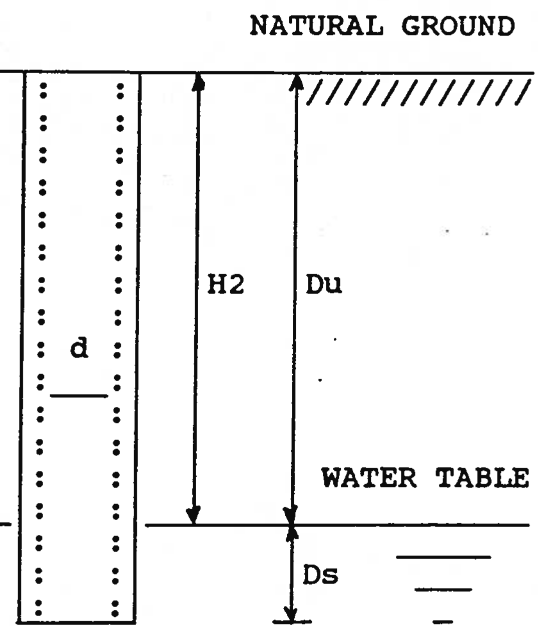
KEY BISCAYNE POLICE STATION
ENID AND FERNWOOD
KEY BISCAYNE, FLORIDA

DRAWN BY: E.H.	CHECKED BY:	DATE: 7/20/93
FILE NO. 93-2385	APPROVED BY:	

July 19, 1993
File No. 93-2385

EXFILTRATION TEST RESULTS
CONSTANT HEAD TEST
TEST NO. 2

DEPTH	SOIL DESCRIPTION
0'-2.5'	FILL, limerock gravel
0.8'-10'	SAND brown to gray fine to medium grained



TEST DATE: 7-16-93
TEST LOCATION: SEE SKETCH

K = HYDRAULIC CONDUCTIVITY = 1.41E-05 (CFS/SQ.FT.- FT. HEAD)

Q = AVERAGE FLOW RATE = 5.27E-04 (CFS)

d = DIAMETER OF TEST HOLE = 0.33 (FT.)

H2 = DEPTH OF WATER TABLE = 4.58 (FT.)

Du = UNSATURATED HOLE DEPTH = 4.58 (FT.)

Ds = SATURATED HOLE DEPTH = 5.42 (FT.)

DEPTH OF HOLE = 10.00 (FT.)

Evelio Horta 7/21/93

Evelio Horta, Ph.D., P.E.
Project Engineer
Fla.Reg.No. 46625

ARDAMAN & ASSOCIATES, INC.
Consulting Engineers in Soils, Hydrogeology, Foundations and Materials Testing

KEY BISCAYNE POLICE STATION
ENID AND FERNWOOD
KEY BISCAYNE, FLORIDA

DRAWN BY: E.H	CHECKED BY:	DATE: 7/20/93
FILE NO 93-2385	APPROVED BY:	

IN-PLACE PERMEABILITY TEST RESULTS

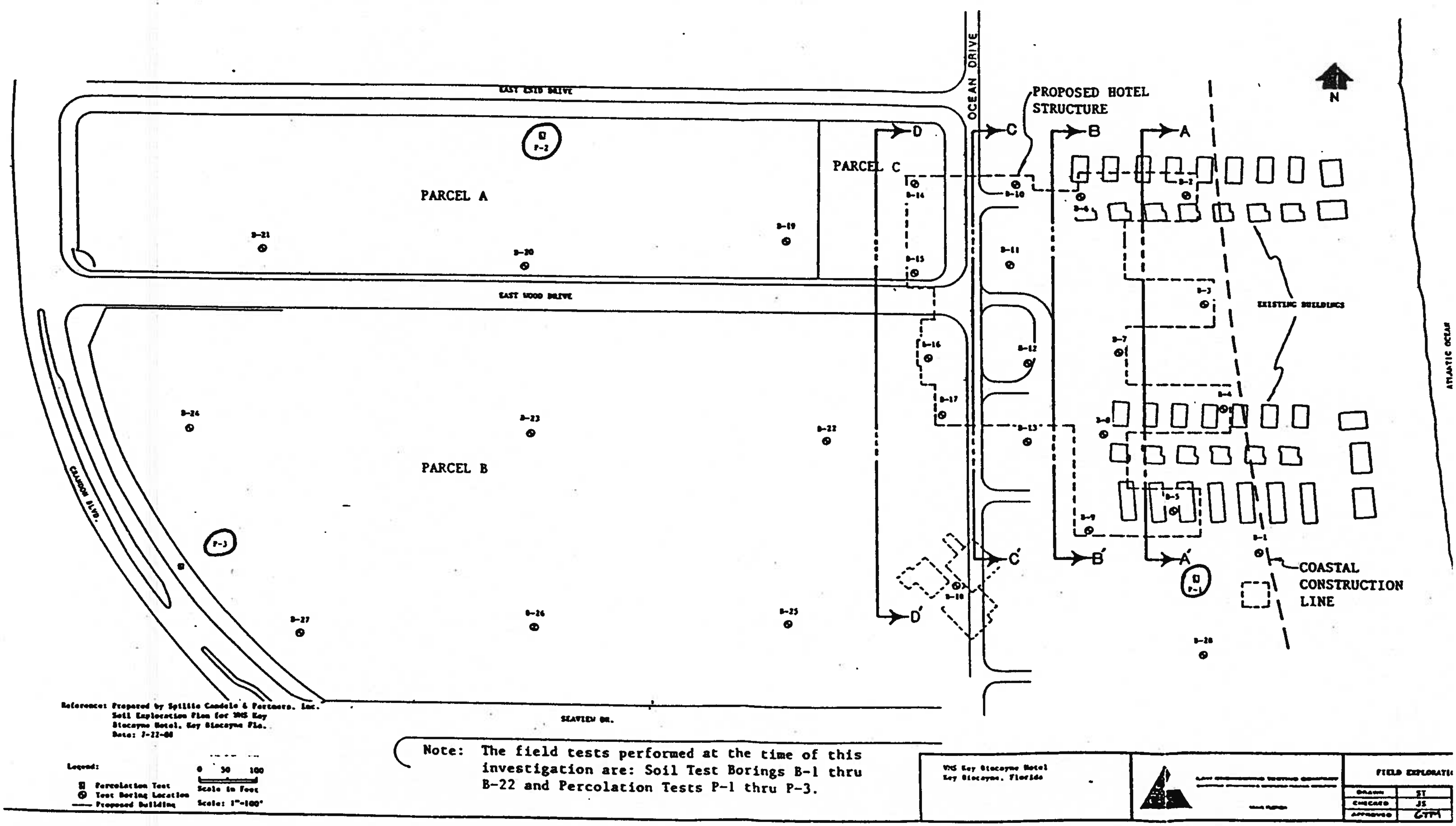
VMS Key Biscayne Hotel
Key Biscayne, Florida

Law Engineering Job No. SFD-G-4625

Date Performed: August 14, 1988

TEST NO.	DIAM. OF HOLE (IN.)	DEPTH OF THE HOLE (FT.)	GROUND WATER LEVEL DEPTH (FT.)	AVG. FLOW RATE (GPM)	K, HYDRAULIC CONDUCTIVITY (CFS/FT2-FT.HEAD)
P-1	12	10	2.8	10.4	3×10^{-4}
P-2	12	10	2.7	3.9	1×10^{-4}
P-3	12	10	3.8	6.0	1×10^{-4}

Note: The above hydraulic conductivities are for trench drains installed to the same depth as the borehole seepage test. The hydraulic conductivity is expressed as inflow per foot of head per linear foot of trench. The value represents an ultimate value. The designer should decide on the required factor of safety.



PARCEL A
PARCEL B
PARCEL C
EAST END DRIVE
EAST WOOD DRIVE
OCEAN DRIVE
CRANDON BLVD.
SEAVIEW DR.
ATLANTIC OCEAN
PROPOSED HOTEL STRUCTURE
EXISTING BUILDINGS
COASTAL CONSTRUCTION LINE
N
P-1
P-2
P-3
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
B-9
B-10
B-11
B-12
B-13
B-14
B-15
B-16
B-17
B-18
B-19
B-20
B-21
B-22
B-23
B-24
B-25
B-26
B-27
B-28
A
A'
B
B'
C
C'
D
D'
Reference: Prepared by Spillis Candela & Partners, Inc.
Soil Exploration Plan for VMS Key Biscayne Hotel, Key Biscayne Fla.
Date: 7-22-88
Legend:
Percolation Test
Test Boring Location
Proposed Building
0 50 100
Scale in Feet
Scale: 1"=100'
Note: The field tests performed at the time of this investigation are: Soil Test Borings B-1 thru B-22 and Percolation Tests P-1 thru P-3.
VMS Key Biscayne Hotel
Key Biscayne, Florida
FIELD EXPLORATI
Drawn ST
Checked JS
Approved

Appendix C

Part 2 Design and Construction (DERM Stormwater Regulations)

PUBLIC WORKS MANUAL

PART 2 DESIGN AND CONSTRUCTION

PUBLIC WORKS DEPARTMENT
METROPOLITAN DADE COUNTY

TABLE I

DESIGN STORM FREQUENCIES AND FLOOD LIMITS		
Type of Area	Rainfall Frequency	Flood Limit
1. Residential and Commercial Areas	5-year	To crown of street, or to within 15' of a dwelling or other occupied building, whichever is lower
2. 2-Lane roads in Residential and Commercial Areas	5-year, except 10-year for a bridge or culvert in the canal system	To crown of street
3. 4-Lane roads in high density, high traffic areas	10-year	To outer edge of traffic lanes
4. Private parking lots and similar paved areas	2-year	(See South Florida Building Code 4611)

D4.03 LOCAL GRADING

1. GENERAL

An acceptable grading plan must be prepared prior to determination of best means of disposal of storm runoff. A proper relation must be established between inlet sites at points of concentration of flood flow from the basin and the direction and degree of slopes which are provided to bring the water to these sites.

Closely related to grades and slopes is the selection and distribution of material used for fill. Impervious fill material is not to be used in swales except where road shoulders must be stabilized. All swale areas are to be solid sodded. To allow for sodding, swales are to be rough-graded to two inches below the elevation shown in Standard Road Details.

Some portions of the drainage system may be established below flood criteria elevations. For example, swales, gutters, and specific waterways may be set below flood criteria as indicated in Part 1, Standard Details, provided that a maximum of 6 inches is not exceeded.

Each grading and drainage plan submitted to the Public Works Department shall establish by plans, cross sections, diagrams, and notes a definite grading pattern. Such drainage plans shall be of broad enough scope to coordinate the pattern details with drainage of adjacent surrounting areas. In cases of extremely flat slopes, paving of swales may be required.

a. Grading for Street Drainage

Generally proposed grades will conform reasonably well with the natural land contours. The intent of establishing flood criteria is to prevent frequent and periodic flooding in low areas and they are not to be used as a basis for making excessive cuts or steep grade which would concentrate the collection of flood waters to an unacceptable extent. Deep cuts and resulting steep grades in areas above flood criteria will not be allowed. (A cut of about 2 feet would be considered a deep cut.)

Grades and disposal facilities may be designed for on site retention with an emergency overflow, or for disposal within the subdivision by adjustment of trades and on-site disposal facilities. In some cases initial seepage installations must be designed for future adaptation to use in an emergency outfall drainage system.

As a guideline a .2% minimum grade should be provided, with flatter grades being allowed only when justified by infiltration tests. However, consideration will be given to varying such grades to allow for condition of swales, adjacent existing and proposed points of collection for drainage, and effects of curb and gutter if to be provided. Flexibility will be allowed in determining minimum grades as related to maximum distance from which water is to be with maximum distances being related to allowable depth of water at chosen low points. See SD 3.5 for curb and gutter sections. Careful attention must be given to effects on existing surroundint areas when planning grades for draining at new development. Special attention must be given to avoid flooding of adjacent properties.

Generally an inlet, collection or seepage structure, or outfall is required at low points in the street drainage system, it being preferable to provide an onsite retention system. Where full on site retention cannot be provided, then an emergency overflow may be permitted provided the first inch of runoff is fully retained on site. Permits are required from the Department of Environmental Resources Management for any overflow into any waterbody in Dade County. (See SD 1.1 and SD 1.2.) Seepage drains can be provided based on favorable infiltration or percolation test results even though the proposed facility may be in a part of the County where tests have not previously revealed high rates. In some areas, even where such tests may show no seepage facilities are required, a sum may be included in the subdivision bond for potential installation of a drainage structure if proved necessary later by excessive ponding.

