CONCEPTUAL STORMWATER MANAGEMENT ANALYSIS

NAPLES BEACH OUTFALLS

PREPARED FOR:

Collier County

PREPARED BY:

Coastal Planning & Engineering

CPE

Gulfshore Engineering, Inc
2375 Tamiami Trail North
Suite 207, Naples 34103

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GEI PN: 305

NOVEMBER
2009

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EXECUTIVE SUMMARY

This analysis centers about the issues underlying the outfall pipes currently installed on Naples Beach. It covers the functionality and impacts of culverts at ten(10) locations which serve as stormwater drainage discharge points for 436 acres of inland coastal area generally extending from the Naples Beach Club south to within few blocks north of the City Pier. Overarching this discussion are the FDEP-mandated requirements which need to be addressed if future beach renourishment proposals are to be implemented.

In particular, the FDEP will need to review and approve a Long-range Management Plan -which needs to include identification of potential funding sources- for the eventual removal of these outfalls from the beach; this is a necessary precondition to the issuance of a Notice to Proceed from the Agency.

The report findings suggest that the existing groins and outfalls play a significant role within the larger stormwater basin network; to a certain extent, this serves to offset the coastal impacts of these facilities. In view of their current function, outright removal may be impractical although it is likely that the current situation can be improved by a plan which would seek to reduce, rather than eliminate, the number of existing outfalls. Future plans could also include maximizing the inland surface water storage which would provide additional water quality benefits to the stormwater runoff discharging into the Gulf. At this time both scenarios are probably achievable within the current Basin II lake network and roadway drainage system.

SECTION 1

WATER MANAGEMENT REPORT NARRATIVE

1. Introduction

The stormwater culverts and beach outfalls referenced in this report currently serve as the final discharge outlets for certain portions of the City of Naples stormwater system. The areas contributing runoff to these culverts lie in the southern portion of Basin II, one of the City's main drainage Basins having the coastline along its western boundary and including approximately 937 acres. The upstream contributing area for the culverts is significantly less, generally extending from the Naples Beach Club south to within few blocks north of the City Pier.

These outfalls extend through the frontal dune system seaward towards the Gulf of Mexico, presumably to reduce the likelihood of beach erosion and to lessen the impact of stormwater discharge. This analysis identifies a total of ten (10) outfall locations with an estimated drainage contributory area of about 436 acres. A breakdown of the contributing sub-areas has been provided in **Appendix A** and the main elements of this system are also illustrated on the accompanying **Conceptual Drainage Exhibit 1**.

Exhibit 1 (11x17 fold out)

2. Existing Drainage Conditions

The majority of the beach outfalls serve a relatively limited upstream area, generally tied to the roadway drainage system along Gulfshore Boulevard. These typically consist of single culverts [ref **Figure 1**], although two locations have a twin-pipe configuration. Importantly, the latter also include larger diameter pipes with significantly greater contributory areas.

Figure 1 ~ Single 18-inch culvert- Outfall #3

In general all the upstream drainage systems are fairly similar. Excess stormwater typically enters the stormwater pipe network through inlets along Gulfshore Boulevard and via an existing conveyance system of roadside swales and pipes. For the most part, the roadway drainage network is incomplete and the pipes are generally undersized. This helps explain the extensive street flooding during significant storm events since much of the drainage effectively reverts to overland flow during larger storm events.

For the purposes of this discussion the outfalls have been generally classified according to the functional characteristics of their upstream stormwater areas.

Figure 2 ~ Twin 30-inch culverts- Outfall #2 (Naples Beach Club)

Of the smaller, single culvert type, seven (7) function as an integral part of the roadway drainage, conveying stormwater captured from the adjacent right of way with flow generally uncontrolled and one(1), the northernmost outfall #1, serves a small residential condominium project. The two (2) double culvert types include the largest, Outfall #6, a continuous flow outfall located downstream of a collector pond, and Outfall #2 located downstream of a control structure, serving a private golf course [**Figure 2**].

A summary of these existing conditions is presented below on the **Table 1.** This table also includes the estimated contributory area to each outfall and an estimate of expected runoff (ac-ft) based on a 25 year/ 3 day SFWMD design storm at each outfall. Please note that the discharge rates provided are based on <u>conceptual-level modeling</u>

only and do not account for any upstream surface storage. A review of existing field conditions and available topographic data shows much variation in potential storage for each of these contributing sub-areas. In particular, Outfall #2 serves a golf course which is mostly open space and includes a significant interconnected lake network; and Outfall #6 includes three (3) interconnected upstream lakes which capture surrounding roadway runoff. Since the details of these systems were not included in this modeling exercise the final drainage outflow volumes (ac-ft) will typically overstate actual observed conditions. In practice, the limited diameters of the outfall culverts can be expected to result in lowered peak discharge rates (cfs) as compared to the results in **Appendix C**.

Table 1 ~ Summary of Beach Outfalls and Contributory Areas

OUTFALL I.D. No.	**ESTIMATED UPSTREAM CONTR. AREA**	**ESTIMATED 25 YR /3 DAY CONTRIBUTORY AREA DISCHARGE**		**CULVERT TYPE /DIAM**	**DESCRIPTION - OUTFALL DISCHARGE FLOW TYPE**
	[ac]	[ac-ft]	% of Total	[ins]	
1	5.1	3.8	*1.3%*	*Single / 24-in*	*Intermittent - Uncontrolled Flow*
2	141.3	**79.5**	***27.3%***	*Double / 30-in*	*Continous - Controlled Flow (weir)*
3	10.3	8.3	*2.9%*	*Single / 18-in*	*Intermittent - Uncontrolled Flow*
4	18.9	13.8	*4.7%*	*Single / 18-in*	*Intermittent - Uncontrolled Flow*
5	5.1	3.8	*1.3%*	*Single / 14-in*	*Intermittent - Uncontrolled Flow*
6	149.5	**102.6**	***35.2%***	*Double / 30-in*	*Continous - Uncontrolled Flow*
7	34.3	25.6	*8.8%*	*Single / 24-in*	*Intermittent - Uncontrolled Flow*
8	48.4	36.5	*12.5%*	*Single / 30-in*	*Intermittent - Uncontrolled Flow*
9	9.5	7.1	*2.4%*	*Single / 18-in*	*Intermittent - Uncontrolled Flow*
10	13.6	10.1	*3.5%*	*Single / 18-in*	*Intermittent - Uncontrolled Flow*
Totals =	**436.0**	**291.1**			

Notes:
1: Discharge rates given are based on conceptual-level modeling only.
2: Outfalls # 2 and #6 contribute an aggregate total of 182.1 (ac-ft) or 62.5% of total discharge

These comments notwithstanding, this modeling effort and the conceptual results presented here are sufficient to demonstrate the order of magnitude of drainage flows arriving at each primary discharge point and the relative importance of each outfall to the overall Basin II drainage system

3. Water Quality Considerations

Up to now, numerous design ideas and proposals have been considered to improve water quality and to alter the discharge characteristics of stormwater out-flowing into the Gulf of Mexico. The maintenance of optimum water quality along the coastline and the gulf beaches is naturally a matter of upmost concern the residents of Naples. To date, indications are that the performance of the storm drainage network and beach outfalls has been satisfactory and that the existing system has proved efficient enough to forego any need for corrective action or beach closures.

The City of Naples has an ambitious program designed to address the problems of stormwater runoff and to mitigate water quality impacts throughout its jurisdiction. Ongoing efforts include Ordinances for the control and use of fertilizers and pesticides as well as stormwater runoff. The current Stormwater Ordinances [Sec 15-115] mandates a minimum level of water quality retention/detention on all properties discharging into City-owned roadway right of ways, consistent with SFWMD standards.

In addition the City's Stormwater Department has an ongoing program designed to maximize the water quality treatment within the City roadways by creating shallow retention swale systems designed to attenuate and capture source runoff entering the right of way.

Although this report does not assess the existing level of water quality treatment available within Basin II, we note that this coverage area includes approximately 24 acres of lakes which collect and attenuate adjacent runoff and provide undeniable treatment benefits to the stormwater Basin. As previously described, this is especially pertinent for the two largest outfalls #2 and #6, which include between them, all of the available lake storage.

Figure 3 ~ View east across Gulfshore Blvd
Final Interior Lake discharging to Outfall #6

Conceptual–level Water Quality calculations have been provided in **Appendix B** which outline the potential requirements of the current system if SFWMD guidelines were implemented. As evidenced by the attached calculations, the existing land use coverage is mostly residential with the exception of a private golf course which covers approximately 130 acres. While these residential neighborhoods are typically comprised of low-density development, and the land use calculations indicate a relatively high ratio of open space, significant tracts of unused open space or unoccupied lots are generally unavailable. This would hamper any efforts to increase the available system volume through the use of additional ponds or other normal storage options - a critical factor in any retrofit scenario. As a logical alternative, potential improvements to the available storage within the existing lakes of Basin II should perhaps be considered.

Alternative proposals include the use and placement of exfiltration trenches along the dune line which would provide some additional water quality treatment to out-flowing runoff. The net benefit of such passive gravity-driven systems is limited however by the lack of available cross-section depth. Drainage inlets along Gulfshore Boulevard are typically low (+/- 4.0’ ~ 5.0’ NGVD) and the net volume achievable from these systems will be modest. This option could potentially add 1.0 to 3.0 ac-ft of storage depending on the selected drainage configuration. The potential volumes available would limit the effectiveness of these improvements to the smaller outfalls. Finally, we must remember that the system, as currently configured, will still require some minimum number of properly functioning stormwater discharge points.

4. Coastal Impact of existing Groins and Outfalls

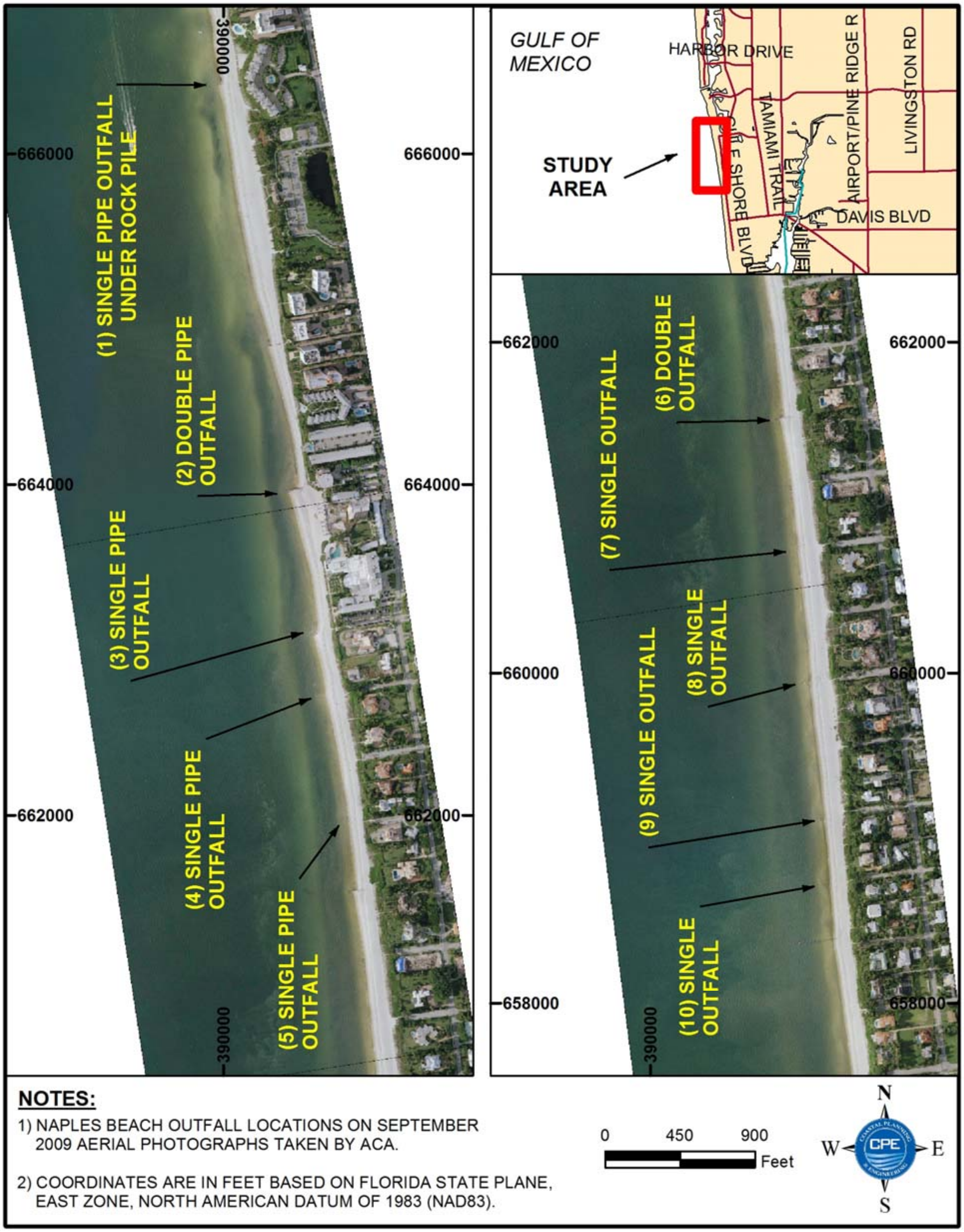
A review of a number of documents shows that coastal impacts caused by the outfalls are either negligible or manageable and that FDEP previous assessment should be updated. The coastal engineering impact of the ten (10) outfalls was characterized by FDEP in their "Intent to Issue" document on the Collier County Beach Nourishment Project dated December 2004, as follows:

“Although these outfalls are adversely affecting the beach by contributing to erosion, impacting turtle nesting habitat, interfering with lateral beach access and degrading water quality, the cost of retrofitting the stormwater system is too great to require removal of the outfalls at this time.”

We examined the following three documents to evaluate these impacts: 2002 Drainage Reconnaissance Report (CPE 2002), Collier County Contour Map based on 2004 Lidar survey (**Appendix D**), 1995 Erosion Control Line (on contour map) and September 2009 aerial photographs [**Figure 4**]. Based on these documents, which show all ten (10) outfalls, the outfall impacts are at most moderate and in most cases imperceptible.

The contour maps (**Appendix D**) are based on conditions before the 2006 renourishment project and show the dry beach and nearshore contours along with the 10 outfall locations. The map clearly shows the groin like impact or lack thereof to the contours caused by the outfalls. It also shows the 1995 ECL, whose shape is influenced by some of the outfalls.

The latest available LIDAR data for the Collier County project area is from USACE flown in May 2004. LIDAR is a method of generating topographical and bathymetric data sets that accurately measures elevations at high resolution (greater than 2 points per square meter) over broad areas, using an airborne platform. For showing the drainage areas applicable to Naples beach area based on topography only, all non-ground objects (buildings, trees, etc.) must be removed (filtered) from the LIDAR data set. To accomplish this, LIDAR data was classified at the point level using filtering algorithms developed by Zhang et al. (Zhang and Whitman, 2005; Zhang et al., 2003). The filters were calibrated using 2004 beach profiles that were collected almost concurrently with the LIDAR data. The beach profile data points used to calibrate the filter include only topography (ground), which is essential to ensure removal of non-ground (e.g. vegetation, buildings, etc.) points while also ensuring that locations of high slope variation (e.g. dune crests) are not inadvertently filtered out. After filtering, the remaining points representing only topography were converted to a digital elevation model (DEM) that represents the drainage surface, and imported into GIS. Foundation features on many structures and buildings also remain in the DEM, but they will influence drainage. The coverage extends from Doctors Pass to Naples Pier, and contains all of the Naples outfalls, and landward beyond Gulf Shore Blvd, the first parallel street. The LIDAR data includes offshore data points, which were contour along with the adjacent uplands. The 10 Naples outfall locations are indentified on the map. (For reference, the NAVD 88 datum is 1.28 feet higher than the NGVD 29 datum, with mean high water at 0.33 feet using the latest NAVD 88 datum.)



NOTES:

1) NAPLES BEACH OUTFALL LOCATIONS ON SEPTEMBER 2009 AERIAL PHOTOGRAPHS TAKEN BY ACA.

2) COORDINATES ARE IN FEET BASED ON FLORIDA STATE PLANE, EAST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83).

Figure 4 ~ Naples, Florida Aerial Photograph with Outfall Location

The 10 outfalls extend across the beach and discharge at the waterline. Therefore there is no dry beach erosion caused by the discharge from these outfalls.