2. STORM DRAINAGE DETAILS FOR STREETS AND DRIVEWAYS

As stated in the preceding paragraphs the guideline for minimum street grading is .2% with some variations allowed depending on the type of system used for removal of flood water. This guideline, the maximum length of continuous fall from one grade point to another, and related standards discussed herein must be allowed to vary somewhat, particularly in "transition areas" where because of existing adjacent subdivisions or older streets constructed under prior standards it will not be practical to adhere exactly to these standards. Developers and contractors should check closely with the Public Works Department and its inspectors whenever such conditions are anticipated in order to prevent problems of this type.

a. Swale Sections in Rock or Marl Areas (Including Driveways)

These sections will be constructed as a straight-line slope from the inside edge of the sidewalk to the edge of pavement or valley gutter (indicated on R 14.6, and also as to driveways on R 12.3, R 12.5, and R 12.6). In certain estate zones where sidewalks are not required the elevation at the property line will not be lower than the crown of the street and this grading standard will prevent ponding where percolation is unsatisfactory.

b. Swale Sections in Sandy Areas (Excluding Driveways)

In areas (generally north of Flagler Street) where infiltration tests show good infiltration the swale section will be constructed (depressed 6 to 9 inches) in accord with R 1.1, R 2.1, R 3.1, R 8.1, R 9.1, R 9.2, and R 11.1. This type swale (between driveways only) will be used for infiltration including runoff from driveways as explained in the following paragraph.

c. Driveways to be Built Without Depressed Swale

All driveways will be graded to conform with R 12.3, R 12.5, and R 12.6, the grade being a straight line from the inside (back) edge of the sidewalk to the edge of the street pavement or valley gutter. In all right-of-way widths without curb and gutter the County standards set the back of the sidewalk at about the same level as the crown of the street or higher. This design provides for driveway runoff directly to the edge of the pavement or valley gutter from whence the normal .2% minimum allowable street grade should carry the water to the point of disposal.

D4.04 DRAINAGE FACILITIES AND STRUCTURES

1. GENERAL

a. Dade County Water Control Plan

The elements of the Dade County Water Control Plan are shown on a map filed in the Public Records. This plan is under continuous study and is revised from time to time. The latest such map is filed in Plat Book 77, Page 42. It shows approximate locations of all existing and proposed canals, levees, dams, control structures, pumping stations, drainage divides, and other drainage features of the water control system of Dade County and the South Florida Water Management District. All additional drainage facilities must be consistent with this over-all Water Control Plan.

A design chart (WC 3.1) for preliminary and tentative hydraulic computations and estimates is included herein. The design of canals and culverts installed locally by

Federal, State, and County agencies over the past 20 years conform generally to the design relations shown on it.

b. Separate Storm Drainage Systems

Storm sewers and sanitary sewers are to be separate systems.

c. Variation from Standard Details

There is no intent to limit design or construction to the particular materials and arrangements shown in the Standard Storm Drainage Details. Use of other materials and details that will provide equivalent results more efficiently may be approved by the Public Works Department, due regard being given to durability as well as performance.

d. Fill as Flood Protection

Protection from floods may be provided by filling an area, but fill is not included in this article as a drainage facility. It is one effective means of lowering flood damage, but protection by fill alone is costly and the size of the area that can be protected by fill alone is limited.

2. DISPOSAL DRAINAGE FACILITIES AND STRUCTURES

a. General

Disposal systems are termed positive drainage systems or seepage systems. Positive systems include canals and storm sewers that drain through a continuous outfall to the bay or ocean or an inland waterway; whereas seepage systems drain into the ground water.

In general, all land and streets should be graded to drain to or toward the nearest catchment or disposal structure, utilizing storm sewers, paved swales, and solid sodded V-type gutter ditches, meeting however other requirements set forth in the Public Works Manual. Seepage facilities will be relied upon as the preferable type of disposal system.

Appendix D

Permitted Outfalls

PERMITTED OUTFALLS

APPENDIX D

WHS 3225.00
FILE: OUTF–LOC.WK3
BY: LMB
DATE: 8–27–93
REV:

INFORMATION RECEIVED FROM DERM – WATER MANAGEMENT DIVISION.
STORMWATER MONITORING & EVALUATION SECTION
DADE COUNTY AND JOINT APPLICANTS

OUTFALL NUMBER	LONGITUDE	LATITUDE	RECEIVING WATER BODY	JURISDICTION	PIPE SIZE (INCHES)	DRAINAGE AREA	BASIN COEFF	LAND USE	APPROX LOCATION (TAKEN FROM WHS SURVEY)
54–42–32–SW001	80–10–14.39	25–41–48.13	BAY	KEY BISCAYNE	15x36	5.085	0.45	URSM	CB 117
54–42–32–SW002	80–10–22.9	25–41–37.57	BAY	KEY BISCAYNE	15x36	11.970	0.45	URSM	CB 125
54–42–32–SW03*	80–10–22	25–41–37	BAY	KEY BISCAYNE	48			URSM	CB 112/114 (CRANDON SYSTEM)
55–42–05–NW001B	80–10–24.44	25–41–27.70	HURRICANE HARBOR	KEY BISCAYNE	10	1.045	0.45	URSM	CB 143
55–42–05–NW002B	80–10–25.88	25–41–23.58	BISCAYNE BAY	KEY BISCAYNE	18	0.948	0.45	URSM	W MATHESON DR
55–42–05–NW003B	80–10–29.37	25–41–20.79	BISCAYNE BAY	KEY BISCAYNE	12	0.697	0.27	URSM	CB 136/137
55–42–05–NW004B	80–10–23.07	25–41–15.13	BISCAYNE BAY	KEY BISCAYNE	18	1.701	0.45	URSM	CB 1
55–42–05–NW005B	80–10–30.47	25–41–11.65	HURRICANE HARBOR	KEY BISCAYNE	18	3.117	0.39	URSM	CB 16?
55–42–05–NW006B	80–10–25.89	25–41–08.56	HURRICANE HARBOR	KEY BISCAYNE	12	3.866	0.35	URSM	CB 8?
55–42–05–NW007B	80–10–23.47	25–41–25.87	HURRICANE HARBOR	KEY BISCAYNE	12	0.896	0.44	URSM	
55–42–05–NW008B	80–10–28.26	25–41–24.83	HURRICANE HARBOR	KEY BISCAYNE	8	1.171	0.25	URSM	
55–42–05–SE001I	80–09–52.20	25–41–06.22	CANAL	KEY BISCAYNE	18	1.207	0.45	URSM	
55–42–05–SE002I	80–09–48.81	25–41–00.50	CANAL	KEY BISCAYNE	18	2.841	0.36	URSM	CB 33
55–42–05–SE003I	80–09–46.68	25–41–04.11	CANAL	KEY BISCAYNE	48	30.111	0.44	URSM	CB 28
55–42–05–SE004I	80–09–46.35	25–41–03.89	CANAL	KEY BISCAYNE	48	7.232	0.21	URSM	CB 27
55–42–05–SE005I	80–09–57.76	25–40–56.72	CANAL	KEY BISCAYNE	48	0.456	0.31	URSM	CB 35
55–42–05–SE006I	80–09–40.59	25–40–58.66	INTRACOASTAL	KEY BISCAYNE	48	0.412	0.33	URSM	CB 34
55–42–05–SE007I	80–09–32.54	25–40–58.07	CANAL	KEY BISCAYNE	48	0.825	0.43	URSM	CRANDON BLVD
55–42–05–SE008I	80–09–32.91	25–40–58.58	CANAL	KEY BISCAYNE	12	0.362	0.42	URSM	CRANDON BLVD
55–42–05–SE009I	80–09–31.14	25–40–56.78	CANAL	KEY BISCAYNE	30	1.222	0.30	URSM	CRANDON BLVD
55–42–05–SE011I	80–09–54.47	25–40–58.07	INTRACOASTAL	KEY BISCAYNE	0	3.498	0.34	URSM	
55–42–05–SW003I	80–10–15.17	25–41–03.39	WATERWAY #1	KEY BISCAYNE	20	1.318	0.38	URSM	CB 18/19 ABANDONED?
55–42–05–SW005I	80–09–57.82	25–40–56.67	WATERWAY #1	KEY BISCAYNE	0	3.178	0.34	URSM	CB 12
55–42–05–SW006B	80–10–16.93	25–41–04.26	HURRICANE HARBOR	KEY BISCAYNE	8	1.349	0.37	URSM	CB 13

* ADDED TO LIST BY WHS. OUTFALL SHOWN ON DERM AERIAL RECORD.

Appendix E

Drainage Calculations

DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN

VILLAGE OF KEY BISCAYNE

Drainage Basin: 1 | 5.69 acres

Storage Swale Volume:
from Worksheet 1 | 10219 | cf

Each Drainage Well
assumed exfil flow | 1500 | gpm | 1 | well(s)

APPENDIX E

PAGE ___ OF ___

WHS NO: 3225.00

FILE: AREADR1.WK3

BY: LMB CHK JVD

DATE: 8-23-93

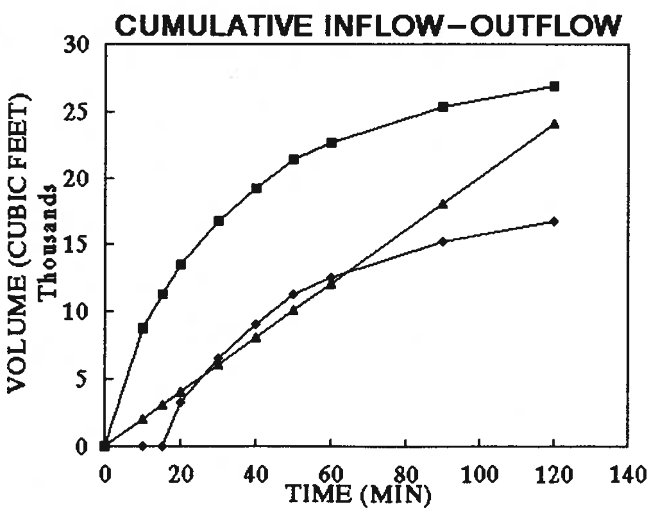
REV: ___________

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	5.69	6.80	14.5	8706	0
15	900	0.375	5.69	5.85	12.5	11234	0
20	1200	0.375	5.69	5.25	11.2	13443	3224
30	1800	0.375	5.69	4.35	9.3	16707	6488
40	2400	0.375	5.69	3.75	8.0	19204	8985
50	3000	0.375	5.69	3.35	7.1	21444	11225
60	3600	0.375	5.69	2.95	6.3	22660	12441
90	5400	0.375	5.69	2.20	4.7	25349	15130
120	7200	0.375	5.69	1.75	3.7	26885	16666

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	3.34	2005		100.00%
15	900	3.34	3008	−3008	100.00%
20	1200	3.34	4011	−787	100.00%
30	1800	3.34	6016	472	100.00%
40	2400	3.34	8021	963	89.28%
50	3000	3.34	10027	1198	89.32%
60	3600	3.34	12032	409	96.71%
90	5400	3.34	18048	−2918	119.29%
120	7200	3.34	24064	−7398	144.39%



WHS NO: 3225.00
FILE: AREADR1.WK3
BY: LMB CHK: JD
DATE: 8–23–93
REV:__________

DRAINAGE WELL FLOW CALCULATIONS
FOR DRAINAGE WELL DESIGN

Sample for Drainage Basin 1

1) Q = ciA

   WHERE:
   c = coefficient of runoff
   i = intensity for a 5 year frequency
   A = Basin Area = 5.69 acres

2) inflow = Q x time = ciAt(60) (Sample Basin 1)

   c for an 80 ft section shown in Exhibit 1.9
   where c = .2 pervious and .9 impervious
   c = 20(.9) + 60(.2) / (20+60) = .375
   .375(i)(5.69)t(60) = 128.03 it

3) Adjusted inflow = inflow – system storage = infl – 10219cf

4) Well discharge = 1 well @ 1500 gmp
   Discharge Rate = (1*1500) / (60*7.48) = 3.34 cfs
   Discharge Volume = rate(t)60 = 3.34(t)60 = 200.4 t

5) Overflow = Adjusted Inflow – Well discharge

6) % Retention = Well Discharge/ Adj. inflow

DRAINAGE CALCULATIONS

APPENDIX E

Worksheet 2

STORM WATER MASTER PLAN

VILLAGE OF KEY BISCAYNE

PAGE___ OF ___

WHS NO: 3225.00

Drainage Basin: 2 5.1 acres

FILE: AREADR2.WK3

Storage Swale Volume:

BY: LMB CHK JVD

from Worksheet 1 9619 cf

DATE: 8-23-93

Each Drainage Well

REV:____________

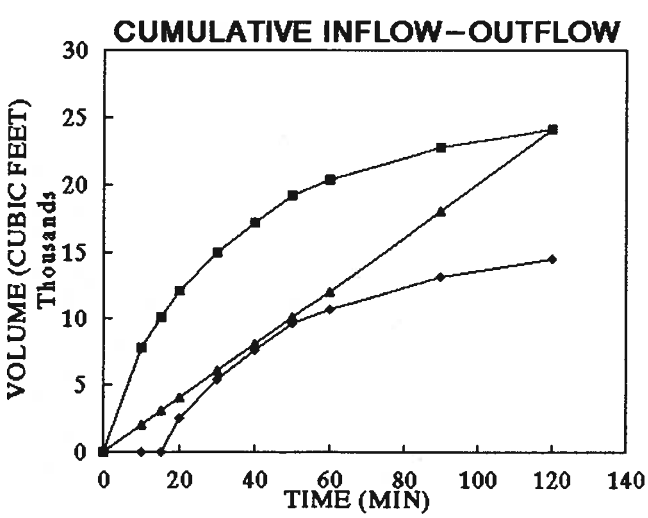
assumed exfil flow 1500 gpm 1 well(s)

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	5.1	6.80	13.0	7803	0
15	900	0.375	5.1	5.85	11.2	10069	0
20	1200	0.375	5.1	5.25	10.0	12049	2430
30	1800	0.375	5.1	4.35	8.3	14975	5356
40	2400	0.375	5.1	3.75	7.2	17213	7594
50	3000	0.375	5.1	3.35	6.4	19221	9602
60	3600	0.375	5.1	2.95	5.6	20311	10692
90	5400	0.375	5.1	2.20	4.2	22721	13102
120	7200	0.375	5.1	1.75	3.3	24098	14479

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	3.34	2005		100.00%
15	900	3.34	3008	−3008	100.00%
20	1200	3.34	4011	−1581	100.00%
30	1800	3.34	6016	−660	100.00%
40	2400	3.34	8021	−428	105.63%
50	3000	3.34	10027	−425	104.43%
60	3600	3.34	12032	−1340	112.54%
90	5400	3.34	18048	−4947	137.76%
120	7200	3.34	24064	−9586	166.21%



DRAINAGE CALCULATIONS

Worksheet 2

APPENDIX E

STORM WATER MASTER PLAN

VILLAGE OF KEY BISCAYNE

PAGE____ OF ____

WHS NO: 3225.00

Drainage Basin: 3 | 31.23 acres

FILE: AREADR3A.WK3

Storage Swale Volume: from Worksheet 1: 72931 cf

BY: LMB CHK: JVD

DATE: 8-23-93

Each Drainage Well assumed exfil flow: 1500 gpm, 3 well(s)

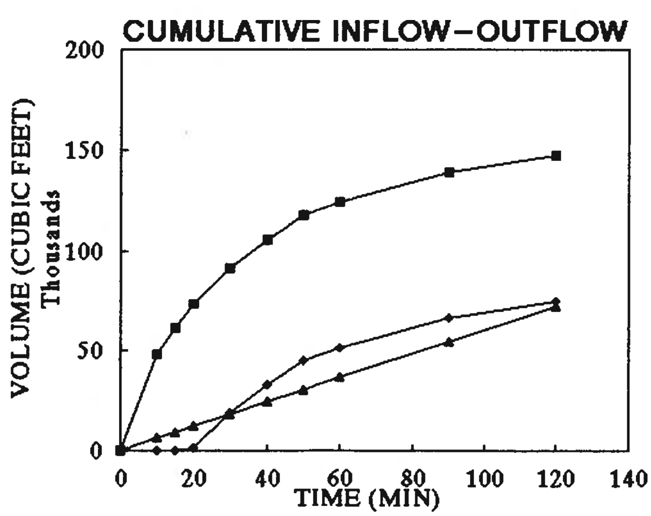
REV:__________

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	31.23	6.80	79.6	47782	0
15	900	0.375	31.23	5.85	68.5	61660	0
20	1200	0.375	31.23	5.25	61.5	73781	850
30	1800	0.375	31.23	4.35	50.9	91699	18768
40	2400	0.375	31.23	3.75	43.9	105401	32470
50	3000	0.375	31.23	3.35	39.2	117698	44767
60	3600	0.375	31.23	2.95	34.5	124373	51442
90	5400	0.375	31.23	2.20	25.8	139130	66199
120	7200	0.375	31.23	1.75	20.5	147562	74631

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	10.03	6016		100.00%
15	900	10.03	9024	−9024	100.00%
20	1200	10.03	12032	−11182	100.00%
30	1800	10.03	18048	720	100.00%
40	2400	10.03	24064	8406	74.11%
50	3000	10.03	30080	14687	67.19%
60	3600	10.03	36096	15346	70.17%
90	5400	10.03	54144	12054	81.79%
120	7200	10.03	72193	2438	96.73%



DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN

VILLAGE OF KEY BISCAYNE

WHS NO: 3225.00
FILE: AREADR3B.WK3
BY: LMB CHK:JD
DATE: 8-23-93
REV:____________

Drainage Basin: 3 | 31.23 acres

Storage Swale Volume: from Worksheet 1 | 72931 cf

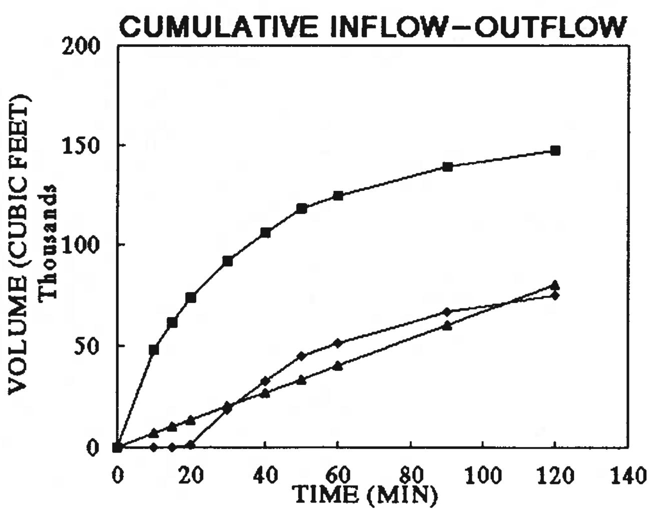
Each Drainage Well assumed exfil flow | 5000 gpm | 1 well(s)

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	31.23	6.80	79.6	47782	0
15	900	0.375	31.23	5.85	68.5	61660	0
20	1200	0.375	31.23	5.25	61.5	73781	850
30	1800	0.375	31.23	4.35	50.9	91699	18768
40	2400	0.375	31.23	3.75	43.9	105401	32470
50	3000	0.375	31.23	3.35	39.2	117698	44767
60	3600	0.375	31.23	2.95	34.5	124373	51442
90	5400	0.375	31.23	2.20	25.8	139130	66199
120	7200	0.375	31.23	1.75	20.5	147562	74631

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Disch vol cf	Over flow	% Retention
0			0		
10	600	11.14	6684		100.00%
15	900	11.14	10027	-10027	100.00%
20	1200	11.14	13369	-12519	100.00%
30	1800	11.14	20053	-1285	100.00%
40	2400	11.14	26738	5732	82.35%
50	3000	11.14	33422	11345	74.66%
60	3600	11.14	40107	11336	77.96%
90	5400	11.14	60160	6038	90.88%
120	7200	11.14	80214	-5583	107.48%



DRAINAGE CALCULATIONS **APPENDIX E**

Worksheet 2

STORM WATER MASTER PLAN **PAGE___ OF ___**

VILLAGE OF KEY BISCAYNE

WHS NO: 3225.00

Drainage Basin: 3 31.23 acres

FILE: AREADR3C.WK3

Storage Swale Volume:

BY: LMB CHK: JVD

from Worksheet 1 72931 cf

DATE: 8-23-93

Each Drainage Well

REV:____________

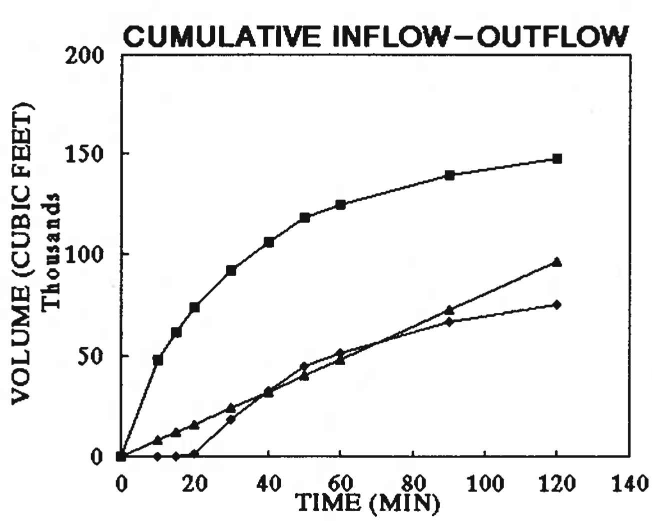
assumed exfil flow 1500 gpm 4 well(s)

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	31.23	6.80	79.6	47782	0
15	900	0.375	31.23	5.85	68.5	61660	0
20	1200	0.375	31.23	5.25	61.5	73781	850
30	1800	0.375	31.23	4.35	50.9	91699	18768
40	2400	0.375	31.23	3.75	43.9	105401	32470
50	3000	0.375	31.23	3.35	39.2	117698	44767
60	3600	0.375	31.23	2.95	34.5	124373	51442
90	5400	0.375	31.23	2.20	25.8	139130	66199
120	7200	0.375	31.23	1.75	20.5	147562	74631

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	13.37	8021		100.00%
15	900	13.37	12032	-12032	100.00%
20	1200	13.37	16043	-15193	100.00%
30	1800	13.37	24064	-5296	100.00%
40	2400	13.37	32086	385	98.82%
50	3000	13.37	40107	4660	89.59%
60	3600	13.37	48128	3314	93.56%
90	5400	13.37	72193	-5994	109.05%
120	7200	13.37	96257	-21626	128.98%



DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN
VILLAGE OF KEY BISCAYNE

Drainage Basin: 4 | 5.6 acres
Storage Swale Volume:
from Worksheet 1 | 10500 cf
Each Drainage Well
assumed exfil flow | 1500 gpm | 1 well(s)

APPENDIX E

PAGE____ OF ____

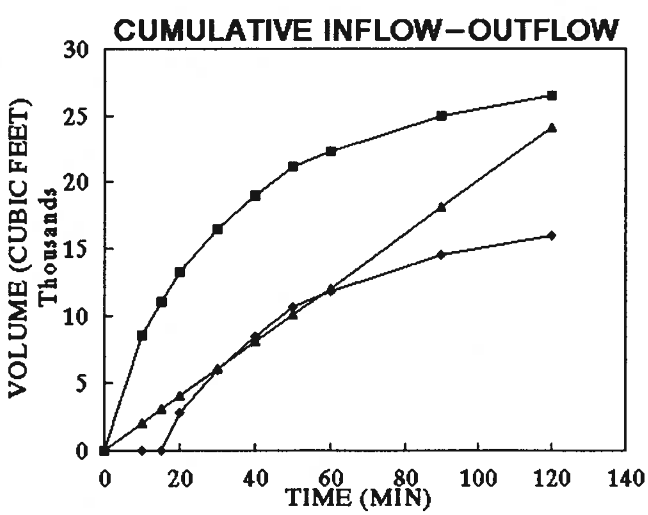
WHS NO: 3225.00
FILE: AREADR4A.WK3
BY: LMB CHK: JVD
DATE: 8-23-93
REV:____________