Three (3) of the outfalls are constructed within or adjacent to rock groins (No. 1-3 in **Table 2**). Collier County removed 36 groins with the 1995/96 nourishment project between Doctors Pass and Naples Pier, leaving 17 beach structures including the 10 outfalls. Generally, it is these combination structures, groin and outfall, that have the greatest impact on the shoreline, along with outfall # 6, Outfall No's. 2 and 6 produce 72% of the peak flow, and drain upland lakes and ponds.

Table 2

Summary of Outfall Characteristics

ADMIN. No.	HISTORIC NUMBER	LOCATION	EROSION IMPACT	PIPELINE DIAMETER	INVERT El. (Ft NGVD)	NOMICNAL PIPE TOP El. (Ft NGVD)	TYPE and CONTRIBUTORY AREA
1	RG-16-1	R60+265'	Small-Moderate	24 in PVC	-0.02	2.11	In Rock Groin for Adjacent Condo
2	O-16-1	R62+650'	Moderate	2 x 30 in PVC	Both -0.14	2.49	Next to Rock Groin for hotel, parking lots, Gulf Shore Blvd. and Ponds
3	O-17-1	R63+535'	Moderate	18 in. PVC	-0.09	1.54	Next to Rock Groin from 8th Ave. N. and Gulf Shore Blvd.
4	O-17-2	R64+000'	Negligible	18 in PVC	-0.66	0.97	7th Avenue North and Gulf Shore Blvd.
5	O-17-3	R65+000'	Negligible	14 in PVC	0.23	1.52	6th Avenue North and Gulf Shore Blvd.
6	O-17-4	R65+410'	Small-Moderate	2 x 30 in PVC	0.17 & -0.52	2.46	Residential lots between 6th and 4th Ave. N., Gulf Shore Blvd. and Lake
7	O-17-5	R66+415'	Negligible	24 in PVC	-1.22	0.91	3rd Avenue North and Gulf Shore Blvd.
8	O-18-1	R67+400'	Negligible	30 in PVC	0.84	3.47	1st Avenue North and Gulf Shore Blvd.
9	O-18-2	R68+430'	Negligible	18 in PVC	0.30	1.93	1st Avenue South and Gulf Shore Blvd.
10	O-18-3	R69+000'	Negligible	18 in PVC	-0.40	1.23	2nd Avenue South and Gulf Shore Blvd.

The 10 outfalls do not block lateral beach access except at or near the waterline (CPE 2002). The pipelines are all buried under the mid- and back-beach. The pipeline invert elevations are very low between -1.22 to +0.84 ft NGVD, averaging -0.14 ft NGVD [**Table 2**]. The outfall pipelines are low all the way back to Gulf Shore Blvd., where street grate elevations are as low as 4 ft NGVD. The highest elevation based on pipeline diameter plus invert elevation is 3.5 ft at outfall # 8, which is below the natural beach berm elevation of 5 ft NGVD. Recent storms have increased back beach elevation another foot in many areas. Each pipeline and associate groin will be emergent or have less than 24 inch cover for some of its route closest to the shoreline, which is in the range of turtle nesting depths. The pipeline thru most of the back beach has more than 24 inch clearance over the buried pipeline, except outfall #8 [**Table 2**].

Based on a review of the four items mentioned earlier, most of the outfalls have an insignificant impact to beach erosion. Outfall #'s 4 ~ 5 and 7~10 show no visible shoreline effect in the September 2009 aerials and the impact to the 2004 Lidar contours and 1995 ECL is negligible. Outfall # 6 discharges 35% of the peak flow of all the outfalls and creates a groin like effect on the beach. Outfall # 2 has the one of highest peak discharge (27%) and is combined with a groin. It has a visible groin like impact in both the 2009 aerial and 2004 LIDAR contour map, which reverses with seasonal wave climate as illustrated in comparing these two. The other two groin/outfall combinations have a small but visible impact to the shoreline and nearshore contours.

A comparison between the 2004 contour map and the 2009 aerial photograph shows a reversal in alongshore transport at the groins. The size of the opposing offset at outfall #2 indicates there is a strong refraction-diffraction effect on Naples beach caused by the shape of the nearshore hardbottom and the bathymetric high that extends offshore from northern Naples beach. Any modification to the lengths of the groin/outfall combination needs to balance the beach offset versus the stabilizing influence of the structures. Since the amount of sand that can be placed is restricted by the hardbottom locations, the groins can substitute for advanced nourishment. Given the combined inlet, near- and far shore-geomorphology and wave climate influences in this region, it is difficult to say they should be modified, since groins have a stabilizing influence in this hard to maintain stretch of beach.

Some groins were retained and repaired with the 1995/96 project, since they contributed to beach stability. They were retained for the 2006 project for the same reason and because beach nourishment mitigates for the groin effect. Nourishment largely mitigates groins impacts by substantially maintain desired beach widths. This is evident in the contour maps [**Appendix D**] by noting the shoreline has not retreated to the ECL 8 years after initial nourishment.

The County plans to use the monitoring data collected since 1996 in conjunction with engineering and modeling of the next beach nourishment to examine if the groins or beach design need to be modified as mitigation for any impacts. The complex influence of multiple alongshore structures, unique nearshore hardbottom geomorphology, offshore bathymetric high and inlet impacts make the irreversible removal of the groins and groin like structures a difficult decision. There is no doubt they have a positive influence on project stability, but there may be room for modifications.

Complaints of erosion trenches across the beach sent to FDEP during the permit process for the last project were caused by private discharges through seawalls from the back of the beach. These discharges are not controlled by the City or County.

5. Conclusions / Discussion of Alternatives to Existing Outfalls

A. Stormwater Drainage Considerations

As highlighted by this report, the significance of the upstream contributory areas and the magnitude of expected outflows complicates the removal of these outfalls and makes any alternative designs more challenging to implement.

Few easily workable options are available. Possible alternative designs could include the conveyance of stormwater east towards Naples Bay, or, by underground aquifer storage, outright removal of this runoff volume. In the latter case, conceptual analyses undertaken for adjacent stormwater Basins within the City have thus yielded inconclusive scenarios with potentially high implementation costs. Similarly, the transfer of stormwater flows east into Naples Bay is likely to have other undesirable consequences. Without the benefit of further study we can certainly speculate that additional flows into the Bay would simply increase freshwater discharges and add to existing water quality impairments. Indeed, any design involving the removal or relocation of these outfalls will require a careful analysis to verify that the solutions being offered do not create greater problems elsewhere for the City. It is in fact likely that the current situation can be improved by a plan which would seek to reduce, rather than eliminate, the number of existing outfalls; a plan which would also maximize the available storage volume upstream of these pipes. Some additional in-depth review may be useful to help identify feasible scenarios which could maximize the available storage achievable within the current Basin II lake network and roadway drainage system.

B. Coastal Impact Considerations

Based on the above preliminary analysis, the following conclusions or recommendations are provided. The discharge from the 10 outfalls has a negligible influence on erosion and accretion in the project area, while the impact of the accompanied groins or the pipelines from the larger outfalls acting as groins should be analyzed for length or fill quantity modification with the next nourishment project.

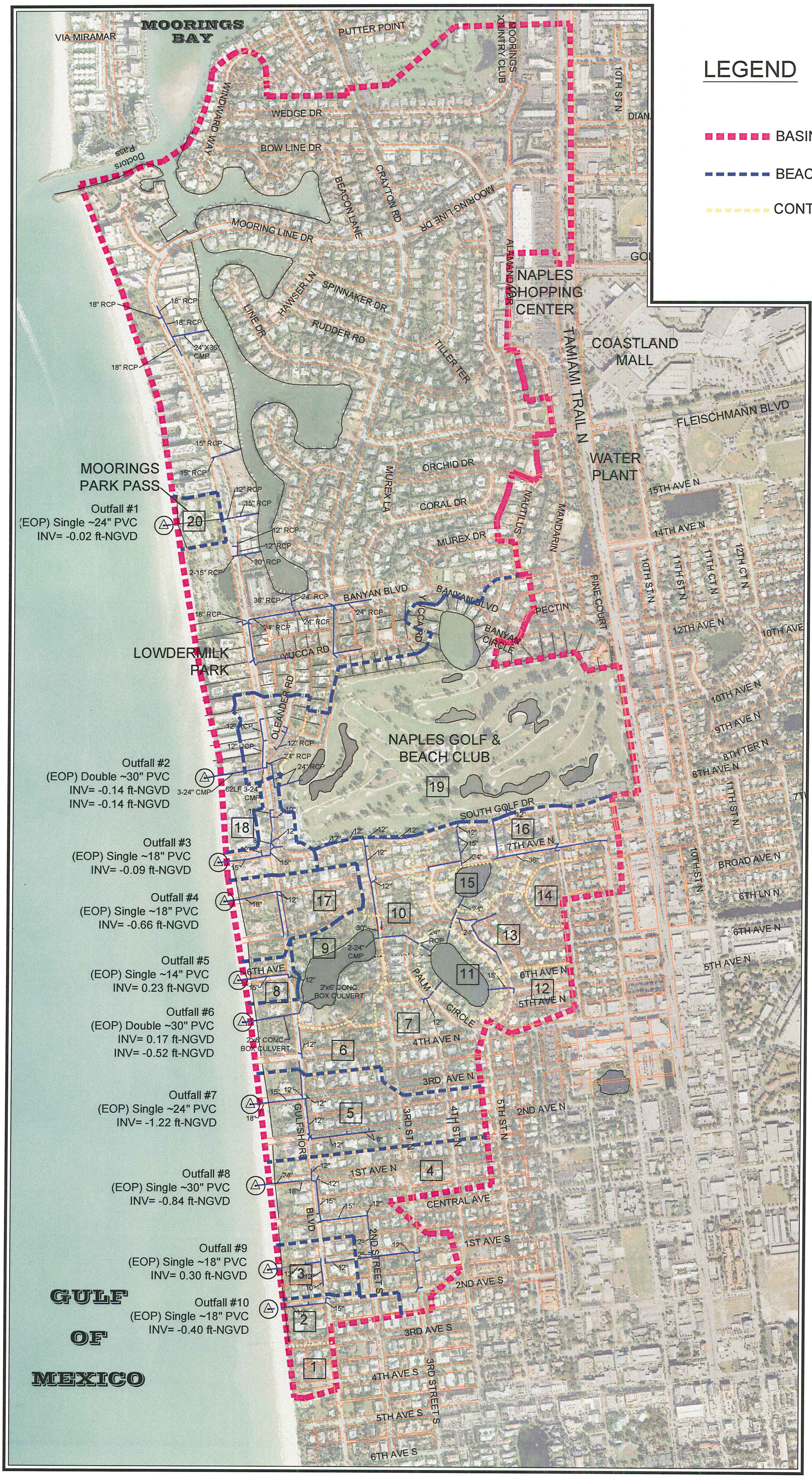
The low flow smaller outfalls have negligible impact on beach erosion, and they are largely buried deeper than expected turtle nest depth except for the region closest to the shoreline.

In conclusion, the current system works well, considering alternatives are very limited. The discharges from the outfalls are not causing visible erosion. The groin like impact of the 4 larger outfalls may warrant length modification to optimize their stabling influence on Naples Beach. Fine tuning the beach restoration program may be an alternative to address this impact.

6. Sources of Reference Data

The following is a partial list of the various reports, meetings, Agencies and documents that have been consulted thus far in this process.

- *Gulfshore Engineering, Inc. Field observations - 2009.*
- *Johnson Engineering, Inc. – Specific Purpose Survey (City of Naples) - 2006*
- *Johnson Engineering, Inc. – Topo Verification (Gulfshore Engineering -2009)*
- *Coastal Planning & Engineering Inc. Lidar Imagery / Topo -2009*
- *Florida Department of Environmental Protection (FDEP)*
- *City of Naples- Engineering Archives, numerous docs, 1981 CH2MHILL Study.*
- *City of Naples- Lidar Imagery, GIS- 2009.*
- *South Florida Water Management District Volume IV- BOR - Feb. 2006.*
- *Evaluation of Current Stormwater Design Criteria within the State of Fla., June 2007 Edition - Harvey Harper, PhD. PE.*
- *Collier County Public GIS files, Property Appraisers on-line database.*
- *Meetings with Staff –Collier County -2009.*
- *Meetings with Staff -City of Naples- 2009*
- *Coastal Planning & Engineering, Inc., Collier County Preliminary Engineering Report, 2003*
- *Coastal Planning & Engineering, Inc., Collier County Beach Restoration Project 6-Year Monitoring Report (contains Appendix A: Drainage Reconnaissance Report), October 2002.*
- *Coastal Planning & Engineering, Inc., 2009 Collier County Annual Topographic and hydrographic Survey Report (September 2009 Aerial Photographs). November 2009*
- *Zhang, K. and Whitman, D., 2005. Comparison of three algorithms for filtering airborne lidar data. Photogrammetric Engineering and Remote Sensing, 71(3): 313-324.*
- *Zhang, K.Q. et al., 2003. A progressive morphological filter for removing nonground measurements from airborne LIDAR data. IEEE Transactions on Geoscience and Remote Sensing, 41(4): 872-882.*



LEGEND

- 🟥 BASIN II DRAINAGE BASIN BOUNDARY
- 🟦 BEACH OUTFALL CONTRIBUTORY AREAS
- 🟨 CONTRIBUTING SUB-AREA DELINEATIONS

0 350' 500' 1000' 2000'

GRAPHIC SCALE IN FEET

TOTAL CONTRIBUTING AREAS FOR BEACH OUFALLS = 436.0 AC

Note:
TOTAL BASIN II AREA = 937.23 AC

OUTFALL PIPE LOCATIONS & INVERTS PER
JOHNSON ENGINEERING - PROJECT NO. 20066096 - 02/06

GULFSHORE ENGINEERING, INC.

2375 Tamiami Trail N, Suite 207
Naples, FL 34103 - (239) 261-2290

City of Naples Florida

BASIN II / BEACH OUTFALLS CONCEPTUAL DRAINAGE EXHIBIT I

EDITION DATE : 2009-07-25

NOTE: DATA SHOWN IS INTENDED FOR CONCEPTUAL PLANNING USE ONLY.

P:\NEW PROJECT-LIST\305-BEACH RENOURISHMENT STUDY\DWGS\OUTBASE-MAP-2009 0625.dwg, 9/16/2009 4:34:05 PM

Appendix A:
Beach Outfall Contributing Sub-areas and Land Use.

BEACH OUTFALL ANALYSIS

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ LAND USE BREAKDOWN FOR BEACH OUTFALL CONTRIBUTORY AREAS

Basin II - Beach Outfalls Analysis Area = 435.97 ac

A. Areas Contributing to existing outfalls = 435.97 acres

1. Subarea ~ 1	=	4.82	acres
2. Sub-area~ 2	=	8.76	acres
3. Sub-area~ 3	=	9.51	acres
4. Sub-area~ 4	=	48.37	acres
5. Sub-area~ 5	=	34.34	acres
6. Sub-area~ 6	=	15.18	acres
7. Sub-area~ 7	=	21.82	acres
8. Sub-area~ 8	=	5.12	acres
9. Sub-area~ 9	=	19.25	acres
10. Sub-area~ 10	=	19.93	acres
11. Sub-area~ 11	=	10.93	acres
12. Sub-area~ 12	=	9.06	acres
13. Sub-area~ 13	=	13.27	acres
14. Sub-area~ 14	=	14.27	acres
15. Sub-area~ 15	=	7.89	acres
16. Sub-area~ 16	=	17.92	acres
17. Sub-area~ 17	=	18.93	acres
18. Sub-area~ 18	=	20.55	acres
19. Sub-area~ 19	=	130.99	acres
20. Sub-area~ 20	=	5.09	acres
Subtotal ===>		435.97	acres

Recapitulated Totals

OVERALL AREA TABLE (INCLUDES Areas 1 ~ 20)

LAND USES	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	23.99	0.00	0.00	23.99	0.00	0.00	23.99
RESIDENTIAL AREAS	227.63	69.89	17.02	0.00	140.72	140.72	86.91
COMMERCIAL / INSTITUTIONAL AREAS	2.35	0.83	0.21	0.00	1.31	1.31	1.04
RIGHT-OF-WAY AREAS	72.53	0.00	35.59	0.00	36.93	36.93	35.59
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	109.47	3.94	9.58	0.00	95.95	95.95	13.52
subtotal ===>	435.97	74.65	62.41	23.99	274.91	274.91	161.06
PERCENTAGE OF TOTAL	100.0%	17.1%	14.3%	5.5%	63.1%	63.1%	36.9%

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ LAND USE BREAKDOWN FOR BEACH OUTFALL CONTRIBUTORY AREAS

Land Use Tables for Individual sub-areas in Basin II...