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	5.6	6.80	14.3	8568	0
15	900	0.375	5.6	5.85	12.3	11057	0
20	1200	0.375	5.6	5.25	11.0	13230	2730
30	1800	0.375	5.6	4.35	9.1	16443	5943
40	2400	0.375	5.6	3.75	7.9	18900	8400
50	3000	0.375	5.6	3.35	7.0	21105	10605
60	3600	0.375	5.6	2.95	6.2	22302	11802
90	5400	0.375	5.6	2.20	4.6	24948	14448
120	7200	0.375	5.6	1.75	3.7	26460	15960

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	3.34	2005		100.00%
15	900	3.34	3008	−3008	100.00%
20	1200	3.34	4011	−1281	100.00%
30	1800	3.34	6016	−73	100.00%
40	2400	3.34	8021	379	95.49%
50	3000	3.34	10027	578	94.55%
60	3600	3.34	12032	−230	101.95%
90	5400	3.34	18048	−3600	124.92%
120	7200	3.34	24064	−8104	150.78%



DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN
VILLAGE OF KEY BISCAYNE

APPENDIX E

PAGE____ OF ____

WHS NO: 3225.00
FILE: AREADR5.WK3
BY: LMB CHK JVD
DATE: 8-23-93
REV:____________

Drainage Basin: 5 | 4.41 acres

Storage Swale Volume:
from Worksheet 1: 8906 cf

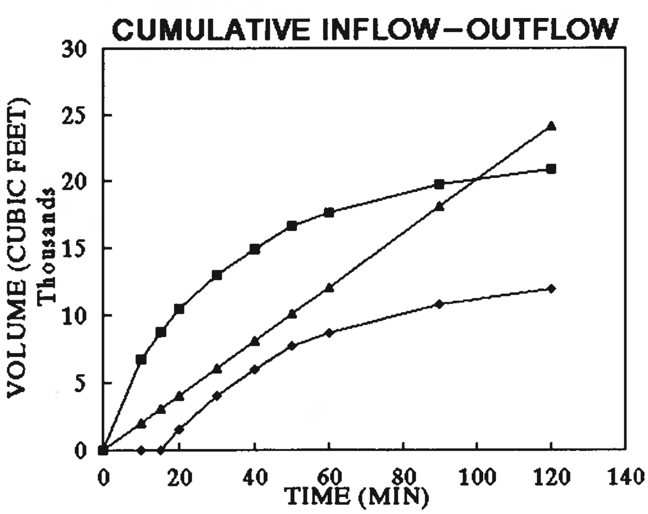
Each Drainage Well
assumed exfil flow: 1500 gpm | 1 well(s)

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	4.41	6.80	11.2	6747	0
15	900	0.375	4.41	5.85	9.7	8707	0
20	1200	0.375	4.41	5.25	8.7	10419	1513
30	1800	0.375	4.41	4.35	7.2	12949	4043
40	2400	0.375	4.41	3.75	6.2	14884	5978
50	3000	0.375	4.41	3.35	5.5	16620	7714
60	3600	0.375	4.41	2.95	4.9	17563	8657
90	5400	0.375	4.41	2.20	3.6	19647	10741
120	7200	0.375	4.41	1.75	2.9	20837	11931

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	3.34	2005		100.00%
15	900	3.34	3008	−3008	100.00%
20	1200	3.34	4011	−2498	100.00%
30	1800	3.34	6016	−1973	100.00%
40	2400	3.34	8021	−2044	134.19%
50	3000	3.34	10027	−2313	129.98%
60	3600	3.34	12032	−3375	138.99%
90	5400	3.34	18048	−7308	168.04%
120	7200	3.34	24064	−12133	201.69%



DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN
VILLAGE OF KEY BISCAYNE

APPENDIX E

PAGE____ OF ____

WHS NO: 3225.00
FILE: AREADR6A.WK3
BY: LMB CHK: JVD
DATE: 8-23-93
REV:____________

Drainage Basin: 6 | 22.95 acres

Storage Swale Volume: from Worksheet 1 50025 cf

Each Drainage Well assumed exfil flow 5000 gpm | 1 well(s)

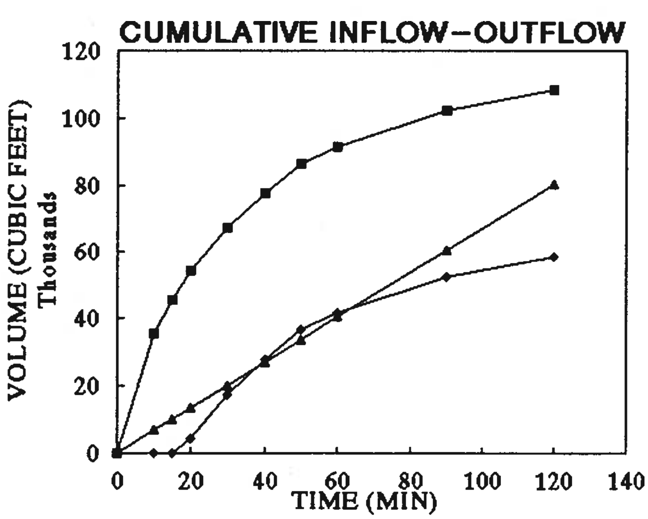
PUMP STATION

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	22.95	6.80	58.5	35114	0
15	900	0.375	22.95	5.85	50.3	45312	0
20	1200	0.375	22.95	5.25	45.2	54219	4194
30	1800	0.375	22.95	4.35	37.4	67387	17362
40	2400	0.375	22.95	3.75	32.3	77456	27431
50	3000	0.375	22.95	3.35	28.8	86493	36468
60	3600	0.375	22.95	2.95	25.4	91398	41373
90	5400	0.375	22.95	2.20	18.9	102242	52217
120	7200	0.375	22.95	1.75	15.1	108439	58414

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	11.14	6684		100.00%
15	900	11.14	10027	−10027	100.00%
20	1200	11.14	13369	−9175	100.00%
30	1800	11.14	20053	−2692	100.00%
40	2400	11.14	26738	693	97.47%
50	3000	11.14	33422	3045	91.65%
60	3600	11.14	40107	1266	96.94%
90	5400	11.14	60160	−7943	115.21%
120	7200	11.14	80214	−21800	137.32%



DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN
VILLAGE OF KEY BISCAYNE

Drainage Basin: 6 | 22.95 acres

Storage Swale Volume:
from Worksheet 1 50025 cf

Each Drainage Well
assumed exfil flow 1500 gpm 3 well(s)

APPENDIX E

PAGE____ OF ____

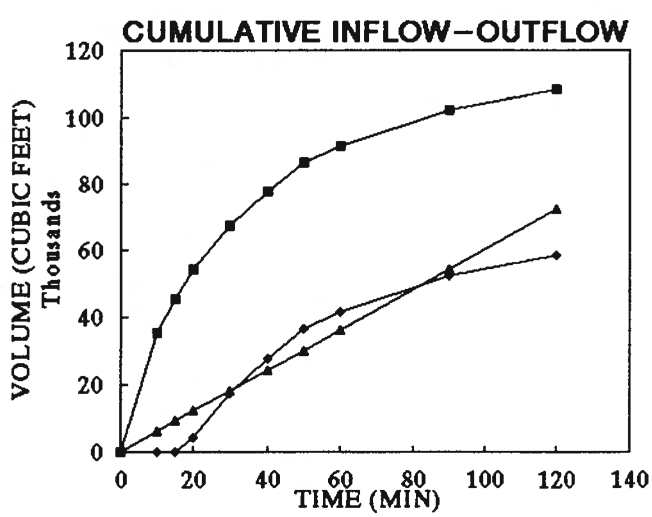
WHS NO: 3225.00
FILE: AREADR6B.WK3
BY: LMB CHK: JVD
DATE: 8-23-93
REV:____________

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	22.95	6.80	58.5	35114	0
15	900	0.375	22.95	5.85	50.3	45312	0
20	1200	0.375	22.95	5.25	45.2	54219	4194
30	1800	0.375	22.95	4.35	37.4	67387	17362
40	2400	0.375	22.95	3.75	32.3	77456	27431
50	3000	0.375	22.95	3.35	28.8	86493	36468
60	3600	0.375	22.95	2.95	25.4	91398	41373
90	5400	0.375	22.95	2.20	18.9	102242	52217
120	7200	0.375	22.95	1.75	15.1	108439	58414

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	10.03	6016		100.00%
15	900	10.03	9024	−9024	100.00%
20	1200	10.03	12032	−7838	100.00%
30	1800	10.03	18048	−686	100.00%
40	2400	10.03	24064	3367	87.73%
50	3000	10.03	30080	6388	82.48%
60	3600	10.03	36096	5277	87.25%
90	5400	10.03	54144	−1927	103.69%
120	7200	10.03	72193	−13779	123.59%



DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN
VILLAGE OF KEY BISCAYNE

Drainage Basin: 7 | 23.87 acres

Storage Swale Volume:
from Worksheet 1 49125 cf

Each Drainage Well
assumed exfil flow 5000 gpm | 1 well(s)

PUMP STATION

APPENDIX E

PAGE ___ OF ___

WHS NO: 3225.00

FILE: AREADR7A.WK3

BY: LMB CHK: JVD

DATE: 8-23-93

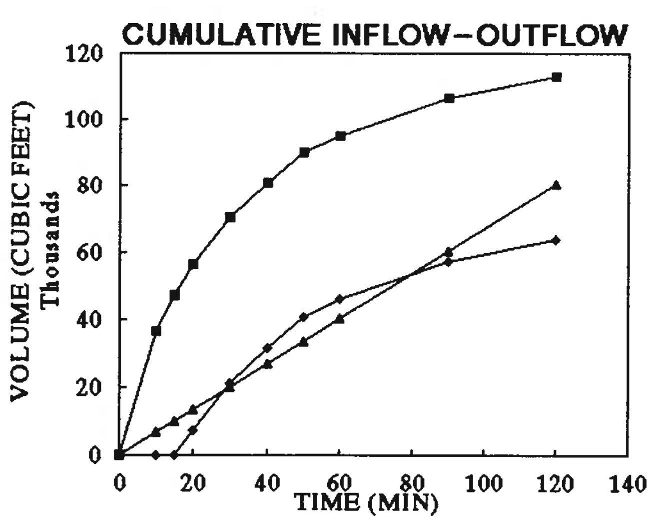
REV: ____________

Cumulative Inflow Q = ciA

min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow (A)
0						0	0
10	600	0.375	23.87	6.80	60.9	36521	0
15	900	0.375	23.87	5.85	52.4	47128	0
20	1200	0.375	23.87	5.25	47.0	56393 -49,125 =	7268
30	1800	0.375	23.87	4.35	38.9	70088	20963
40	2400	0.375	23.87	3.75	33.6	80561	31436
50	3000	0.375	23.87	3.35	30.0	89960	40835
60	3600	0.375	23.87	2.95	26.4	95062	45937
90	5400	0.375	23.87	2.20	19.7	106341	57216
120	7200	0.375	23.87	1.75	15.7	112786	63661

Cumulative exfiltration

min	Tc sec	Q cfs	Well Dischg vol cf (B)	Over flow (C = A − B)	% Retention
0			0		
10	600	11.14	6684		100.00%
15	900	11.14	10027	−10027	100.00%
20	1200	11.14	7268 − 13369	−6101	100.00%
30	1800	11.14	20053	910	100.00%
40	2400	11.14	26738	4698	85.05%
50	3000	11.14	33422	7413	81.85%
60	3600	11.14	40107	5830	87.31%
90	5400	11.14	60160	−2945	105.15%
120	7200	11.14	80214	−16553	126.00%