SUB AREA ~ 1

Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	3.82	0.79	0.18	0.00	2.85	2.85	0.97
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	1.00	0.00	0.56	0.00	0.43	0.43	0.56
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	4.82	0.79	0.75	0.00	3.28	3.28	1.53
PERCENTAGE OF TOTAL	100.0%	16.3%	15.5%	0.0%	68.1%	68.1%	31.9%

SUB AREA ~ 2

Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	6.20	1.97	0.51	0.00	3.72	3.72	2.48
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	2.56	0.00	1.27	0.00	1.29	1.29	1.27
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	8.76	1.97	1.78	0.00	5.01	5.01	3.75
PERCENTAGE OF TOTAL	100.0%	22.5%	20.3%	0.0%	57.2%	57.2%	42.8%

SUB AREA ~ 3

Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	7.82	2.50	0.35	0.00	4.98	4.98	2.84
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	1.68	0.00	0.89	0.00	0.80	0.80	0.89
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	9.51	2.50	1.23	0.00	5.78	5.78	3.73
PERCENTAGE OF TOTAL	100.0%	26.2%	13.0%	0.0%	60.8%	60.8%	39.2%

SUB AREA ~ 4

Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	33.31	11.29	2.77	0.00	19.25	19.25	14.06
COMMERCIAL / INSTITUTIONAL AREAS	2.35	0.83	0.21	0.00	1.31	1.31	1.04
RIGHT-OF-WAY AREAS	12.71	0.00	5.81	0.00	6.89	6.89	5.81
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	48.37	12.12	8.80	0.00	27.45	27.45	20.92
PERCENTAGE OF TOTAL	100.0%	25.1%	18.2%	0.0%	56.8%	56.8%	43.2%

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ LAND USE BREAKDOWN FOR BEACH OUTFALL CONTRIBUTORY AREAS

SUB AREA ~ 5 **Drainage Contributory Sub-areas Basin II**

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	26.46	8.19	1.91	0.00	16.35	16.35	10.10
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	7.88	0.00	3.57	0.00	4.32	4.32	3.57
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	34.34	8.19	5.48	0.00	20.67	20.67	13.67
PERCENTAGE OF TOTAL	100.0%	23.9%	16.0%	0.0%	60.2%	60.2%	39.8%

SUB AREA ~ 6 **Drainage Contributory Sub-areas Basin II**

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	11.82	1.95	0.62	0.00	9.25	9.25	2.57
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	3.35	0.00	1.62	0.00	1.73	1.73	1.62
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	15.18	1.95	2.24	0.00	10.98	10.98	4.19
PERCENTAGE OF TOTAL	100.0%	12.9%	14.7%	0.0%	72.4%	72.4%	27.6%

SUB AREA ~ 7 **Drainage Contributory Sub-areas Basin II**

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	14.80	6.56	1.35	0.00	6.89	6.89	7.91
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	7.03	0.00	3.06	0.00	3.97	3.97	3.06
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	21.82	6.56	4.41	0.00	10.86	10.86	10.97
PERCENTAGE OF TOTAL	100.0%	30.0%	20.2%	0.0%	49.7%	49.7%	50.3%

SUB AREA ~ 8 **Drainage Contributory Sub-areas Basin II**

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	3.99	0.87	0.16	0.00	2.96	2.96	1.03
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	1.13	0.00	0.62	0.00	0.51	0.51	0.62
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	5.12	0.87	0.78	0.00	3.47	3.47	1.65
PERCENTAGE OF TOTAL	100.0%	16.9%	15.2%	0.0%	67.8%	67.8%	32.2%

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ LAND USE BREAKDOWN FOR BEACH OUTFALL CONTRIBUTORY AREAS

SUB AREA ~ 9 **Drainage Contributory Sub-areas Basin II**

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	5.73	0.00	0.00	5.73	0.00	0.00	5.73
RESIDENTIAL AREAS	11.95	2.06	0.33	0.00	9.56	9.56	2.39
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	1.56	0.00	0.41	0.00	1.15	1.15	0.41
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	19.25	2.06	0.75	5.73	10.71	10.71	8.54
PERCENTAGE OF TOTAL	100.0%	10.7%	3.9%	29.8%	55.6%	55.6%	44.4%

SUB AREA ~ 10 **Drainage Contributory Sub-areas Basin II**

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	13.95	3.83	1.44	0.00	8.67	8.67	5.27
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	5.98	0.00	3.16	0.00	2.82	2.82	3.16
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	19.93	3.83	4.60	0.00	11.50	11.50	8.43
PERCENTAGE OF TOTAL	100.0%	19.2%	23.1%	0.0%	57.7%	57.7%	42.3%

SUB AREA ~ 11 **Drainage Contributory Sub-areas Basin II**

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	4.47	0.00	0.00	4.47	0.00	0.00	4.47
RESIDENTIAL AREAS	6.46	2.84	0.00	0.00	3.62	3.62	2.84
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	10.93	2.84	0.00	4.47	3.62	3.62	7.31
PERCENTAGE OF TOTAL	100.0%	26.0%	0.0%	40.9%	33.1%	33.1%	66.9%

SUB AREA ~ 12 **Drainage Contributory Sub-areas Basin II**

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	7.08	2.67	0.46	0.00	3.95	3.95	3.13
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	1.99	0.00	0.79	0.00	1.20	1.20	0.79
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	9.06	2.67	1.25	0.00	5.15	5.15	3.91
PERCENTAGE OF TOTAL	100.0%	29.4%	13.8%	0.0%	56.8%	56.8%	43.2%

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ LAND USE BREAKDOWN FOR BEACH OUTFALL CONTRIBUTORY AREAS

SUB AREA ~ 13 Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	10.28	3.95	0.75	0.00	5.57	5.57	4.70
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	2.99	0.00	1.43	0.00	1.57	1.57	1.43
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	13.27	3.95	2.18	0.00	7.14	7.14	6.13
PERCENTAGE OF TOTAL	100.0%	29.8%	16.4%	0.0%	53.8%	53.8%	46.2%

SUB AREA ~ 14 Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	10.40	4.61	0.83	0.00	4.97	4.97	5.44
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	3.87	0.00	2.34	0.00	1.53	1.53	2.34
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	14.27	4.61	3.17	0.00	6.49	6.49	7.78
PERCENTAGE OF TOTAL	100.0%	32.3%	22.2%	0.0%	45.5%	45.5%	54.5%

SUB AREA ~ 15 Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	1.99	0.00	0.00	1.99	0.00	0.00	1.99
RESIDENTIAL AREAS	5.26	1.64	0.16	0.00	3.46	3.46	1.80
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	0.64	0.00	0.31	0.00	0.33	0.33	0.31
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	7.89	1.64	0.47	1.99	3.79	3.79	4.10
PERCENTAGE OF TOTAL	100.0%	20.8%	5.9%	25.2%	48.0%	48.0%	52.0%

SUB AREA ~ 16 Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	12.55	5.87	1.16	0.00	5.52	5.52	7.03
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	5.37	0.00	3.09	0.00	2.28	2.28	3.09
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	17.92	5.87	4.26	0.00	7.80	7.80	10.12
PERCENTAGE OF TOTAL	100.0%	32.7%	23.7%	0.0%	43.5%	43.5%	56.5%

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ LAND USE BREAKDOWN FOR BEACH OUTFALL CONTRIBUTORY AREAS

SUB AREA ~ 17

Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	14.83	4.20	1.08	0.00	9.54	9.54	5.28
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	4.10	0.00	2.31	0.00	1.80	1.80	2.31
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	18.93	4.20	3.38	0.00	11.34	11.34	7.59
PERCENTAGE OF TOTAL	100.0%	22.2%	17.9%	0.0%	59.9%	59.9%	40.1%

SUB AREA ~ 18

Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	9.41	1.07	1.55	0.00	6.79	6.79	2.62
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	5.13	0.00	3.06	0.00	2.07	2.07	3.06
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	6.01	2.59	3.37	0.00	0.04	0.04	5.97
subtotal ===>	20.55	3.66	7.99	0.00	8.90	8.90	11.65
PERCENTAGE OF TOTAL	100.0%	17.8%	38.9%	0.0%	43.3%	43.3%	56.7%

SUB AREA ~ 19

Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	11.80	0.00	0.00	11.80	0.00	0.00	11.80
RESIDENTIAL AREAS	12.16	2.08	0.48	0.00	9.59	9.59	2.57
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	3.56	0.00	1.30	0.00	2.26	2.26	1.30
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	103.47	1.35	6.20	0.00	95.91	95.91	7.55
subtotal ===>	130.99	3.43	7.99	11.80	107.76	107.76	23.22
PERCENTAGE OF TOTAL	100.0%	2.6%	6.1%	9.0%	82.3%	82.3%	17.7%

SUB AREA ~ 20

Drainage Contributory Sub-areas Basin II

ROW DRAINAGE AND LAKE SYSTEM	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDENTIAL AREAS	5.09	0.95	0.92	0.00	3.22	3.22	1.87
COMMERCIAL / INSTITUTIONAL AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT-OF-WAY AREAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RETENTION AREAS- SWALES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMUNITY PARKS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALANCE UPLANDS / PRESERVES / OPEN SPACE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subtotal ===>	5.09	0.95	0.92	0.00	3.22	3.22	1.87
PERCENTAGE OF TOTAL	100.0%	18.7%	18.1%	0.0%	63.2%	63.2%	36.8%

Appendix B:
Estimated Water Quality Requirements (each outfall)

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

BEACH OUTFALLS ANALYSIS

ESTIMATED WATER QUALITY REQUIREMENTS

STORMWATER MANAGEMENT REPORT
WATER QUALITY CALCULATIONS EACH SUB-PROJECT

PREPARED FOR:
COLLIER COUNTY

PREPARED BY:

GULFSHORE
ENGINEERING, INC.

2375 TAMIAMI TRL N., SUITE 207
NAPLES, FLA. 34103

This Edition DATE:
15-Feb-10

GEI PN: 305

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #1

Contributory Project Area = **5.1 ac**

A. Land Use Table...

LAND USES	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
RESIDENTIAL AREAS	5.09	0.95	0.92	0.00	3.22	3.22	1.87
subtotals ===>	5.09	0.95	0.92	0.00	3.22	3.22	1.87
PERCENTAGE OF TOTAL	100.0%	18.7%	18.1%	0.0%	63.2%	63.2%	36.8%

Summary

Total Area = **5.09** **ac** **100.0%**

Total Pervious Site Area = **3.22** **ac** **63.2%**

Total Impervious Site Area = **1.87** **36.8%**

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

this formula computes the volume of the 1st inch of runoff

V1= A*[1/12]

V1 = 0.42 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'** **A' = A - [Roofs + Lakes]**

A' = 4.1

Impervious Area for computation [ac] = **A"** **A" = A' - [Pervious Area]**

A" = 0.9

% Impervious = **Imperv %** **Imperv % = A" / A'**

Imperv % = 22.21%

Storage Volume [ac-ft] = **V2** **V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]**

V2 = 0.24 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = **0.42** **ac-ft**

Summary

Final Site Water Quality Volume Required = **0.42 ac-ft**

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #2

Contributory Project Area = **141.3 ac** This area includes the golf course

A. Land Use Table...

	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	11.80	0.00	0.00	11.80	0.00	0.00	11.80
RESIDENTIAL AREAS	16.86	2.62	1.26	0.00	12.99	12.99	3.87
PAVEMENT / SIDEWALK / DRIVEWAYS	6.13	0.00	2.83	0.00	3.29	3.29	2.83
BALANCE UPLANDS / PRESERVES / OPEN SPACE	106.47	2.65	7.89	0.00	95.93	95.93	10.54
subtotals ===>	141.26	5.26	11.98	11.80	112.21	112.21	29.05
PERCENTAGE OF TOTAL	100.0%	3.7%	8.5%	8.4%	79.4%	79.4%	20.6%

Summary

Total Area = **141.26** **ac** **100.0%**

Total Pervious Site Area = **112.21** **ac** **79.4%**

Total Impervious Site Area = **29.05** **20.6%**

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

Storage Volume [ac-ft] = **V1** this formula computes the volume
Site area [ac] = **A** of the 1st inch of runoff

V1= A*[1/12]

V1 = 11.77 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'** **A' = A - [Roofs + Lakes]**
A' = 124.2

Impervious Area for computation [ac] = **A''** **A'' = A' - [Pervious Area]**
A'' = 12.0

% Impervious = **Imperv %** **Imperv % = A'' / A'**
Imperv % = 9.65%

Storage Volume [ac-ft] = **V2** **V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]**
V2 = 2.60 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = **11.77** **ac-ft**

Summary

Final Site Water Quality Volume Required = **11.77 ac-ft** Note! Lake storage is not included

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #3

Contributory Project Area = **10.3 ac**

A. Land Use Table...

	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
RESIDENTIAL AREAS	4.70	0.53	0.78	0.00	3.40	3.40	1.31
PAVEMENT / SIDEWALK / DRIVEWAYS	2.57	0.00	1.53	0.00	1.03	1.03	1.53
BALANCE UPLANDS / PRESERVES / OPEN SPACE	3.00	1.30	1.69	0.00	0.02	0.02	2.98
subtotals ===>	10.27	1.83	4.00	0.00	4.45	4.45	5.82
PERCENTAGE OF TOTAL	100.0%	17.8%	38.9%	0.0%	43.3%	43.3%	56.7%

Summary

Total Area = **10.27** **ac** **100.0%**

Total Pervious Site Area = **4.45** **ac** **43.3%**

Total Impervious Site Area = **5.82** **56.7%**

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

this formula computes the volume
of the 1st inch of runoff

V1= A*[1/12]

V1 = 0.86 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'** **A' = A - [Roofs + Lakes]**

A' = 8.4

Impervious Area for computation [ac] = **A"** **A" = A' - [Pervious Area]**

A" = 4.0

% Impervious = **Imperv %** **Imperv % = A" / A'**

Imperv % = 47.31%

Storage Volume [ac-ft] = **V2** **V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]**

V2 = 1.01 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = **1.01** **ac-ft**

Summary

Final Site Water Quality Volume Required = **1.01 ac-ft**

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #4

Contributory Project Area = **18.9 ac**

A. Land Use Table...

	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
RESIDENTIAL AREAS	14.83	4.20	1.08	0.00	9.54	9.54	5.28
PAVEMENT / SIDEWALK / DRIVEWAYS	4.10	0.00	2.31	0.00	1.80	1.80	2.31
subtotals ===>	18.93	4.20	3.38	0.00	11.34	11.34	7.59
PERCENTAGE OF TOTAL	100.0%	22.2%	17.9%	0.0%	59.9%	59.9%	40.1%

Summary

Total Area = **18.93** **ac** **100.0%**

Total Pervious Site Area = **11.34** **ac** **59.9%**

Total Impervious Site Area = **7.59** **40.1%**

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

this formula computes the volume of the 1st inch of runoff

V1= A*[1/12]

V1 = 1.58 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'** **A' = A - [Roofs + Lakes]**

A' = 14.7

Impervious Area for computation [ac] = **A"** **A" = A' - [Pervious Area]**

A" = 3.4

% Impervious = **Imperv %** **Imperv % = A" / A'**

Imperv % = 22.98%

Storage Volume [ac-ft] = **V2** **V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]**

V2 = 0.91 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = **1.58** **ac-ft**

Summary

Final Site Water Quality Volume Required = **1.58 ac-ft**

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #5

Contributory Project Area = **5.1 ac**

A. Land Use Table...

LAND USES	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
RESIDENTIAL AREAS	3.99	0.87	0.16	0.00	2.96	2.96	1.03
PAVEMENT / SIDEWALK / DRIVEWAYS	1.13	0.00	0.62	0.00	0.51	0.51	0.62
subtotals ===>	5.12	0.87	0.78	0.00	3.47	3.47	1.65
PERCENTAGE OF TOTAL	100.0%	16.9%	15.2%	0.0%	67.8%	67.8%	32.2%

Summary

Total Area = **5.12** **ac** **100.0%**

Total Pervious Site Area = **3.47** **ac** **67.8%**

Total Impervious Site Area = **1.65** **32.2%**

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

this formula computes the volume of the 1st inch of runoff

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

V1= A*[1/12]

V1 = 0.43 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'** **A' = A - [Roofs + Lakes]**

A' = 4.2

Impervious Area for computation [ac] = **A''** **A'' = A' - [Pervious Area]**

A'' = 0.8

% Impervious = **Imperv %** **Imperv % = A'' / A'**

Imperv % = 18.32%

Storage Volume [ac-ft] = **V2** **V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]**

V2 = 0.20 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = **0.43** **ac-ft**

Summary

Final Site Water Quality Volume Required = **0.43 ac-ft**

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #6

Contributory Project Area = **149.5 ac**

A. Land Use Table...

	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
WATER MANAGEMENT PONDS / LAKES	12.19	0.00	0.00	12.19	0.00	0.00	12.19
RESIDENTIAL AREAS	104.55	35.98	7.11	0.00	61.46	61.46	43.09
PAVEMENT / SIDEWALK / DRIVEWAYS	32.78	0.00	16.20	0.00	16.58	16.58	16.20
subtotals ===>	149.52	35.98	23.32	12.19	78.04	78.04	71.48
PERCENTAGE OF TOTAL	100.0%	24.1%	15.6%	8.2%	52.2%	52.2%	47.8%

Summary

Total Area = **149.52** **ac** **100.0%**

Total Pervious Site Area = **78.04** **ac** **52.2%**

Total Impervious Site Area = **71.48** **47.8%**

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

this formula computes the volume
of the 1st inch of runoff

V1= A*[1/12]

V1 = 12.46 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'** **A' = A - [Roofs + Lakes]**

A' = 101.4

Impervious Area for computation [ac] = **A''** **A'' = A' - [Pervious Area]**

A'' = 23.3

% Impervious = **Imperv %** **Imperv % = A'' / A'**

Imperv % = 23.01%

Storage Volume [ac-ft] = **V2** **V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]**

V2 = 6.58 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = **12.46** **ac-ft**

Summary

Final Site Water Quality Volume Required = **12.46 ac-ft** Note! Lake storage is not included

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #7

Contributory Project Area = **34.3 ac**

A. Land Use Table...

	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
RESIDENTIAL AREAS	26.46	8.19	1.91	0.00	16.35	16.35	10.10
PAVEMENT / SIDEWALK / DRIVEWAYS	7.88	0.00	3.57	0.00	4.32	4.32	3.57
subtotals ===>	34.34	8.19	5.48	0.00	20.67	20.67	13.67
PERCENTAGE OF TOTAL	100.0%	23.9%	16.0%	0.0%	60.2%	60.2%	39.8%

Summary

Total Area = 34.34 ac 100.0%

Total Pervious Site Area = 20.67 ac 60.2%

Total Impervious Site Area = 13.67 39.8%

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

this formula computes the volume
of the 1st inch of runoff

V1= A*[1/12]

V1 = 2.86 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'**

A' = 26.1

A' = A - [Roofs + Lakes]

Impervious Area for computation [ac] = **A"**

A" = 5.5

A" = A' - [Pervious Area]

% Impervious = **Imperv %**

Imperv % = 20.95%

Imperv % = A" / A'

Storage Volume [ac-ft] = **V2**

V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]

V2 = 1.50 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = 2.86 ac-ft

Summary

Final Site Water Quality Volume Required = 2.86 ac-ft

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS
Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #8

Contributory Project Area = 48.4 ac

A. Land Use Table...

	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
RESIDENTIAL AREAS	33.31	11.29	2.77	0.00	19.25	19.25	14.06
COMMERCIAL / INSTITUTIONAL AREAS	2.35	0.83	0.21	0.00	1.31	1.31	1.04
PAVEMENT / SIDEWALK / DRIVEWAYS	12.71	0.00	5.81	0.00	6.89	6.89	5.81
subtotals ===>	48.37	12.12	8.80	0.00	27.45	27.45	20.92
PERCENTAGE OF TOTAL	100.0%	25.1%	18.2%	0.0%	56.8%	56.8%	43.2%

Summary

Total Area = 48.37 ac 100.0%

Total Pervious Site Area = 27.45 ac 56.8%

Total Impervious Site Area = 20.92 43.2%

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

this formula computes the volume of the 1st inch of runoff

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

V1= A*[1/12]

V1 = 4.03 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'**

A' = A - [Roofs + Lakes]

A' = 36.2

Impervious Area for computation [ac] = **A''**

A'' = A' - [Pervious Area]

A'' = 8.8

% Impervious = **Imperv %**

Imperv % = A'' / A'

Imperv % = 24.27%

Storage Volume [ac-ft] = **V2**

V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]

V2 = 2.45 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = 4.03 ac-ft

Summary

Final Site Water Quality Volume Required = 4.03 ac-ft

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #9

Contributory Project Area = **9.5 ac**

A. Land Use Table...

LAND USES	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
RESIDENTIAL AREAS	7.82	2.50	0.35	0.00	4.98	4.98	2.84
PAVEMENT / SIDEWALK / DRIVEWAYS	1.68	0.00	0.89	0.00	0.80	0.80	0.89
subtotals ===>	9.51	2.50	1.23	0.00	5.78	5.78	3.73
PERCENTAGE OF TOTAL	100.0%	26.2%	13.0%	0.0%	60.8%	60.8%	39.2%

Summary

Total Area	=	**9.51**	**ac**	**100.0%**
Total Pervious Site Area	=	**5.78**	**ac**	**60.8%**
Total Impervious Site Area	=	**3.73**		**39.2%**

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

this formula computes the volume of the 1st inch of runoff

V1= A*[1/12]

V1 = 0.79 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'** **A' = A - [Roofs + Lakes]**

A' = 7.0

Impervious Area for computation [ac] = **A"** **A" = A' - [Pervious Area]**

A" = 1.2

% Impervious = **Imperv %** **Imperv % = A" / A'**

Imperv % = 17.60%

Storage Volume [ac-ft] = **V2** **V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]**

V2 = 0.35 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = **0.79** **ac-ft**

Summary

Final Site Water Quality Volume Required = **0.79 ac-ft**

CITY OF NAPLES ~ BASIN II / BEACH OUTFALLS

Gulfshore Engineering, Inc.

BASIN II ~ ESTIMATED WATER QUALITY SITE DATA COMPUTATIONS

Outfall #10

Contributory Project Area = **13.6 ac** This area includes the golf course

A. Land Use Table...

	LAND DESCRIPTION					WATER MANAGEMENT CLASSIFICATION	
LAND USES	AREA [ac]	BUILDINGS [ac]	PAVEMENT [ac]	LAKES / WET [ac]	GREEN [ac]	PERVIOUS	IMPERVIOUS
RESIDENTIAL AREAS	10.02	2.76	0.69	0.00	6.57	6.57	3.45
PAVEMENT / SIDEWALK / DRIVEWAYS	3.55	0.00	1.84	0.00	1.72	1.72	1.84
subtotals ===>	13.57	2.76	2.53	0.00	8.29	8.29	5.28
PERCENTAGE OF TOTAL	100.0%	20.3%	18.6%	0.0%	61.1%	61.1%	38.9%

Summary

Total Area = **13.57** **ac** **100.0%**

Total Pervious Site Area = **8.29** **ac** **61.1%**

Total Impervious Site Area = **5.28** **38.9%**

B. Water Quality Computation...

1. Using "First Inch" Water Storage computation

Definitions and Equations....

Storage Volume [ac-ft] = **V1**

Site area [ac] = **A**

this formula computes the volume of the 1st inch of runoff

V1= A*[1/12]

V1 = 1.13 ac-ft

2. Using "2.5 Inches X % impervious" Water Storage computation

Definitions and Equations....

Site area for computation [ac] = **A'** **A' = A - [Roofs + Lakes]**

A' = 10.8

Impervious Area for computation [ac] = **A''** **A'' = A' - [Pervious Area]**

A'' = 2.5

% Impervious = **Imperv %** **Imperv % = A'' / A'**

Imperv % = 23.36%

Storage Volume [ac-ft] = **V2** **V2 = [2.5" x Imperv%] x [A - Lakes] x [1/12]**

V2 = 0.66 ac-ft

Computed Water Quality Storage Volume (largest criteria controls) = **1.13** **ac-ft**

Summary

Final Site Water Quality Volume Required = **1.13 ac-ft**

Appendix C:
Existing Conditions Urban Runoff Analysis (each outfall)

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

EXISTING CONDITIONS URBAN RUNOFF ANALYSIS

PREPARED FOR:
COLLIER COUNTY

PREPARED BY:

GULFSHORE ENGINEERING, INC.

GULFSHORE ENGINEERING, INC.
2375 TAMIAMI TRAIL NORTH, SUITE 207
NAPLES, FLA. 34103

DATE:
February-10

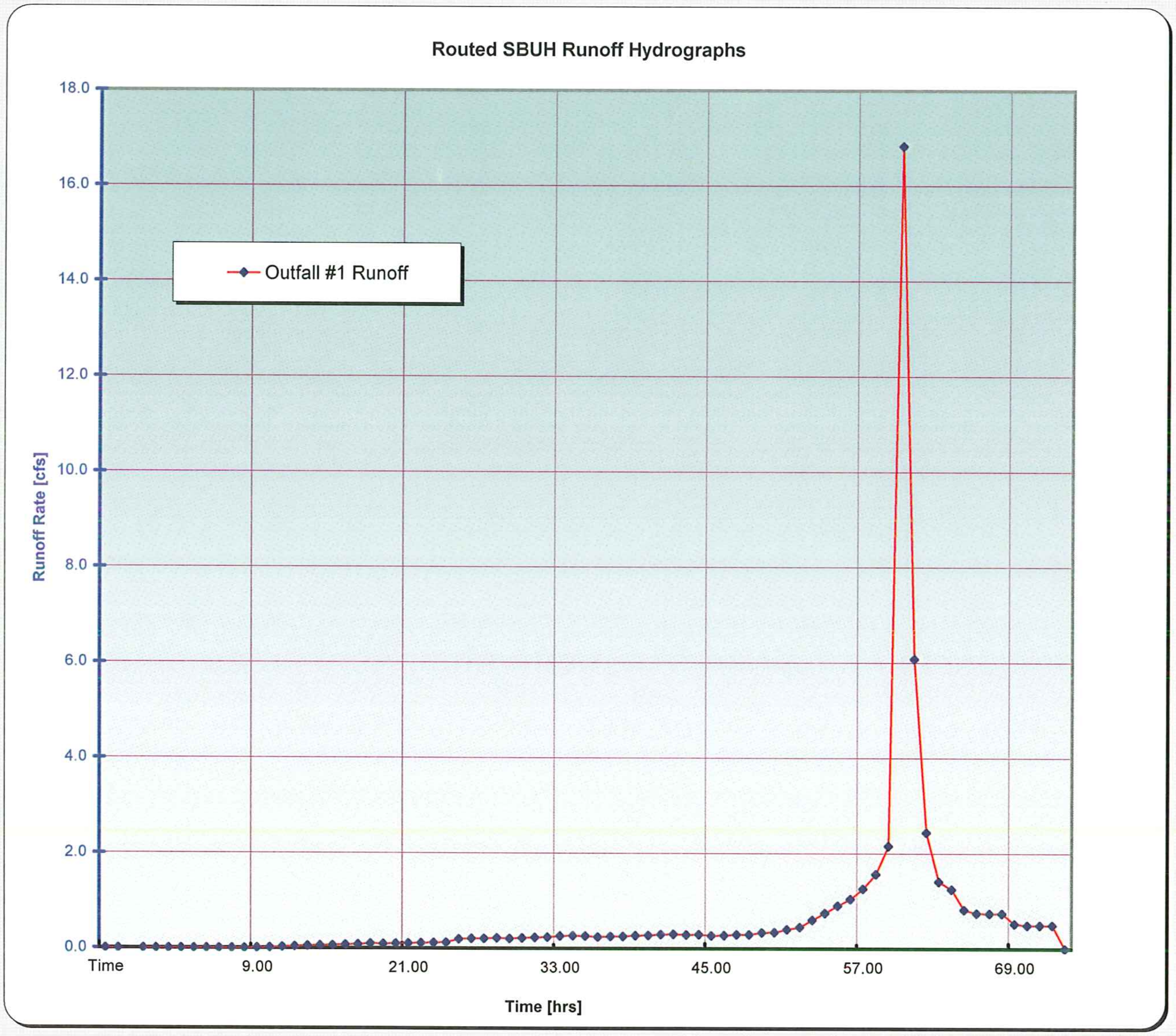
GEI PN: 305

Beach Outfall No.1 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

Peak Outflow :	16.8 cfs ==>	3.31	cfs / ac
Total contributing area :	5.1 ac		
25yr/3 Day Runoff :	3.8 ac-ft		

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

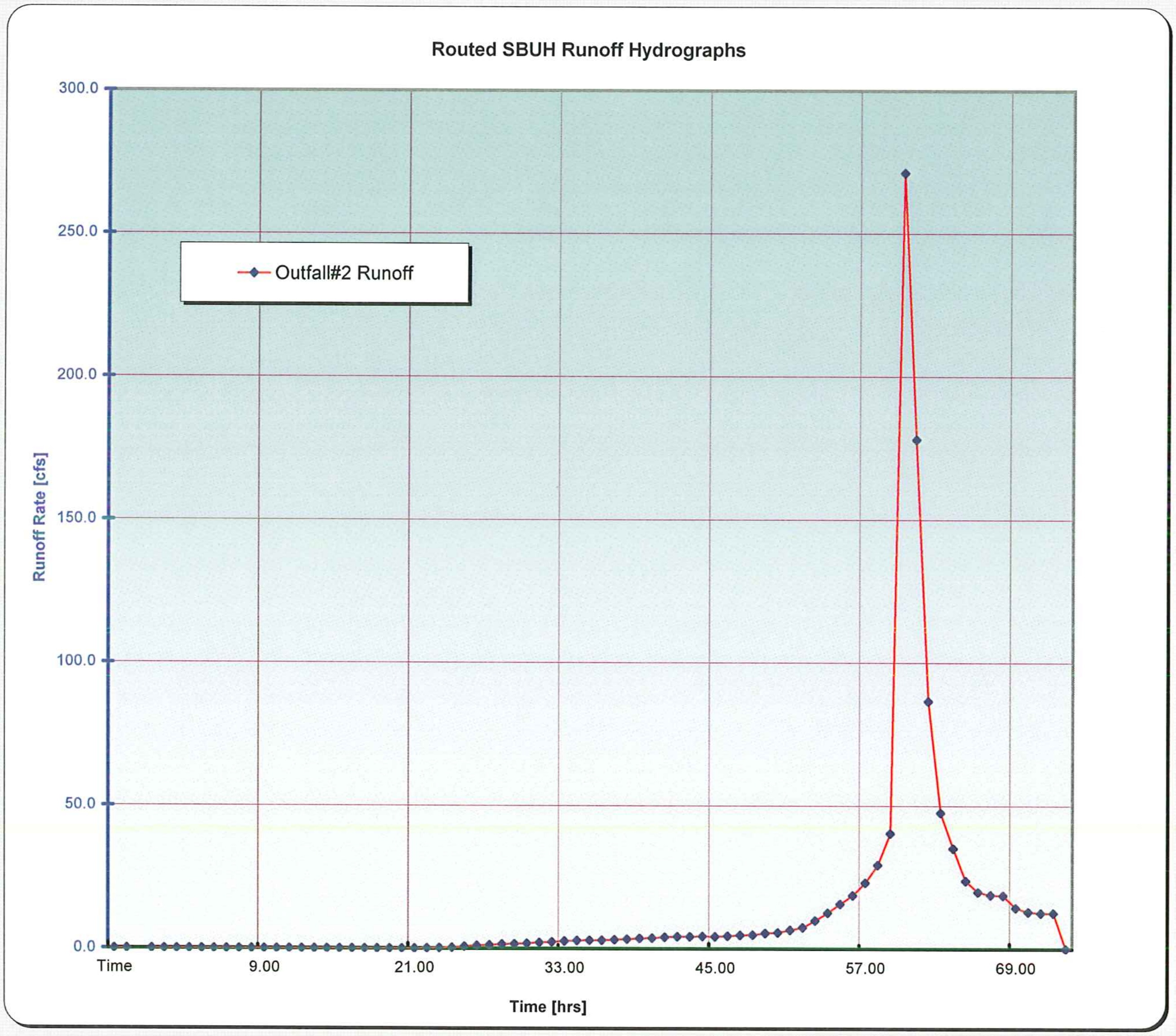
Gulfshore Engineering, Inc.