DRAINAGE CALCULATIONS **APPENDIX E**

Worksheet 2

STORM WATER MASTER PLAN

VILLAGE OF KEY BISCAYNE

PAGE____ OF ____

WHS NO: 3225.00

FILE: AREADR7B.WK3

BY: LMB CHK: JVD

DATE: 8-23-93

REV:__________

Drainage Basin: 7 23.87 acres

Storage Swale Volume:

from Worksheet 1 49125 cf

Each Drainage Well

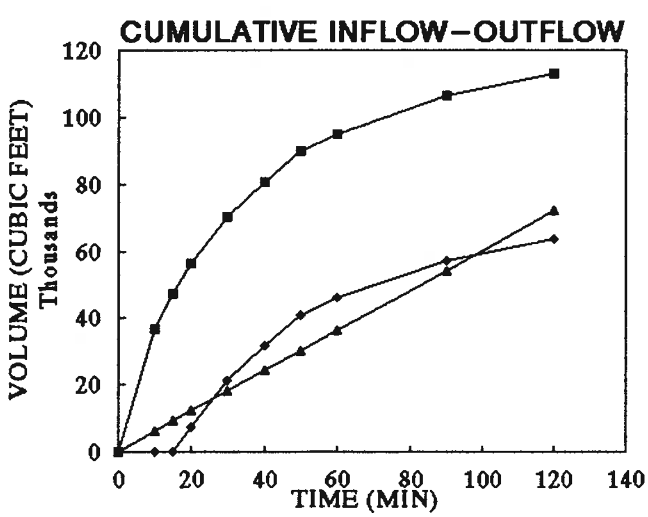
assumed exfil flow 1500 gpm 3 well(s)

Cumulative Inflow Q = ciA

min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	23.87	6.80	60.9	36521	0
15	900	0.375	23.87	5.85	52.4	47128	0
20	1200	0.375	23.87	5.25	47.0	56393	7268
30	1800	0.375	23.87	4.35	38.9	70088	20963
40	2400	0.375	23.87	3.75	33.6	80561	31436
50	3000	0.375	23.87	3.35	30.0	89960	40835
60	3600	0.375	23.87	2.95	26.4	95062	45937
90	5400	0.375	23.87	2.20	19.7	106341	57216
120	7200	0.375	23.87	1.75	15.7	112786	63661

Cumulative exfiltration

min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	10.03	6016		100.00%
15	900	10.03	9024	-9024	100.00%
20	1200	10.03	12032	-4764	100.00%
30	1800	10.03	18048	2915	100.00%
40	2400	10.03	24064	7372	76.55%
50	3000	10.03	30080	10755	73.66%
60	3600	10.03	36096	9841	78.58%
90	5400	10.03	54144	3071	94.63%
120	7200	10.03	72193	-8532	113.40%



DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN
VILLAGE OF KEY BISCAYNE

Drainage Basin: 7 | 23.87 acres

Storage Swale Volume:
from Worksheet 1 | 49125 cf

Each Drainage Well
assumed exfil flow | 1500 gpm | 4 well(s)

APPENDIX E

PAGE___ OF ___

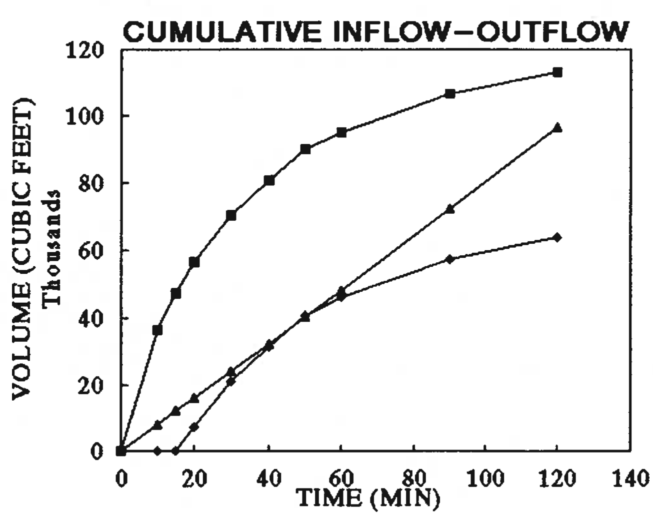
WHS NO: 3225.00
FILE: AREADR7C.WK3
BY: LMB CHK: JVD
DATE: 8-23-93
REV:__________

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	23.87	6.80	60.9	36521	0
15	900	0.375	23.87	5.85	52.4	47128	0
20	1200	0.375	23.87	5.25	47.0	56393	7268
30	1800	0.375	23.87	4.35	38.9	70088	20963
40	2400	0.375	23.87	3.75	33.6	80561	31436
50	3000	0.375	23.87	3.35	30.0	89960	40835
60	3600	0.375	23.87	2.95	26.4	95062	45937
90	5400	0.375	23.87	2.20	19.7	106341	57216
120	7200	0.375	23.87	1.75	15.7	112786	63661

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	13.37	8021		100.00%
15	900	13.37	12032	−12032	100.00%
20	1200	13.37	16043	−8775	100.00%
30	1800	13.37	24064	−3101	100.00%
40	2400	13.37	32086	−649	102.07%
50	3000	13.37	40107	728	98.22%
60	3600	13.37	48128	−2191	104.77%
90	5400	13.37	72193	−14977	126.18%
120	7200	13.37	96257	−32596	151.20%



DRAINAGE CALCULATIONS

Worksheet 2

STORM WATER MASTER PLAN
VILLAGE OF KEY BISCAYNE

APPENDIX E

PAGE____ OF ____

WHS NO: 3225.00
FILE: AREADR8A.WK3
BY: LMB CHK JVD
DATE: 8-23-93
REV:____________

Drainage Basin: 8 | 19.22 acres

Storage Swale Volume: from Worksheet 1 | 44175 cf

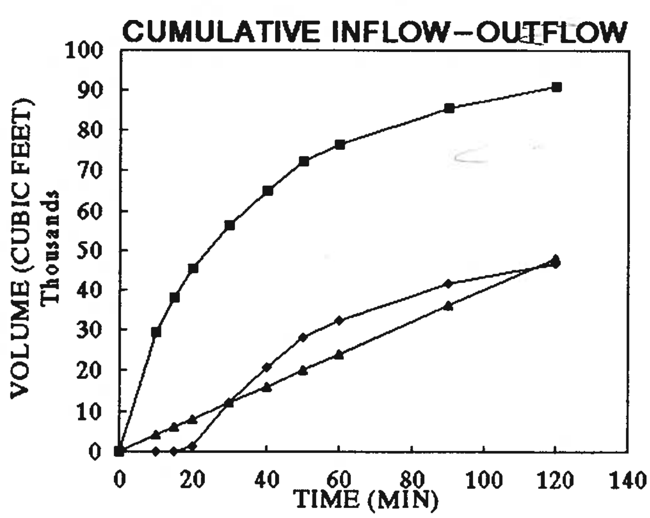
Each Drainage Well assumed exfil flow | 1500 gpm | 2 well(s)

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	19.22	6.80	49.0	29407	0
15	900	0.375	19.22	5.85	42.2	37947	0
20	1200	0.375	19.22	5.25	37.8	45407	1232
30	1800	0.375	19.22	4.35	31.4	56435	12260
40	2400	0.375	19.22	3.75	27.0	64868	20692
50	3000	0.375	19.22	3.35	24.1	72435	28260
60	3600	0.375	19.22	2.95	21.3	76544	32369
90	5400	0.375	19.22	2.20	15.9	85625	41450
120	7200	0.375	19.22	1.75	12.6	90815	46640

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	6.68	4011		100.00%
15	900	6.68	6016	−6016	100.00%
20	1200	6.68	8021	−6789	100.00%
30	1800	6.68	12032	228	100.00%
40	2400	6.68	16043	4650	77.53%
50	3000	6.68	20053	8207	70.96%
60	3600	6.68	24064	8304	74.34%
90	5400	6.68	36096	5354	87.08%
120	7200	6.68	48128	−1489	103.19%



DRAINAGE CALCULATIONS **APPENDIX E**

Worksheet 2

STORM WATER MASTER PLAN

VILLAGE OF KEY BISCAYNE

PAGE___ OF ___

WHS NO: 3225.00

FILE: AREADR8B.WK3

BY: LMB CHK JVD

DATE: 8-23-93

REV:__________

Drainage Basin: 8 19.22 acres

Storage Swale Volume:

from Worksheet 1 44175 cf

Each Drainage Well

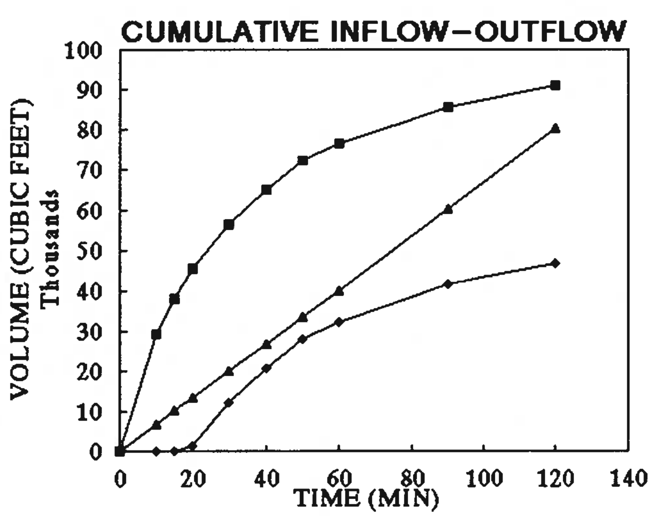
assumed exfil flow 5000 gpm 1 well(s)

Cumulative Inflow Q = ciA

Tc min	Tc sec	c	A acres	i in/hr	Q cfs	Vol cf	Adjusted inflow
0						0	0
10	600	0.375	19.22	6.80	49.0	29407	0
15	900	0.375	19.22	5.85	42.2	37947	0
20	1200	0.375	19.22	5.25	37.8	45407	1232
30	1800	0.375	19.22	4.35	31.4	56435	12260
40	2400	0.375	19.22	3.75	27.0	64868	20692
50	3000	0.375	19.22	3.35	24.1	72435	28260
60	3600	0.375	19.22	2.95	21.3	76544	32369
90	5400	0.375	19.22	2.20	15.9	85625	41450
120	7200	0.375	19.22	1.75	12.6	90815	46640

Cumulative exfiltration

Tc min	Tc sec	Q cfs	Well Dischg vol cf	Over flow	% Retention
0			0		
10	600	11.14	6684		100.00%
15	900	11.14	10027	−10027	100.00%
20	1200	11.14	13369	−12137	100.00%
30	1800	11.14	20053	−7794	100.00%
40	2400	11.14	26738	−6045	129.22%
50	3000	11.14	33422	−5162	118.27%
60	3600	11.14	40107	−7738	123.91%
90	5400	11.14	60160	−18710	145.14%
120	7200	11.14	80214	−33574	171.99%