Beach Outfall No.2 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

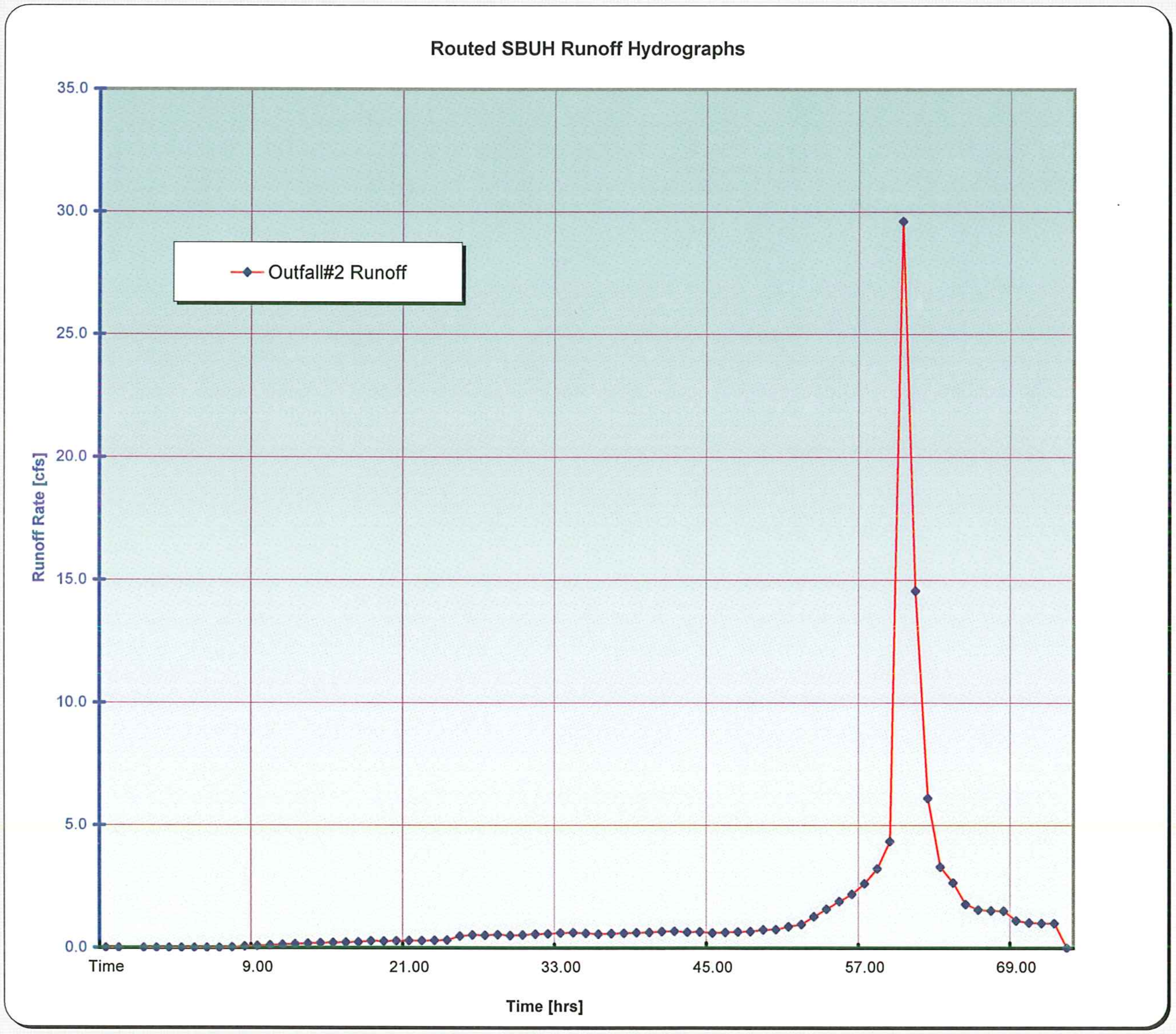
Peak Outflow :	**304.7 cfs ==>**	**2.16**	**cfs / ac**
Total contributing area :	**141.3 ac**		
25yr/3 Day Runoff :	**79.5 ac-ft**		

Beach Outfall No.3 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

Peak Outflow :	**31.2 cfs ==>**	**3.04**	**cfs / ac**
Total contributing area :	**10.3 ac**		
25yr/3 Day Runoff :	**8.3 ac-ft**		

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

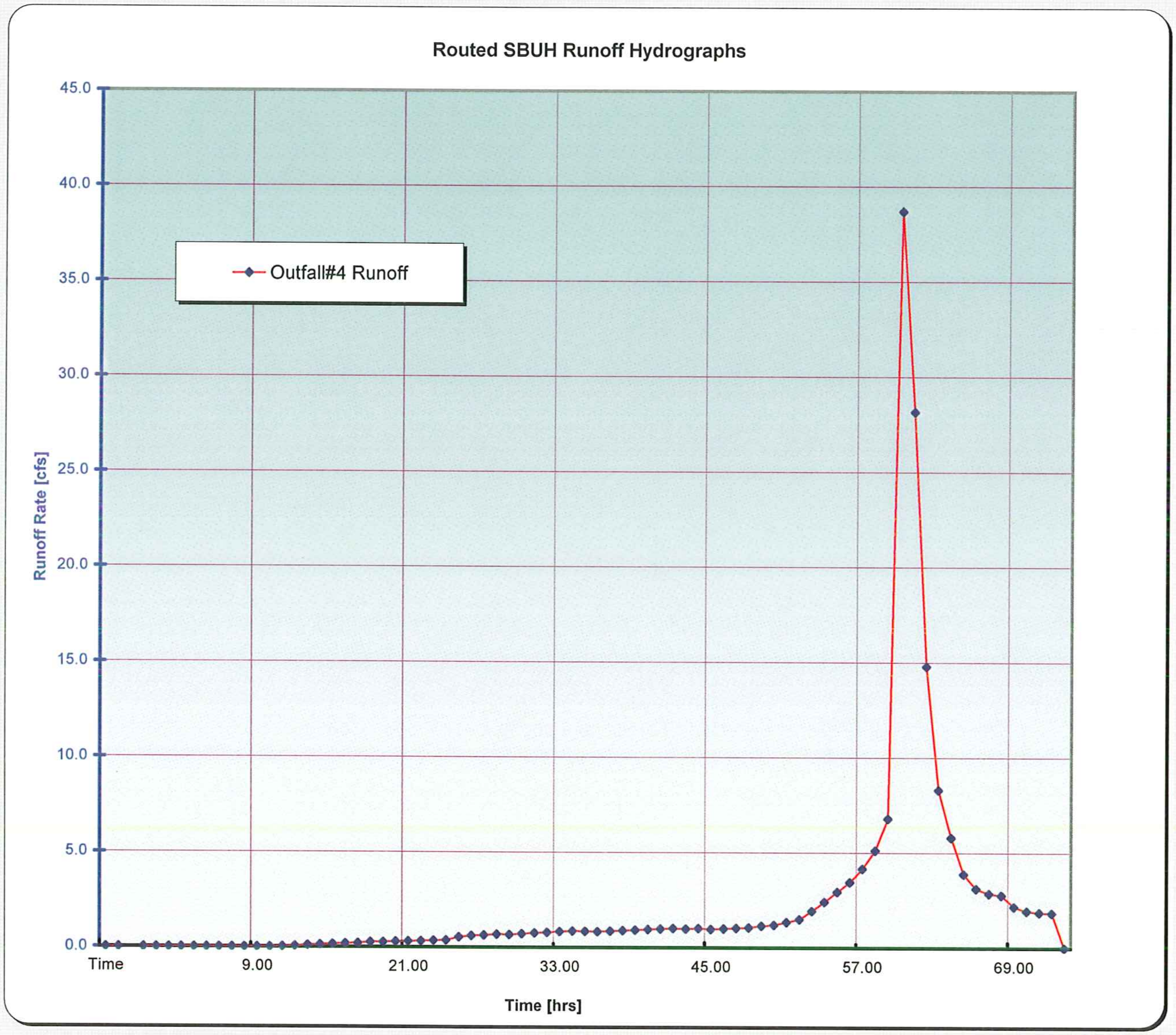
Gulfshore Engineering, Inc.

Beach Outfall No.4 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

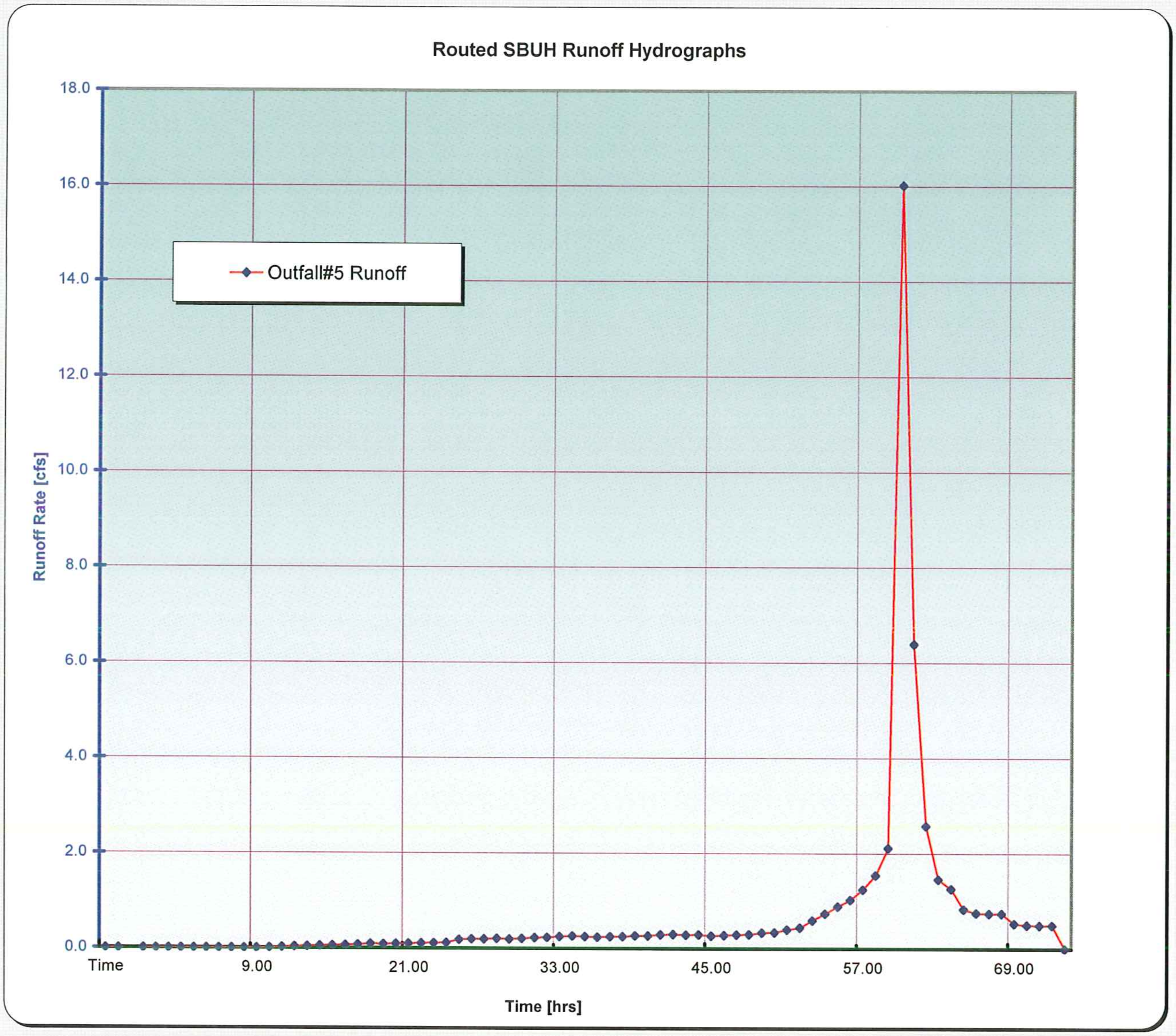
Peak Outflow :	**43.9 cfs ==>**	**2.32**	**cfs / ac**
Total contributing area :	**18.9 ac**		
25yr/3 Day Runoff :	**13.8 ac-ft**		

Beach Outfall No.5 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

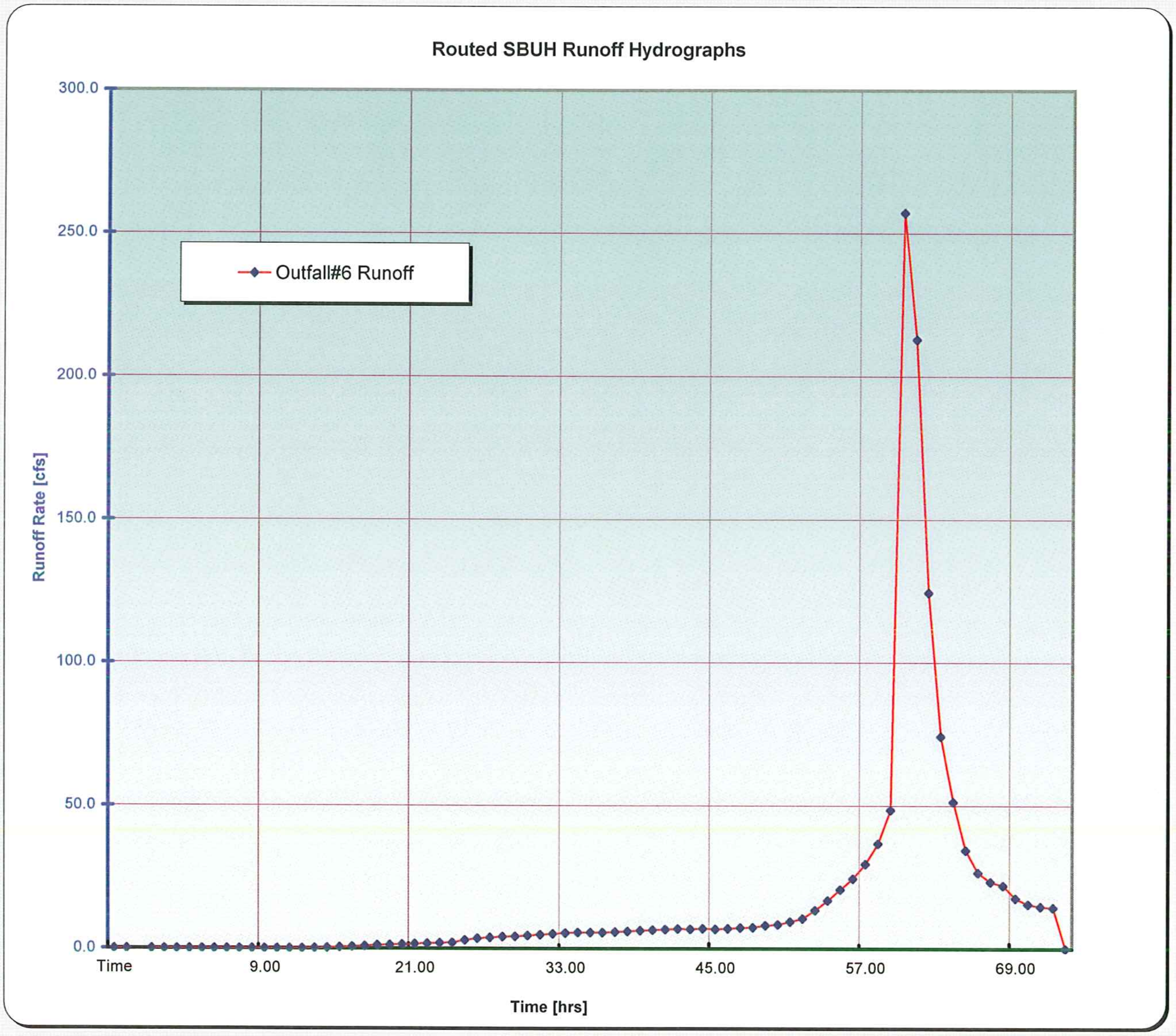
Peak Outflow :	**16.2 cfs ==>**	**3.17**	**cfs / ac**
Total contributing area :	**5.1 ac**		
25yr/3 Day Runoff :	**3.8 ac-ft**		

Beach Outfall No.6 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

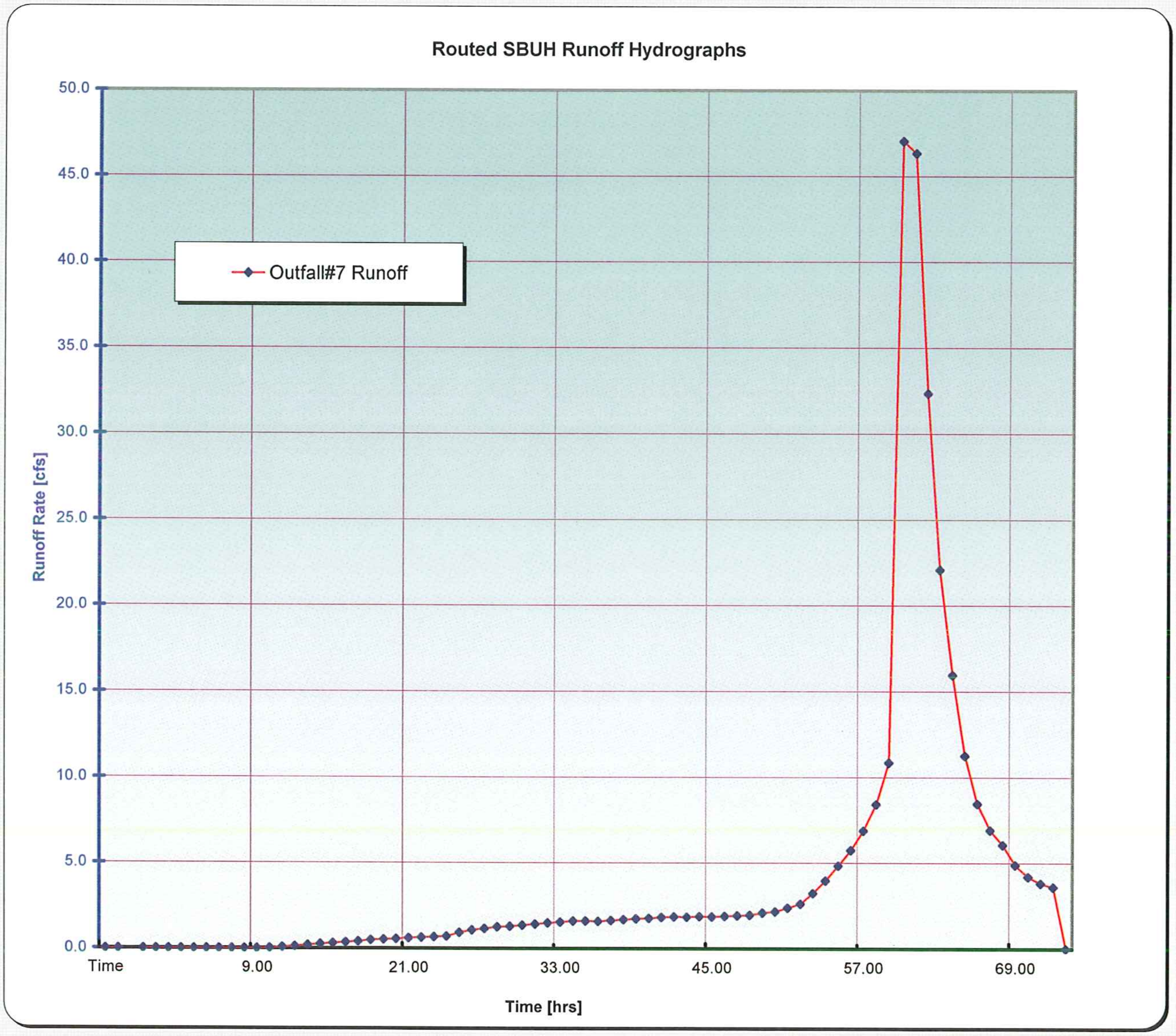
Peak Outflow :	**298.1 cfs ==>**	**1.99**	**cfs / ac**
Total contributing area :	**149.5 ac**		
25yr/3 Day Runoff :	**102.6 ac-ft**		

Beach Outfall No.7 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

Peak Outflow :	**55.7 cfs ==>**	**1.62**	**cfs / ac**
Total contributing area :	**34.3 ac**		
25yr/3 Day Runoff :	**25.6 ac-ft**		

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

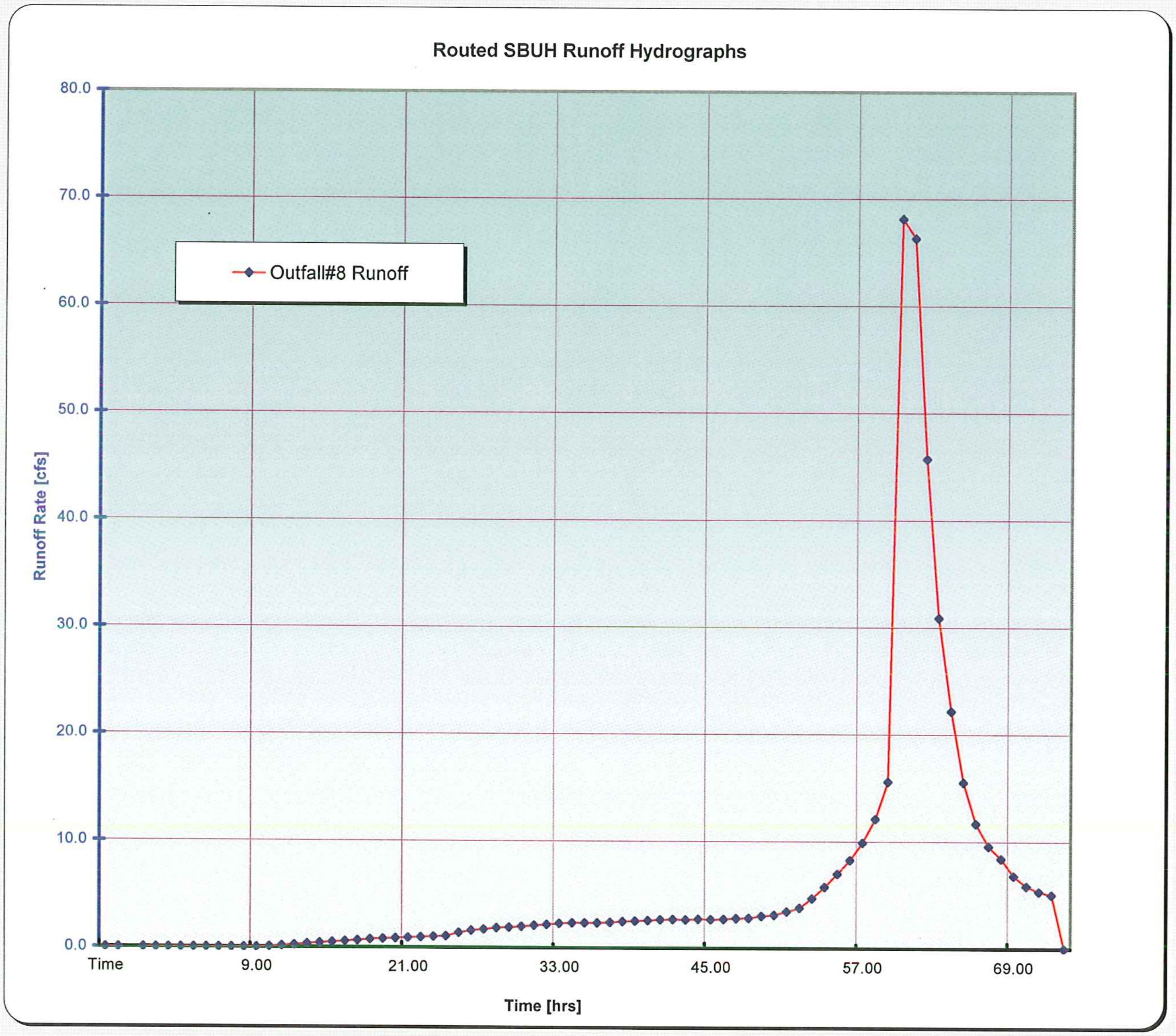
Gulfshore Engineering, Inc.

Beach Outfall No.8 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

Peak Outflow :	**80.6 cfs ==>**	**1.67**	**cfs / ac**
Total contributing area :	**48.4 ac**		
25yr/3 Day Runoff :	**36.5 ac-ft**		

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

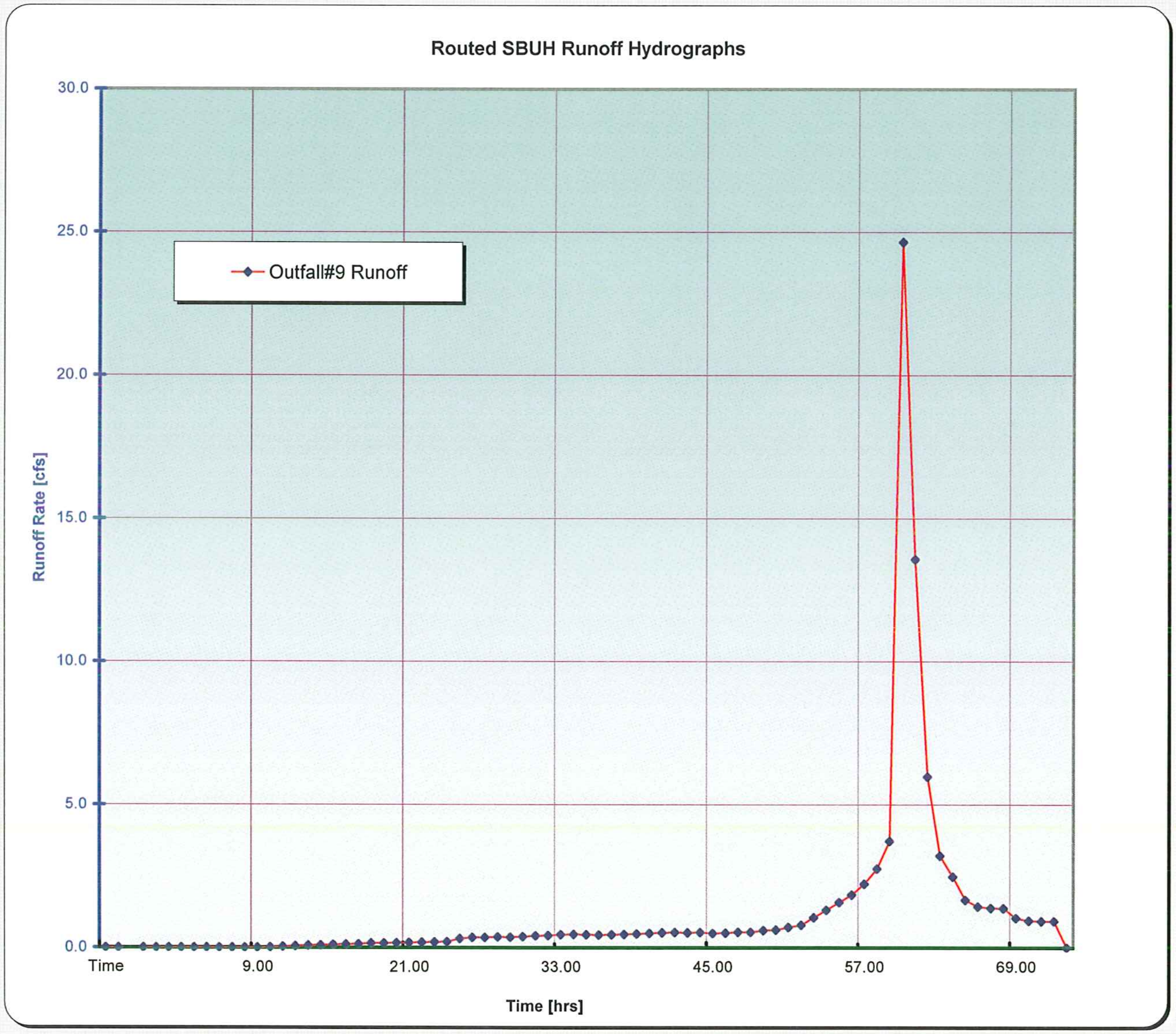
Gulfshore Engineering, Inc.

Beach Outfall No.9 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

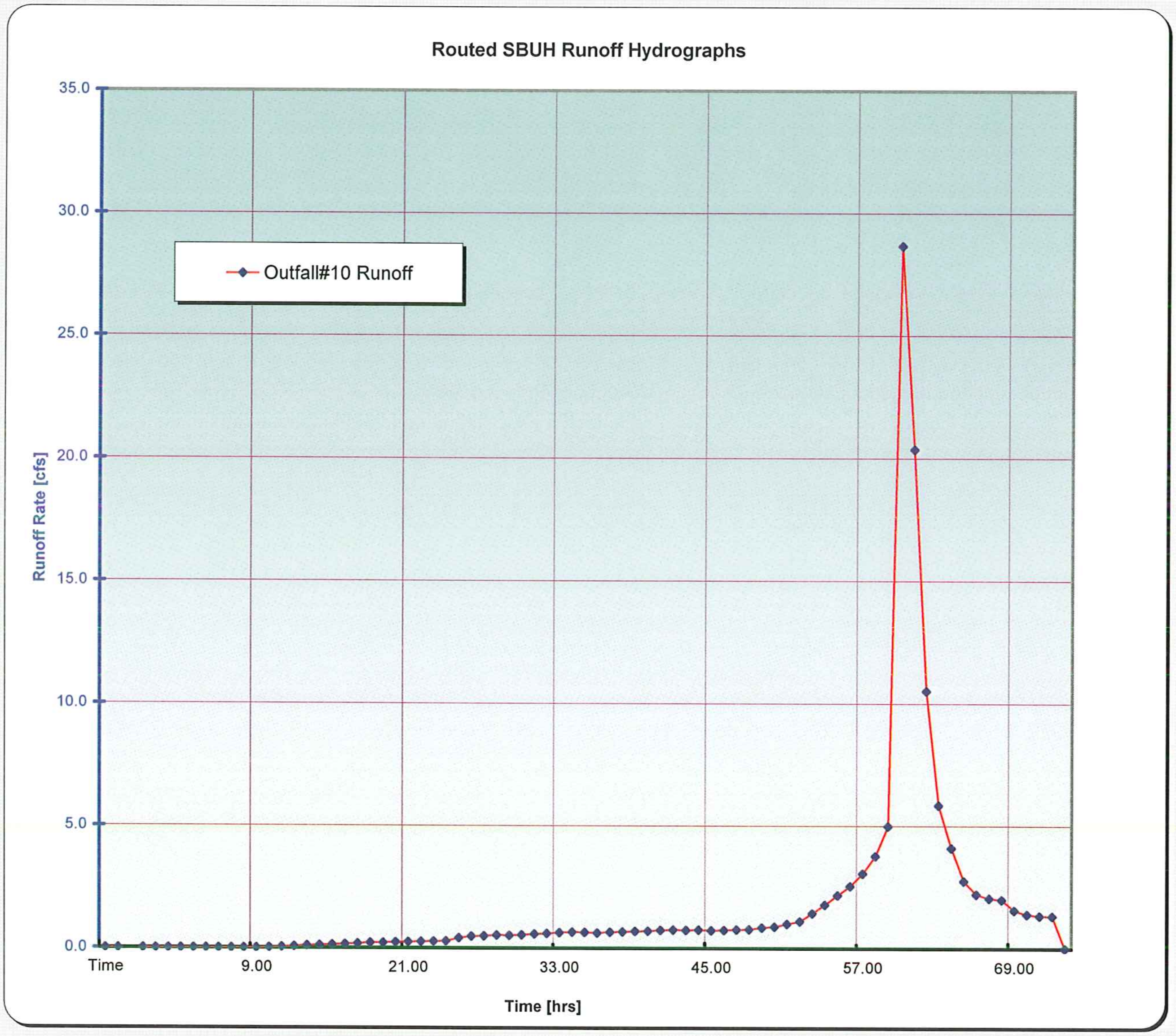
Peak Outflow :	**26.6 cfs ==>**	**2.80**	**cfs / ac**
Total contributing area :	**9.5 ac**		
25yr/3 Day Runoff :	**7.1 ac-ft**		

Beach Outfall No.10 ~ Runoff under Existing Conditions

SUMMARY PAGE

25YR / 3 DAY STORM EVENT

Estimated Flows have been routed to generate runoff hydrograph
Expected peak flowrate is established from hydrograph shown below.