Appendix F

Preliminary Estimate of Construction Costs Basin Alternatives with Pump Stations

KEY BISCAYNE STORMWATER MASTER PLAN

APPENDIX F

JOB NO:3225.00

FILE:COSTEST2.WK3

DATE: 9-7-93

PRELIMINARY ESTIMATE OF CONSTRUCTION COSTS

BASIN ALTERNATIVES WITH PUMP STATIONS

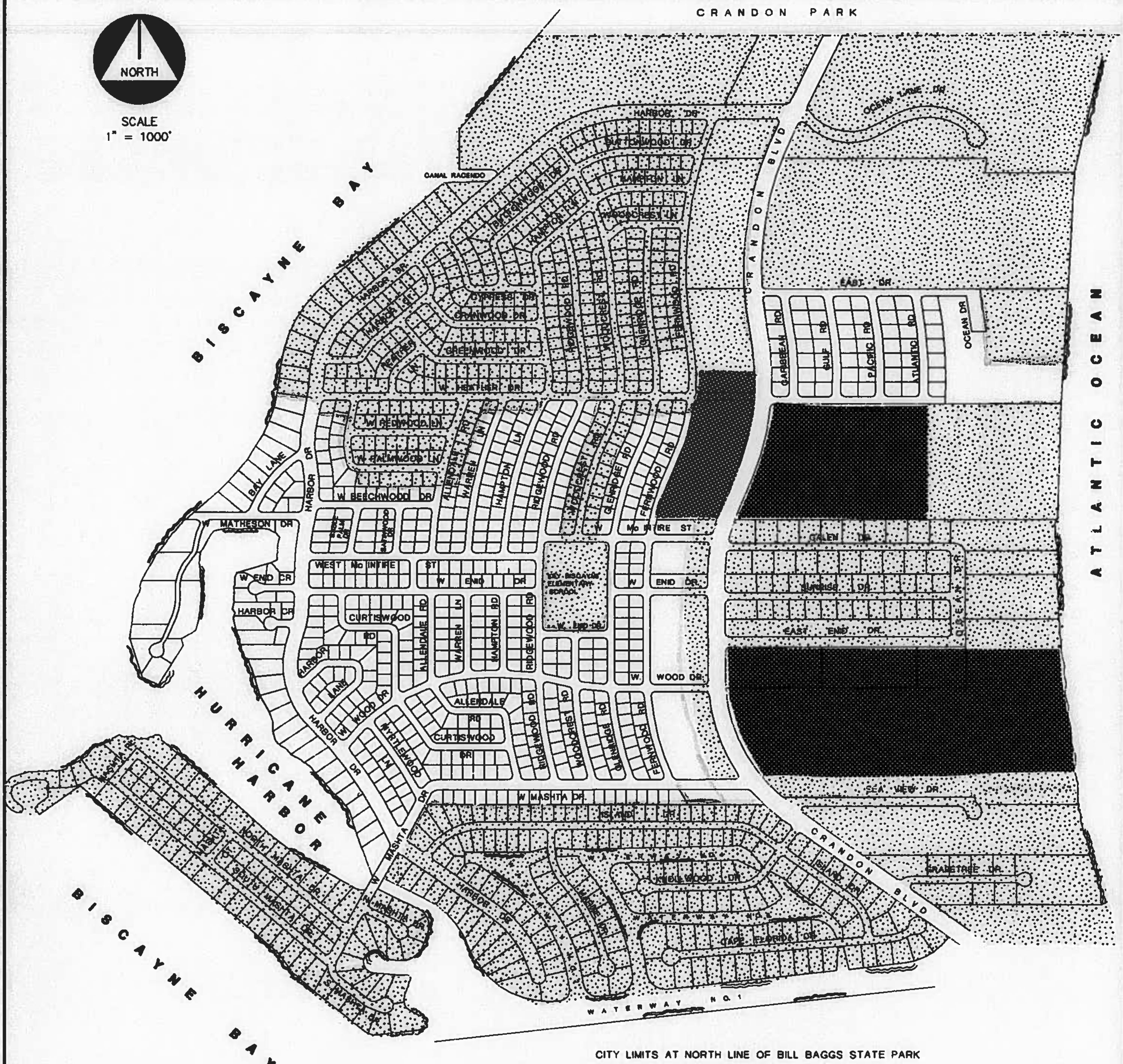
ITEM NO	DESCRIPTION	UNIT	EST UNIT COST	BASIN 3 QUANTITY	BASIN 3 EST COST	BASIN 6A QUANTITY	BASIN 6A EST COST	BASIN 6B QUANTITY	BASIN 6B EST COST	BASIN 7A QUANTITY	BASIN 7A EST COST	BASIN 7B QUANTITY	BASIN 7B EST COST	BASIN 8 QUANTITY	BASIN 8 EST COST
1	NEW CATCH BASIN W/ BAFFLES	EA	$2,000	10	$20,000	23	$46,000	30	$60,000	37	$74,000	27	$54,000	18	$36,000
2	18" DRAINAGE PIPE	LF	$28	4900	$137,200	2600	$72,800	4820	$134,960	3980	$111,440	4600	$128,800	5200	$145,600
3	24" DRAINAGE PIPE	LF	$35	2250	$78,750	1180	$41,300		$0	2700	$94,500	450	$15,750	350	$12,250
4	30" DRAINAGE PIPE	LF	$45		$0	350	$15,750		$0		$0		$0		$0
5	DRAINAGE WELL	EA	$18,000	2	$36,000	2	$36,000		$0	2	$36,000		$0	2	$36,000
6	POLL CONTROL STRUCT	EA	$16,000	1	$16,000	1	$16,000		$0	1	$16,000		$0	1	$16,000
7	OUTFALL WEIR W/STRUCTURE	EA	$10,000	1	$10,000	1	$10,000		$0	1	$10,000		$0	1	$10,000
8	PUMP STATION (SEE NOTE 1)	EA	$200,000	1	$200,000	1	$200,000		$0	1	$200,000		$0	1	$200,000
9	REHAB 1 – ADD BAFFLE	EA	$500		$0		$0	3	$1,500		$0		$0	15	$7,500
10	REHAB 2 – ADD PAVT & BAFFLE	EA	$1,000	2	$2,000		$0	1	$1,000		$0		$0	5	$5,000
11	REHAB 3 – REPAIR F&G, TOP SLAB & ADD BAFFLE	EA	$1,500	1	$1,500		$0		$0		$0		$0	1	$1,500
12	REHAB 4 – ADD PIPES, REPAIR STRUCT	EA	$1,500	8	$12,000	8	$12,000	5	$7,500	7	$10,500		$0	23	$34,500
13	REMOVE & REPLACE CATCH BASIN	EA	$2,500	3	$7,500		$0	1	$2,500	2	$5,000		$0	7	$17,500
14	SWALE RESTORATION	LF	$5	14450	$72,250	5800	$29,000	5800	$29,000	8400	$42,000	4600	$23,000	9400	$47,000
	SUBTOTALS				$593,200		$478,850		$236,460		$599,440		$221,550		$568,850
	ADMIN, ENG, FINANCING, & CONTINGENCY		EST 35%		$207,620		$167,598		$82,761		$209,804		$77,543		$199,098
	DRAINAGE SUBTOTALS				$800,820		$646,448		$319,221		$809,244		$299,093		$767,948
15	PAVEMENT RESTORATION – 1" OVERLAY	LF	$12	14450	$173,400	5800	$69,600	5800	$69,600	8400	$100,800	4600	$55,200	9400	$112,800
	ADMIN, ENG, FINANCING, & CONTINGENCY		EST 35%		$60,690		$24,360		$24,360		$35,280		$19,320		$39,480
	PAVEMENT SUBTOTALS				$234,090		$93,960		$93,960		$136,080		$74,520		$152,280
	BASIN SUBTOTALS				$1,034,910		$740,408		$413,181		$945,324		$373,613		$920,228

BASINS 1,2,4,5 (W/O PUMP STATONS) (SEE PREVIOUS WORKSHEET EXHIBIT)	$854,251
BASINS 3,6,7,8 (WITH PUMP STATIONS)	$4,427,663
BASIN 1–8 TOTAL (WITH PUMP STATIONS)	$5,281,914 PLUS MAINT COSTS

NOTE 1: MAINTENANCE COSTS FOR EACH PUMP STATION
ESTIMATED AT $100 PER MONTH PER STATION
$100 X 12 MONTHS X 4 STAT = $4800 PER YEAR

Appendix G

Sewered Areas within the Village of Key Biscayne



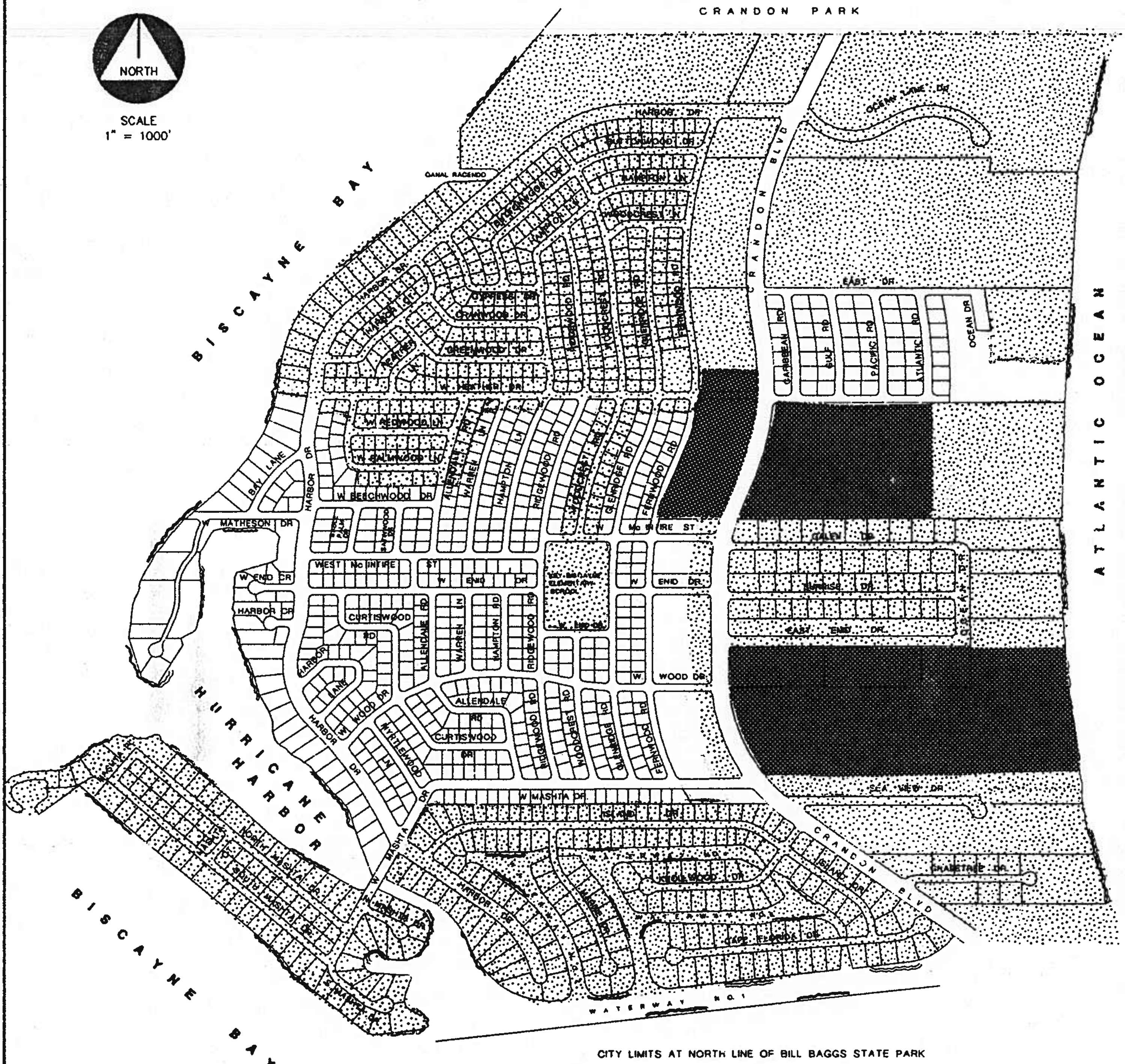
VILLAGE OF KEY BISCAYNE, FLORIDA

SEWERED AREAS

- NOW SERVED BY SEWERS
- VACANT BUT SERVABLE BY SEWERS
- UNSERVED

WILLIAMS, HATFIELD & STONER, INC.

SOURCES: C.A.P. ENGINEERING CONSULTANTS
ROBERT K. SWARTHOUT, INC.