Contributing Sub-Area Runoff Summary

Peak Outflow : 32.3 cfs ==> 2.38 cfs / ac

Total contributing area : 13.6 ac
25yr/3 Day Runoff : 10.1 ac-ft

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #1

Total Basin Area [A] = **5.09** **ac**

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	0.00	0%	0	0.00	
BUILDINGS/ROOFS	0.95	19%	98	93.10	
PAVEMENT / ROADWAY	0.92	18%	98	90.2	
OPEN SPACE AREA	3.22	63%	80	257.6	⇩
Total ===>	5.09			440.9	**86.6**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 1.55 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 20%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 0.21 ==> 0.51 inches

Final Computed Soil Storage [S] = **2.05** **inches**

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.23

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number [**CN**] = 86.6

Computed Site Storage (**S**) = 1.55 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL =** $\dfrac{L^{0.8}*(S+1)^{0.7}}{1900 * Sb^{0.5}}$

b) Watershed Lag Time

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time [**TL**] = 0.28 Hrs

Estimated Time of Concentration [**Tc**] = 0.48 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc =** $\dfrac{0.007*(n*L)^{0.8}}{(P2)^{0.5}*Sb^{0.4}}$

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County [**P2**} = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration [**Tc**] = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.25 Hrs ==> 15 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved	1	**V = 16.1345*Sb^0.5**
Paved	2	**V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #1

Select Surface ==> 2

Estimated Segment Travel Distance [**L**] = 100 Ft
Estimated Flowpath Slope [**Sb**] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft
Estimated Flow Velocity [**V**] = 0.64 ft/sec

Time of Concentration for this segment [Tc] = 0.04 Hrs ==> 3 mins

Estimated Tc for both segments = 0.29 Hrs ==> 17 mins
Final Tc adjust + 50% for additional surface ponding & storage = 0.43 Hrs ==> 26 mins

D. Santa Barbara Hydrograph Procedure…

Estimated Basin Time of Concentration = **0.43** **Hrs**

Using SFWMD Mass Distribution Input …
Storm Frequency = **25** YR
Duration = **72** HR

Summary of Results
Maximum Discharge = 16.83 cfs
Time Elapsed = 60.00 Hr

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE	Instant.	Outfall #1
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]	Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.01	0.01	0.00
10.00	0.061	0.50	0.00	0.00	0.00	0.03	0.03	0.01
11.00	0.067	0.55	0.01	0.00	0.00	0.04	0.04	0.03
12.00	0.073	0.60	0.02	0.01	0.00	0.05	0.05	0.04
13.00	0.079	0.65	0.03	0.01	0.00	0.03	0.03	0.05
14.00	0.085	0.70	0.04	0.02	0.00	0.04	0.04	0.05
15.00	0.091	0.75	0.05	0.02	0.00	0.04	0.04	0.06
16.00	0.097	0.80	0.06	0.03	0.00	0.05	0.05	0.07
17.00	0.103	0.85	0.08	0.03	0.00	0.05	0.05	0.08
18.00	0.110	0.91	0.10	0.04	0.00	0.12	0.12	0.10
19.00	0.116	0.96	0.11	0.05	0.00	0.13	0.13	0.09
20.00	0.122	1.01	0.13	0.06	0.00	0.13	0.13	0.10
21.00	0.128	1.05	0.15	0.07	0.00	0.14	0.14	0.10
22.00	0.134	1.10	0.18	0.07	0.00	0.15	0.15	0.11
23.00	0.140	1.15	0.20	0.08	0.00	0.15	0.15	0.11
24.00	0.146	1.20	0.22	0.09	0.00	0.16	0.16	0.12
25.00	0.155	1.28	0.26	0.11	0.00	0.17	0.17	0.19
26.00	0.164	1.35	0.30	0.13	0.00	0.18	0.18	0.21
27.00	0.173	1.43	0.34	0.14	0.01	0.28	0.28	0.21
28.00	0.182	1.50	0.38	0.16	0.01	0.29	0.29	0.22
29.00	0.190	1.57	0.42	0.18	0.00	0.20	0.20	0.20
30.00	0.199	1.64	0.46	0.20	0.00	0.21	0.21	0.21
31.00	0.208	1.71	0.51	0.21	0.00	0.21	0.21	0.23
32.00	0.217	1.79	0.55	0.23	0.00	0.22	0.22	0.24
33.00	0.226	1.86	0.60	0.26	0.00	0.22	0.22	0.26

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #1

34.00	0.235	1.94	0.65	0.28	0.00	0.23	0.23	0.27
35.00	0.244	2.01	0.70	0.30	0.01	0.35	0.35	0.26
36.00	0.252	2.08	0.75	0.32	0.00	0.23	0.23	0.24
37.00	0.261	2.15	0.80	0.34	0.00	0.24	0.24	0.25
38.00	0.270	2.22	0.85	0.36	0.01	0.24	0.24	0.25
39.00	0.279	2.30	0.91	0.38	0.01	0.25	0.25	0.27
40.00	0.288	2.37	0.96	0.41	0.01	0.25	0.25	0.27
41.00	0.297	2.45	1.01	0.43	0.01	0.25	0.25	0.30
42.00	0.306	2.52	1.07	0.45	0.01	0.26	0.26	0.30
43.00	0.315	2.60	1.13	0.48	0.01	0.39	0.39	0.29
44.00	0.324	2.67	1.18	0.50	0.01	0.39	0.39	0.30
45.00	0.332	2.74	1.24	0.52	0.01	0.26	0.26	0.27
46.00	0.341	2.81	1.29	0.55	0.01	0.27	0.27	0.28
47.00	0.350	2.88	1.35	0.57	0.01	0.27	0.27	0.29
48.00	0.359	2.96	1.41	0.60	0.01	0.27	0.27	0.30
49.00	0.369	3.04	1.48	0.63	0.01	0.27	0.27	0.34
50.00	0.379	3.12	1.54	0.66	0.01	0.28	0.28	0.34
51.00	0.391	3.22	1.63	0.69	0.01	0.42	0.42	0.40
52.00	0.404	3.33	1.71	0.73	0.01	0.56	0.56	0.45
53.00	0.421	3.47	1.83	0.78	0.01	0.57	0.57	0.60
54.00	0.442	3.64	1.98	0.84	0.01	0.72	0.72	0.75
55.00	0.467	3.85	2.15	0.91	0.02	0.87	0.87	0.90
56.00	0.496	4.09	2.36	1.00	0.02	1.18	1.18	1.04
57.00	0.530	4.37	2.61	1.11	0.03	1.34	1.34	1.26
58.00	0.572	4.71	2.91	1.24	0.03	1.66	1.66	1.56
59.00	0.628	5.17	3.33	1.41	0.05	2.46	2.46	2.15
60.00	1.015	8.36	6.32	2.68	0.56	27.03	27.03	16.83
61.00	1.126	9.28	7.20	3.05	0.06	3.10	3.10	6.08
62.00	1.177	9.70	7.61	3.23	0.04	1.80	1.80	2.44
63.00	1.209	9.96	7.86	3.34	0.02	1.15	1.15	1.41
64.00	1.239	10.21	8.10	3.44	0.02	1.15	1.15	1.25
65.00	1.257	10.36	8.25	3.50	0.01	0.66	0.66	0.82
66.00	1.275	10.51	8.39	3.56	0.01	0.66	0.66	0.75
67.00	1.293	10.65	8.53	3.62	0.01	0.66	0.66	0.74
68.00	1.311	10.80	8.68	3.68	0.01	0.66	0.66	0.74
69.00	1.323	10.90	8.78	3.72	0.01	0.49	0.49	0.52
70.00	1.335	11.00	8.87	3.76	0.01	0.49	0.49	0.50
71.00	1.347	11.10	8.97	3.80	0.01	0.49	0.49	0.49
72.00	1.359	11.20	9.06	3.84	0.01	0.49	0.49	0.49

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #2

Total Basin Area [A] = **141.3** **ac** *Note: includes Golf Course area*

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	11.80	8%	0	0.00	
BUILDINGS/ROOFS	5.26	4%	98	515.48	
PAVEMENT / ROADWAY	11.98	8%	98	1174.0	
OPEN SPACE AREA	112.21	79%	80	8976.8	
Total ===>	141.25			10666.3	**75.5**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 3.24 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 40%

Estimated Average storage Depth [ins] = 6

Computed Vol.[ac-ft] = 22.44 ==> 1.91 inches

Final Computed Soil Storage [S] = 5.15 inches *Note! Lake storage is not included*

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.14

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number [**CN**] = 75.5

Computed Site Storage (**S**) = 3.24 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL =** $\frac{L^{0.8}*(S+1)^{0.7}}{1900 * Sb^{0.5}}$

b) Watershed Lag Time

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time [**TL**] = 0.41 Hrs

Estimated Time of Concentration [**Tc**] = 0.68 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc =** $\frac{0.007*(n*L)^{0.8}}{(P2)^{0.5}*Sb^{0.4}}$

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County [**P2**} = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration [**Tc**] = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.35 Hrs ==> 21 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved	1	**V = 16.1345*Sb^0.5**
Paved	2	**V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #2

Select Surface ==> 1

Estimated Segment Travel Distance [**L**] = 300 Ft

Estimated Flowpath Slope [**Sb**] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft

Estimated Flow Velocity [**V**] = 0.51 ft/sec

Time of Concentration for this segment [Tc] = 0.16 Hrs ==> 10 mins

Estimated Tc for both segments = 0.51 Hrs ==> 31 mins

Final Tc adjust + 50% for additional surface ponding & storage = 0.77 Hrs ==> 46 mins

D. Santa Barbara Hydrograph Procedure…

Estimated Basin Time of Concentration = **0.77** **Hrs**

Using SFWMD Mass Distribution Input …

Storm Frequency = **25** YR

Duration = **72** HR

Summary of Results

Maximum Discharge = 304.7 cfs

Time Elapsed = 60.25 Hr

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE		Instant.	Outfall#2
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]		Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00		0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00		0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00		0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00		0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00		0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00		0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00		0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00		0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00		0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.00		0.00	0.00
10.00	0.061	0.50	0.00	0.00	0.00	0.00		0.00	0.00
11.00	0.067	0.55	0.00	0.00	0.00	0.00		0.00	0.00
12.00	0.073	0.60	0.00	0.00	0.00	0.00		0.00	0.00
13.00	0.079	0.65	0.00	0.00	0.00	0.00		0.00	0.00
14.00	0.085	0.70	0.00	0.00	0.00	0.00		0.00	0.00
15.00	0.091	0.75	0.00	0.00	0.00	0.00		0.00	0.00
16.00	0.097	0.80	0.00	0.00	0.00	0.00		0.00	0.00
17.00	0.103	0.85	0.00	0.00	0.00	0.00		0.00	0.00
18.00	0.110	0.91	0.00	0.00	0.00	0.00		0.00	0.00
19.00	0.116	0.96	0.00	0.00	0.00	0.00		0.00	0.00
20.00	0.122	1.01	0.00	0.00	0.00	0.00		0.00	0.00
21.00	0.128	1.05	0.00	0.00	0.00	0.06		0.06	0.01
22.00	0.134	1.10	0.00	0.01	0.00	0.24		0.24	0.09
23.00	0.140	1.15	0.00	0.03	0.01	0.41		0.41	0.21
24.00	0.146	1.20	0.01	0.07	0.01	0.57		0.57	0.34
25.00	0.155	1.28	0.01	0.13	0.02	0.81		0.81	0.70
26.00	0.164	1.35	0.02	0.22	0.02	1.05		1.05	1.00
27.00	0.173	1.43	0.03	0.33	0.04	1.88		1.88	1.21
28.00	0.182	1.50	0.04	0.46	0.05	2.20		2.20	1.47
29.00	0.190	1.57	0.05	0.59	0.03	1.66		1.66	1.60
30.00	0.199	1.64	0.06	0.76	0.04	1.86		1.86	1.84
31.00	0.208	1.71	0.08	0.94	0.04	2.05		2.05	2.11
32.00	0.217	1.79	0.10	1.15	0.05	2.24		2.24	2.33
33.00	0.226	1.86	0.12	1.36	0.05	2.41		2.41	2.62

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #2

34.00	0.235	1.94	0.14	1.60	0.05	2.58	2.58	2.84
35.00	0.244	2.01	0.16	1.85	0.08	4.11	4.11	2.91
36.00	0.252	2.08	0.18	2.08	0.06	2.89	2.89	2.92
37.00	0.261	2.15	0.20	2.36	0.06	3.04	3.04	3.15
38.00	0.270	2.22	0.23	2.65	0.07	3.19	3.19	3.33
39.00	0.279	2.30	0.25	2.95	0.07	3.33	3.33	3.57
40.00	0.288	2.37	0.28	3.27	0.07	3.47	3.47	3.75
41.00	0.297	2.45	0.31	3.60	0.07	3.60	3.60	4.03
42.00	0.306	2.52	0.34	3.94	0.08	3.73	3.73	4.21
43.00	0.315	2.60	0.37	4.30	0.12	5.77	5.77	4.18
44.00	0.324	2.67	0.40	4.66	0.12	5.95	5.95	4.37
45.00	0.332	2.74	0.42	5.00	0.08	4.08	4.08	4.23
46.00	0.341	2.81	0.46	5.38	0.09	4.19	4.19	4.43
47.00	0.350	2.88	0.49	5.78	0.09	4.30	4.30	4.67
48.00	0.359	2.96	0.53	6.18	0.09	4.41	4.41	4.83
49.00	0.369	3.04	0.56	6.65	0.09	4.52	4.52	5.39
50.00	0.379	3.12	0.60	7.12	0.10	4.63	4.63	5.64
51.00	0.391	3.22	0.65	7.70	0.15	7.13	7.13	6.55
52.00	0.404	3.33	0.71	8.35	0.20	9.76	9.76	7.40
53.00	0.421	3.47	0.78	9.23	0.21	10.09	10.09	9.87
54.00	0.442	3.64	0.88	10.35	0.27	13.09	13.09	12.57
55.00	0.467	3.85	1.00	11.73	0.34	16.33	16.33	15.64
56.00	0.496	4.09	1.14	13.41	0.47	22.65	22.65	18.72
57.00	0.530	4.37	1.31	15.45	0.55	26.56	26.56	23.12
58.00	0.572	4.71	1.54	18.08	0.70	33.91	33.91	29.36
59.00	0.628	5.17	1.85	21.76	1.07	51.72	51.72	40.40
60.00	1.015	8.36	4.31	50.72	13.18	637.73	637.73	271.13
61.00	1.126	9.28	5.08	59.78	1.57	75.86	75.86	177.93
62.00	1.177	9.70	5.44	64.01	0.92	44.42	44.42	86.53
63.00	1.209	9.96	5.67	66.69	0.59	28.45	28.45	47.60
64.00	1.239	10.21	5.88	69.22	0.59	28.60	28.60	35.17
65.00	1.257	10.36	6.01	70.74	0.34	16.40	16.40	23.78
66.00	1.275	10.51	6.14	72.27	0.34	16.44	16.44	19.91
67.00	1.293	10.65	6.27	73.80	0.34	16.49	16.49	18.90
68.00	1.311	10.80	6.40	75.34	0.34	16.54	16.54	18.67
69.00	1.323	10.90	6.49	76.36	0.26	12.43	12.43	14.32
70.00	1.335	11.00	6.57	77.39	0.26	12.45	12.45	12.95
71.00	1.347	11.10	6.66	78.42	0.26	12.47	12.47	12.59
72.00	1.359	11.20	6.75	79.45	0.26	12.49	12.49	12.51

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #3

Total Basin Area [A] = **10.3** **ac**

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	0.00	0%	0	0.00	
BUILDINGS/ROOFS	1.83	18%	98	179.34	
PAVEMENT / ROADWAY	4.00	39%	98	392.0	
OPEN SPACE AREA	4.44	43%	80	355.2	⇩
Total ===>	10.27			926.5	**90.2**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 1.08 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 20%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 0.30 ==> 0.35 inches

Final Computed Soil Storage [S] = **1.43** **inches**

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.18

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number **[CN]** = 90.2

Computed Site Storage **(S)** = 1.08 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL = L^0.8*(S +1)^0.7 / 1900 * Sb^0.5**

b) Watershed Lag Time

Estimated Segment Travel Distance **[L]** = 100 Ft

Estimated Flowpath Slope **[Sb]** = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time **[TL]** = 0.25 Hrs

Estimated Time of Concentration **[Tc]** = 0.41 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc = 0.007*(n*L)^0.8 / (P2)^0.5*Sb^0.4**