CITY LIMITS AT NORTH LINE OF BILL BAGGS STATE PARK

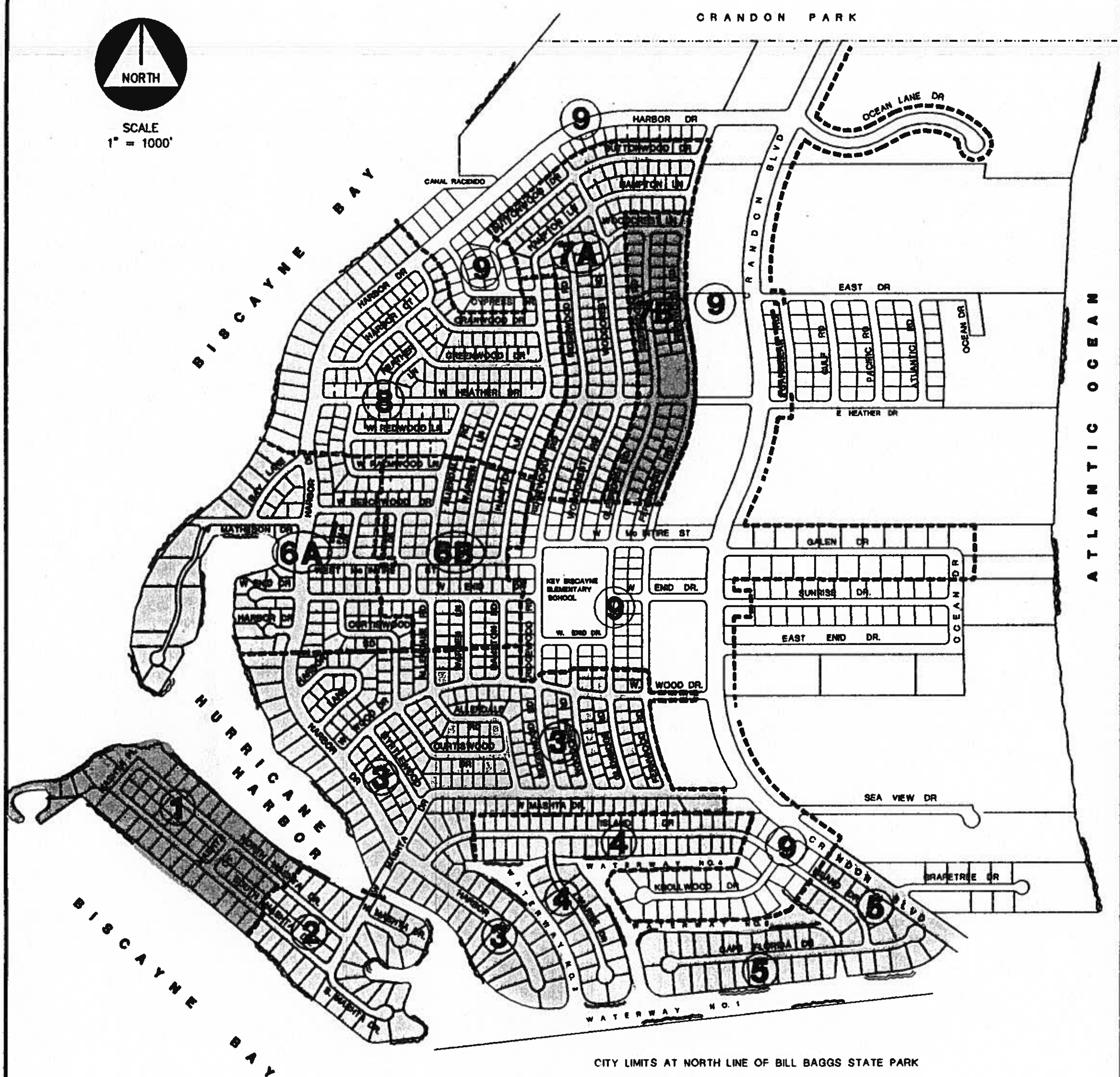
VILLAGE OF KEY BISCAYNE, FLORIDA

SEWERED AREAS

- NOW SERVED BY SEWERS
- VACANT BUT SERVABLE BY SEWERS
- UNSERVED

WILLIAMS, HATFIELD & STONER, INC.

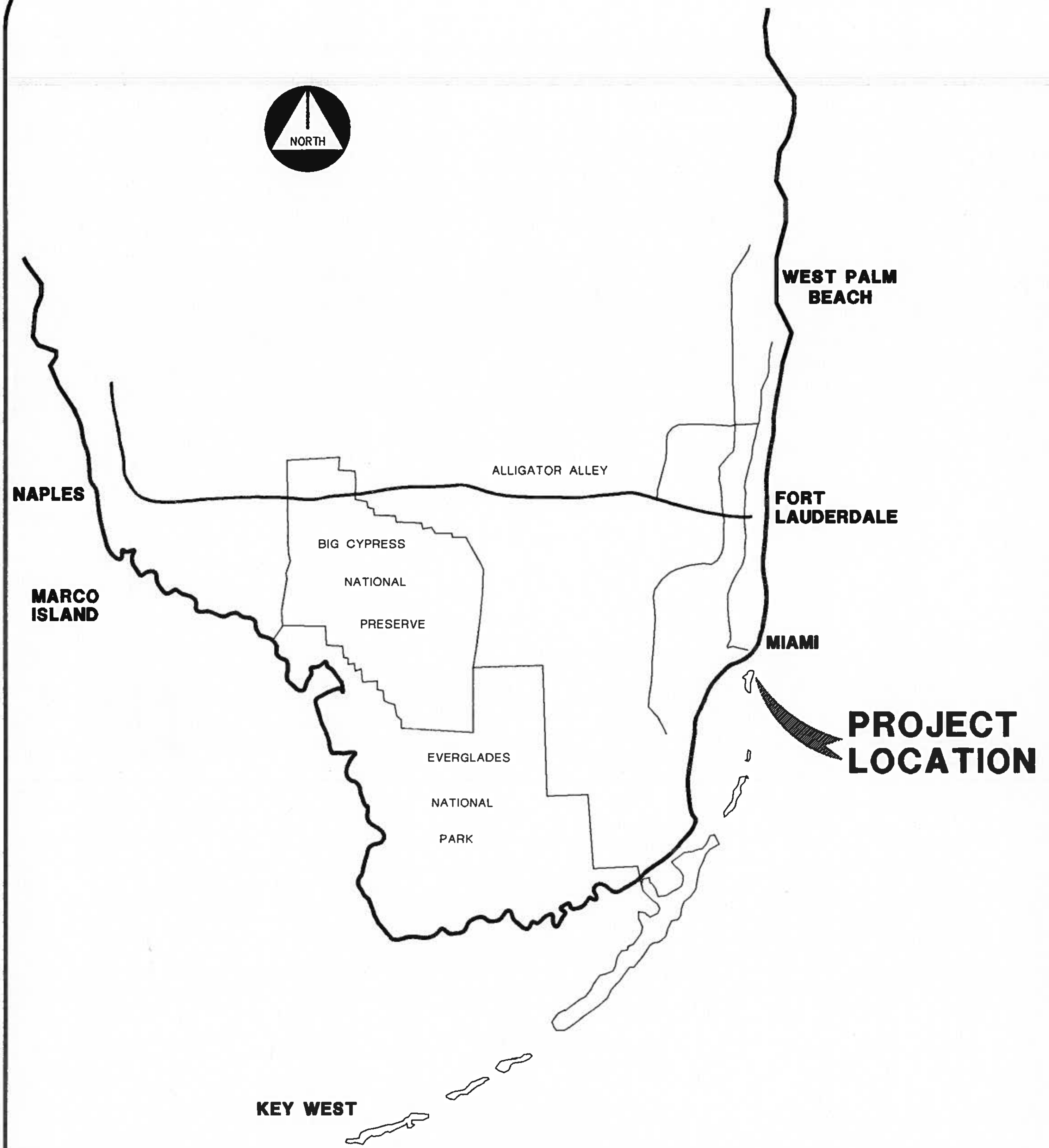
SOURCES: C.A.P. ENGINEERING CONSULTANTS
ROBERT K. SWARTHOUT, INC.



VILLAGE OF KEY BISCAYNE, FLORIDA

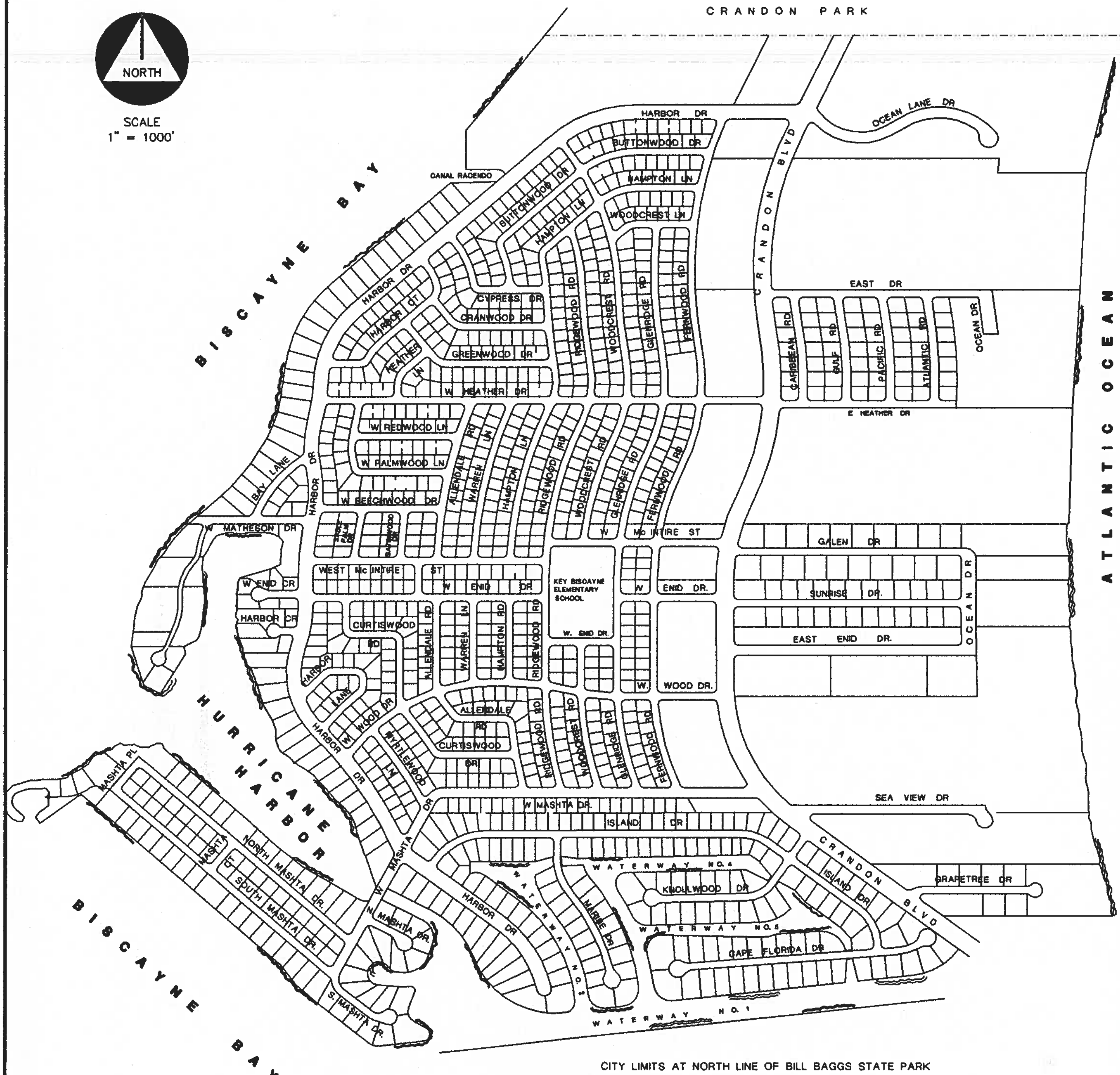
WILLIAMS, HATFIELD & STONER, INC.

PROPOSED DRAINAGE BASINS
EXHIBIT 2.2



WILLIAMS, HATFIELD & STONER, INC.

REGIONAL LOCATION
EXHIBIT 1.1



VILLAGE OF KEY BISCAYNE, FLORIDA

STREET MAP
EXHIBIT 2.1

WILLIAMS, HATFIELD & STONER, INC.

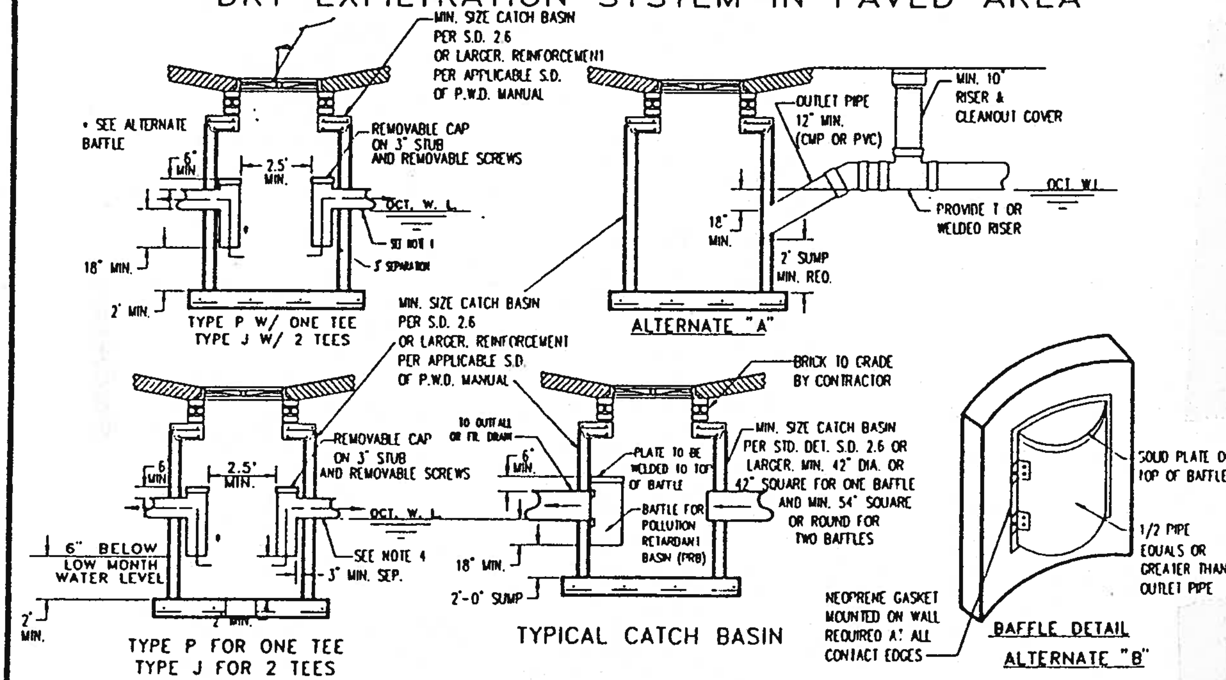
METRO DADE

METROPOLITAN DADE COUNTY, FLORIDA
ENVIRONMENTAL RESOURCES MANAGEMENT
111 NW 1st STREET
SUITE 1310
MIAMI, FLORIDA 33128-1971
(305) 375-DERM

ENVIRONMENTAL REVIEW OF DRAINAGE SYSTEM

- ☐ REVIEW FOR COMPLIANCE TO DADE COUNTY AQUIFER PROTECTION REQUIREMENTS.
- ☐ PROVIDE OIL & GREASE INTERCEPTOR @ ALL CATCH BASINS PRECEDING FRENCH DRAIN AS PER ATTACHED STD. DET. BELOW.
- ☐ PROVIDE OIL & GREASE INTERCEPTORS AT STRUCTURE NO. ____________________
- ☐ ALL FRENCH DRAINS TO HAVE INVERT OF PERFORATED PIPE MIN. ELEVATION OF OCTOBER GROUND WATER LEVEL OF ________ NGVD. OR HIGHER.
- ☐ REVIEW FOR COMPLIANCE W/SECTION 24-12.1 OF THE METRO DADE COUNTY CODE.
- ☐ COMMENTS: ____________________

DRY EXFILTRATION SYSTEM IN PAVED AREA



CATCH BASIN GREASE & OIL SEPARATOR

(WITH SEEPAGE HOLE AT BOTTOM)

PRECEDING FRENCH DRAIN

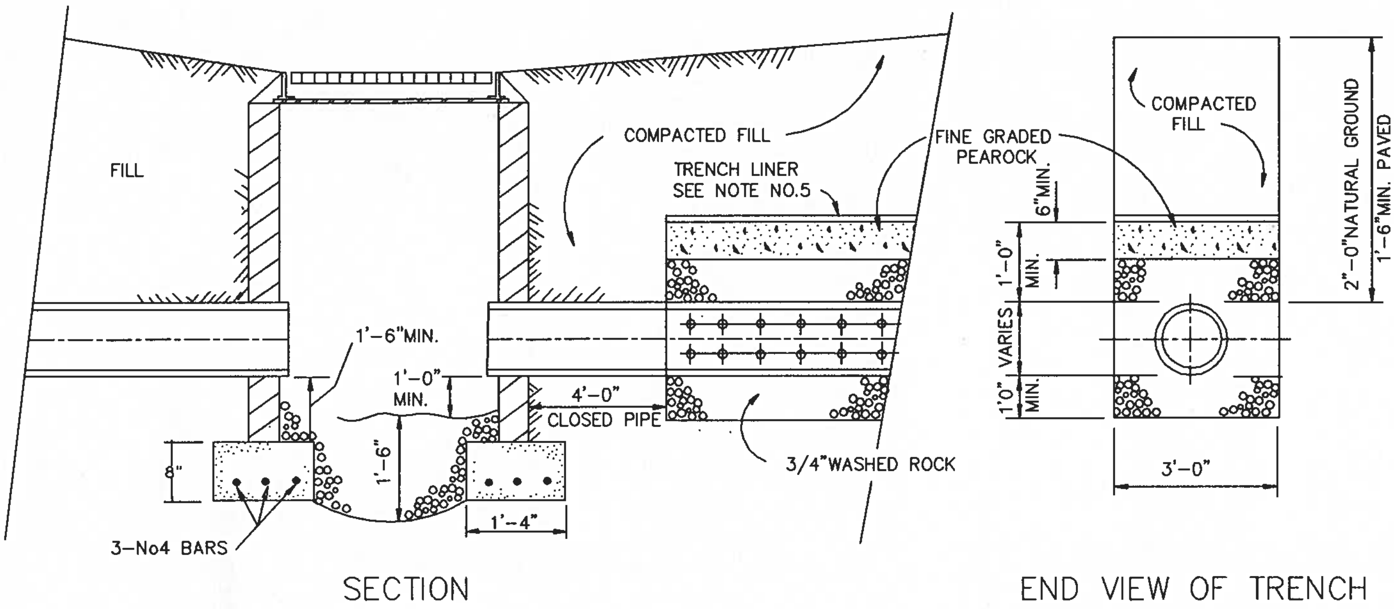
TWO (2) TEES AS SHOWN IF F.D. AT BOTH SIDES OF STRUCTURE

NOTES:

1 – ABOVE STRUCTURE TYPE "P" S.D. 2.6 IS RECOMMENDED FOR SMALL DRAINAGE AREAS LESS THAN 0.20 ACRE PER CATCH BASIN.
2 – FOR DRAINAGE AREAS EQUAL TO OR GREATER THAN 0.20 BUT NOT EXCEEDING .3 ACRE PROVIDE TYPE "J" AS PER S.D. 2.6 STRUCTURES.
3 – ALL INVERTS OF PERFORATED PIPES TO BE AT OCTOBER WATER TABLE.
4 – WHEN PRETREATMENT IS REQUIRED IN A DRY EXFILTRATION SYSTEM, IF GRADE CONDITION ON SITE IS SUCH THAT THE INVERT OF THE NON PERFOFATED PIPE LEAVING THE CATCH BASIN IS BELOW THE OCTOBER GROUND WATER LEVEL; A TRANSITION IS REQUIRED FROM THIS INVERT ELEVATION TO THE INVERT OF THE PERFORATED PIPE.
5 – ALL OTHER ALTERNATIVES TO THE ABOVE OIL & GREASE INTERCEPTORS MUST BE REVIEWED AND APPROVED BY D.E.R.M. PRIOR TO ISSUANCE OF A CONSTRUCTION PERMIT

WILLIAMS, HATFIELD & STONER, INC.

TYPICAL CATCH BASIN
EXHIBIT 3.6



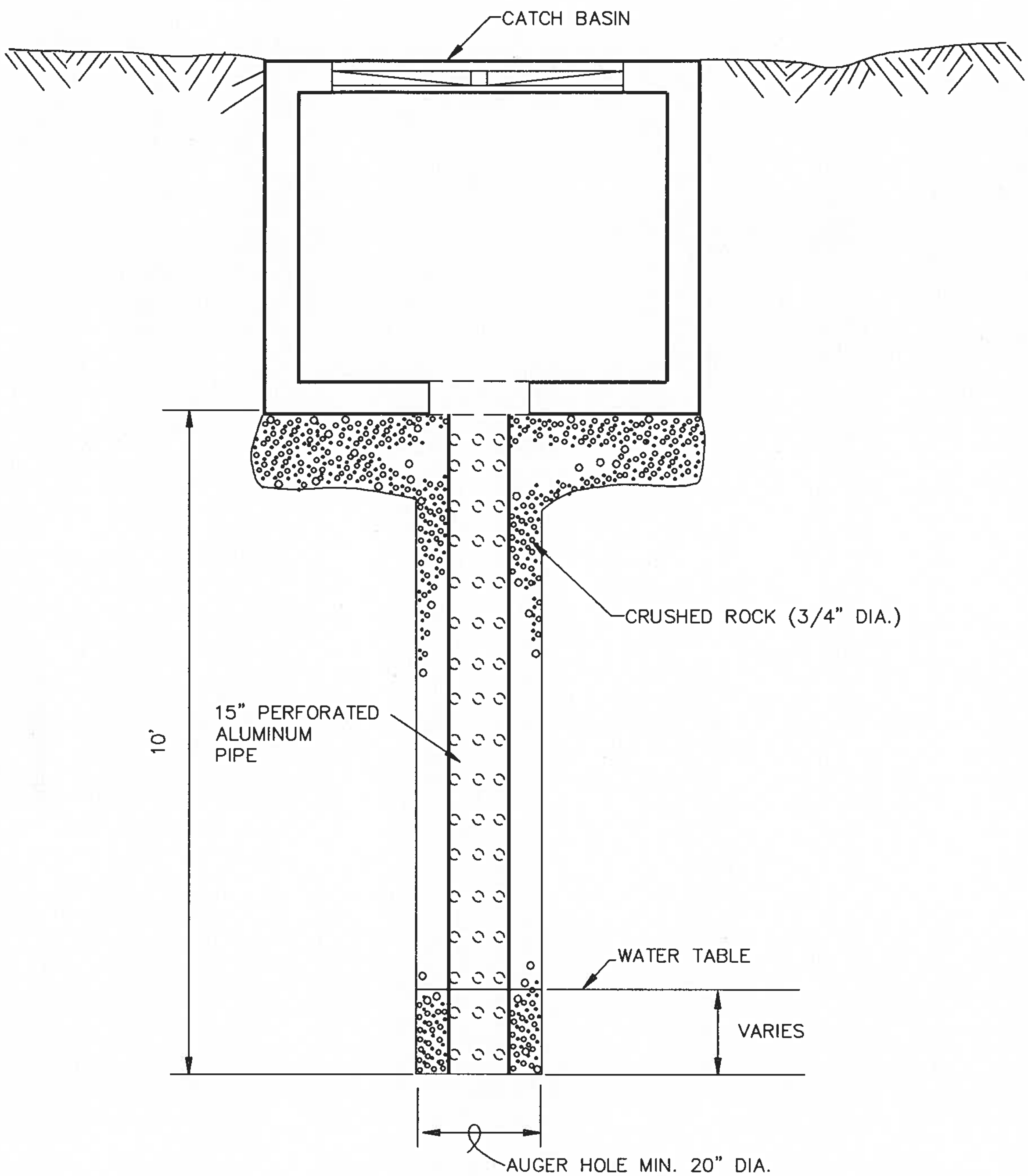
NOTES

1 DRAIN FIELD MAY BE OF SLOTTED CONCRETE PIPE OR PERFORATED METAL PIPE.
2. PIPES SHALL TERMINATE 2 FEET FROM END OF TRENCH OR CONNECT TO ADDITIONAL CATCH BASINS AS REQUIRED.
3. COVER PIPE ENDS WITH NO.10 GALVANIZED OR ALUMINUM SCREEN. OPENING SHALL BE NO LARGER THAN 1/2" x 1/2".
4. BALLAST ROCK SHALL BE FROM FRESH WATER WASHED FREE OF DELETERIOUS MATTER.
5. SIDES AND TOP OF TRENCH SHALL BE LINED WITH A PLASTIC BLANKET (GEOTEXTILE FABRIC) AND SAHLL COMPLY WITH F.D.O.T. "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" AND SECTION 985, 1986 EDITION

EXFILTRATION TRENCH

WILLIAMS, HATFIELD & STONER, INC.

TYPICAL FRENCH DRAIN EXHIBIT 1.8



CROSS SECTION

WILLIAMS, HATFIELD & STONER, INC.

TYPICAL AUGER WELL
EXHIBIT 1.7