Estimated Segment Travel Distance **[L]** = 100 Ft

Estimated Flowpath Slope **[Sb]** = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County **[P2}** = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration **[Tc]** = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.21 Hrs ==> 13 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved 1 **V = 16.1345*Sb^0.5**

Paved 2 **V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #3

Select Surface ==> 2

Estimated Segment Travel Distance [**L**] = 400 Ft
Estimated Flowpath Slope [**Sb**] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft
Estimated Flow Velocity [**V**] = 0.64 ft/sec

Time of Concentration for this segment [Tc] = 0.17 Hrs ==> 10 mins

Estimated Tc for both segments = 0.39 Hrs ==> 23 mins
Final Tc adjust + 50% for additional surface ponding & storage = 0.58 Hrs ==> 35 mins

D. Santa Barbara Hydrograph Procedure...

Estimated Basin Time of Concentration = **0.58** **Hrs**

Using SFWMD Mass Distribution Input ...
Storm Frequency = **25** YR
Duration = **72** HR

Summary of Results
Maximum Discharge = 31.2 cfs
Time Elapsed = 60.25 Hr

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE	Instant.	Outfall#3
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]	Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.05	0.05	0.02
8.00	0.049	0.40	0.01	0.01	0.00	0.09	0.09	0.05
9.00	0.055	0.45	0.02	0.01	0.00	0.13	0.13	0.08
10.00	0.061	0.50	0.03	0.02	0.00	0.16	0.16	0.11
11.00	0.067	0.55	0.04	0.04	0.00	0.19	0.19	0.13
12.00	0.073	0.60	0.06	0.05	0.00	0.22	0.22	0.15
13.00	0.079	0.65	0.07	0.06	0.00	0.12	0.12	0.18
14.00	0.085	0.70	0.09	0.08	0.00	0.14	0.14	0.19
15.00	0.091	0.75	0.11	0.10	0.00	0.15	0.15	0.21
16.00	0.097	0.80	0.14	0.12	0.00	0.16	0.16	0.22
17.00	0.103	0.85	0.16	0.14	0.00	0.16	0.16	0.24
18.00	0.110	0.91	0.19	0.16	0.01	0.35	0.35	0.28
19.00	0.116	0.96	0.21	0.18	0.01	0.36	0.36	0.27
20.00	0.122	1.01	0.24	0.21	0.01	0.38	0.38	0.28
21.00	0.128	1.05	0.27	0.23	0.01	0.39	0.39	0.29
22.00	0.134	1.10	0.30	0.25	0.01	0.40	0.40	0.30
23.00	0.140	1.15	0.33	0.28	0.01	0.42	0.42	0.31
24.00	0.146	1.20	0.36	0.31	0.01	0.43	0.43	0.32
25.00	0.155	1.28	0.41	0.35	0.01	0.44	0.44	0.48
26.00	0.164	1.35	0.45	0.39	0.01	0.46	0.46	0.52
27.00	0.173	1.43	0.51	0.43	0.01	0.70	0.70	0.52
28.00	0.182	1.50	0.56	0.48	0.01	0.72	0.72	0.54
29.00	0.190	1.57	0.60	0.52	0.01	0.49	0.49	0.51
30.00	0.199	1.64	0.66	0.56	0.01	0.50	0.50	0.53
31.00	0.208	1.71	0.71	0.61	0.01	0.51	0.51	0.56
32.00	0.217	1.79	0.77	0.66	0.01	0.52	0.52	0.57
33.00	0.226	1.86	0.83	0.71	0.01	0.53	0.53	0.61

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #3

34.00	0.235	1.94	0.88	0.76	0.01	0.53	0.53	0.62
35.00	0.244	2.01	0.94	0.81	0.02	0.81	0.81	0.60
36.00	0.252	2.08	1.00	0.85	0.01	0.55	0.55	0.57
37.00	0.261	2.15	1.06	0.90	0.01	0.55	0.55	0.59
38.00	0.270	2.22	1.12	0.95	0.01	0.56	0.56	0.60
39.00	0.279	2.30	1.18	1.01	0.01	0.56	0.56	0.62
40.00	0.288	2.37	1.24	1.06	0.01	0.57	0.57	0.63
41.00	0.297	2.45	1.30	1.11	0.01	0.57	0.57	0.67
42.00	0.306	2.52	1.36	1.17	0.01	0.58	0.58	0.68
43.00	0.315	2.60	1.43	1.22	0.02	0.87	0.87	0.65
44.00	0.324	2.67	1.49	1.28	0.02	0.88	0.88	0.66
45.00	0.332	2.74	1.55	1.32	0.01	0.59	0.59	0.61
46.00	0.341	2.81	1.61	1.38	0.01	0.59	0.59	0.63
47.00	0.350	2.88	1.68	1.43	0.01	0.60	0.60	0.66
48.00	0.359	2.96	1.74	1.49	0.01	0.60	0.60	0.66
49.00	0.369	3.04	1.81	1.55	0.01	0.60	0.60	0.74
50.00	0.379	3.12	1.89	1.61	0.01	0.61	0.61	0.75
51.00	0.391	3.22	1.97	1.69	0.02	0.91	0.91	0.87
52.00	0.404	3.33	2.07	1.77	0.03	1.22	1.22	0.96
53.00	0.421	3.47	2.20	1.88	0.03	1.23	1.23	1.27
54.00	0.442	3.64	2.35	2.01	0.03	1.55	1.55	1.58
55.00	0.467	3.85	2.54	2.18	0.04	1.88	1.88	1.90
56.00	0.496	4.09	2.76	2.36	0.05	2.52	2.52	2.19
57.00	0.530	4.37	3.02	2.59	0.06	2.86	2.86	2.63
58.00	0.572	4.71	3.35	2.86	0.07	3.53	3.53	3.23
59.00	0.628	5.17	3.78	3.24	0.11	5.18	5.18	4.35
60.00	1.015	8.36	6.86	5.87	1.15	55.82	55.82	29.61
61.00	1.126	9.28	7.76	6.64	0.13	6.36	6.36	14.55
62.00	1.177	9.70	8.17	6.99	0.08	3.69	3.69	6.11
63.00	1.209	9.96	8.43	7.21	0.05	2.35	2.35	3.31
64.00	1.239	10.21	8.67	7.42	0.05	2.35	2.35	2.66
65.00	1.257	10.36	8.82	7.55	0.03	1.34	1.34	1.78
66.00	1.275	10.51	8.97	7.67	0.03	1.34	1.34	1.56
67.00	1.293	10.65	9.11	7.80	0.03	1.35	1.35	1.52
68.00	1.311	10.80	9.26	7.92	0.03	1.35	1.35	1.51
69.00	1.323	10.90	9.36	8.01	0.02	1.01	1.01	1.11
70.00	1.335	11.00	9.45	8.09	0.02	1.01	1.01	1.03
71.00	1.347	11.10	9.55	8.17	0.02	1.01	1.01	1.01
72.00	1.359	11.20	9.65	8.26	0.02	1.01	1.01	1.01

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #4

Total Basin Area [A] = **18.9** **ac**

A. Land Use Table...

LAND USE DESCRIPTION	**AREA** [ac]	[%]	**Selected CN**	**CN PRODUCT**	**Weighted "CN"**
LAKES	0.00	0%	0	0.00	
BUILDINGS/ROOFS	4.20	22%	98	411.60	
PAVEMENT / ROADWAY	3.38	18%	98	331.2	
OPEN SPACE AREA	11.35	60%	80	908.0	⇩
***Total* ===>**	18.93			1650.8	**87.2**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 1.47 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 40%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 1.51 ==> 0.96 inches

Final Computed Soil Storage [S] = 2.43 inches

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.12

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number [**CN**] = 87.2

Computed Site Storage (**S**) = 1.47 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL = L^0.8*(S +1)^0.7 / 1900 * Sb^0.5**

b) Watershed Lag Time

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time [**TL**] = 0.28 Hrs

Estimated Time of Concentration [**Tc**] = 0.47 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc = 0.007*(n*L)^0.8 / (P2)^0.5*Sb^0.4**

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County [**P2**} = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration [**Tc**] = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.24 Hrs ==> 14 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved	1	**V = 16.1345*Sb^0.5**
Paved	2	**V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #4

Select Surface ==> 1

Estimated Segment Travel Distance [L] = 700 Ft
Estimated Flowpath Slope [Sb] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft
Estimated Flow Velocity [V] = 0.51 ft/sec

Time of Concentration for this segment [Tc] = 0.38 Hrs ==> 23 mins

Estimated Tc for both segments = 0.62 Hrs ==> 37 mins
Final Tc adjust + 50% for additional surface ponding & storage = 0.93 Hrs ==> 56 mins

D. Santa Barbara Hydrograph Procedure...

Estimated Basin Time of Concentration = **0.93 Hrs**

Using SFWMD Mass Distribution Input ...
Storm Frequency = **25** YR
Duration = **72** HR

Summary of Results
Maximum Discharge = 43.9 cfs
Time Elapsed = 60.25 Hr

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE	Instant.	Outfall#4
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]	Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.061	0.50	0.00	0.00	0.00	0.01	0.01	0.00
11.00	0.067	0.55	0.00	0.00	0.00	0.06	0.06	0.02
12.00	0.073	0.60	0.01	0.01	0.00	0.10	0.10	0.05
13.00	0.079	0.65	0.01	0.02	0.00	0.08	0.08	0.09
14.00	0.085	0.70	0.02	0.03	0.00	0.10	0.10	0.12
15.00	0.091	0.75	0.03	0.04	0.00	0.12	0.12	0.15
16.00	0.097	0.80	0.04	0.06	0.00	0.13	0.13	0.18
17.00	0.103	0.85	0.05	0.07	0.00	0.15	0.15	0.20
18.00	0.110	0.91	0.06	0.10	0.01	0.34	0.34	0.25
19.00	0.116	0.96	0.08	0.12	0.01	0.37	0.37	0.26
20.00	0.122	1.01	0.09	0.14	0.01	0.40	0.40	0.28
21.00	0.128	1.05	0.11	0.17	0.01	0.43	0.43	0.30
22.00	0.134	1.10	0.13	0.20	0.01	0.46	0.46	0.32
23.00	0.140	1.15	0.14	0.23	0.01	0.48	0.48	0.34
24.00	0.146	1.20	0.16	0.26	0.01	0.51	0.51	0.36
25.00	0.155	1.28	0.19	0.31	0.01	0.54	0.54	0.52
26.00	0.164	1.35	0.23	0.36	0.01	0.57	0.57	0.61
27.00	0.173	1.43	0.26	0.41	0.02	0.90	0.90	0.63
28.00	0.182	1.50	0.30	0.47	0.02	0.94	0.94	0.67
29.00	0.190	1.57	0.33	0.53	0.01	0.65	0.65	0.67
30.00	0.199	1.64	0.37	0.59	0.01	0.68	0.68	0.71
31.00	0.208	1.71	0.41	0.65	0.01	0.70	0.70	0.75
32.00	0.217	1.79	0.46	0.72	0.01	0.72	0.72	0.78
33.00	0.226	1.86	0.50	0.79	0.02	0.74	0.74	0.83

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #4

34.00	0.235	1.94	0.54	0.86	0.02	0.76	0.76	0.86
35.00	0.244	2.01	0.59	0.93	0.02	1.17	1.17	0.85
36.00	0.252	2.08	0.63	0.99	0.02	0.80	0.80	0.83
37.00	0.261	2.15	0.68	1.07	0.02	0.81	0.81	0.86
38.00	0.270	2.22	0.73	1.15	0.02	0.83	0.83	0.89
39.00	0.279	2.30	0.78	1.22	0.02	0.84	0.84	0.92
40.00	0.288	2.37	0.83	1.30	0.02	0.86	0.86	0.94
41.00	0.297	2.45	0.88	1.38	0.02	0.87	0.87	0.98
42.00	0.306	2.52	0.93	1.47	0.02	0.88	0.88	1.01
43.00	0.315	2.60	0.98	1.55	0.03	1.34	1.34	0.98
44.00	0.324	2.67	1.04	1.63	0.03	1.36	1.36	1.01
45.00	0.332	2.74	1.08	1.71	0.02	0.92	0.92	0.97
46.00	0.341	2.81	1.14	1.79	0.02	0.93	0.93	1.00
47.00	0.350	2.88	1.19	1.88	0.02	0.94	0.94	1.03
48.00	0.359	2.96	1.25	1.97	0.02	0.95	0.95	1.05
49.00	0.369	3.04	1.31	2.07	0.02	0.96	0.96	1.14
50.00	0.379	3.12	1.37	2.17	0.02	0.97	0.97	1.18
51.00	0.391	3.22	1.45	2.29	0.03	1.47	1.47	1.34
52.00	0.404	3.33	1.53	2.42	0.04	1.98	1.98	1.49
53.00	0.421	3.47	1.65	2.60	0.04	2.01	2.01	1.93
54.00	0.442	3.64	1.78	2.82	0.05	2.55	2.55	2.41
55.00	0.467	3.85	1.95	3.08	0.06	3.11	3.11	2.94
56.00	0.496	4.09	2.15	3.39	0.09	4.21	4.21	3.45
57.00	0.530	4.37	2.39	3.77	0.10	4.81	4.81	4.15
58.00	0.572	4.71	2.69	4.24	0.12	5.99	5.99	5.13
59.00	0.628	5.17	3.09	4.88	0.18	8.87	8.87	6.80
60.00	1.015	8.36	6.02	9.50	2.04	98.93	98.93	38.69
61.00	1.126	9.28	6.89	10.87	0.24	11.39	11.39	28.15
62.00	1.177	9.70	7.29	11.50	0.14	6.62	6.62	14.79
63.00	1.209	9.96	7.55	11.90	0.09	4.22	4.22	8.30
64.00	1.239	10.21	7.78	12.28	0.09	4.23	4.23	5.80
65.00	1.257	10.36	7.92	12.50	0.05	2.42	2.42	3.88
66.00	1.275	10.51	8.07	12.73	0.05	2.42	2.42	3.12
67.00	1.293	10.65	8.21	12.95	0.05	2.42	2.42	2.86
68.00	1.311	10.80	8.35	13.18	0.05	2.43	2.43	2.77
69.00	1.323	10.90	8.45	13.33	0.04	1.82	1.82	2.17
70.00	1.335	11.00	8.54	13.48	0.04	1.82	1.82	1.94
71.00	1.347	11.10	8.64	13.63	0.04	1.82	1.82	1.86
72.00	1.359	11.20	8.73	13.78	0.04	1.82	1.82	1.84

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #5

Total Basin Area [A] = **5.1** **ac**

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	0.00	0%	0	0.00	
BUILDINGS/ROOFS	0.87	17%	98	85.26	
PAVEMENT / ROADWAY	0.78	15%	98	76.4	
OPEN SPACE AREA	3.47	68%	80	277.6	⇩
Total ===>	5.12			439.3	**85.8**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 1.65 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 20%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 0.23 ==> 0.54 inches

Final Computed Soil Storage [S] = **2.20** **inches**

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.21

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number [**CN**] = 85.8

Computed Site Storage (**S**) = 1.65 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL =** $\frac{L^{0.8}(S+1)^{0.7}}{1900 * Sb^{0.5}}$

b) Watershed Lag Time

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb ==>** 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time [**TL**] = 0.29 Hrs

Estimated Time of Concentration [**Tc**] = 0.49 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc =** $\frac{0.007(n L)^{0.8}}{(P2)^{0.5} Sb^{0.4}}$

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb ==>** 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County [**P2**} = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration [**Tc**] = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.25 Hrs ==> 15 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved 1 **V = 16.1345*Sb^0.5**

Paved 2 **V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #5

Select Surface ==> 2

Estimated Segment Travel Distance [L] = 140 Ft
Estimated Flowpath Slope [Sb] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft
Estimated Flow Velocity [V] = 0.64 ft/sec

Time of Concentration for this segment [Tc] = 0.06 Hrs ==> 4 mins

Estimated Tc for both segments = 0.31 Hrs ==> 19 mins
Final Tc adjust + 50% for additional surface ponding & storage = 0.47 Hrs ==> 28 mins

D. Santa Barbara Hydrograph Procedure...

Estimated Basin Time of Concentration = **0.47 Hrs**

Using SFWMD Mass Distribution Input ...
Storm Frequency = **25** YR
Duration = **72** HR

Summary of Results
Maximum Discharge = 16.2 cfs
Time Elapsed = 60.25 Hr

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE		Instant.	Outfall#5
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]		Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00		0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00		0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00		0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00		0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00		0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00		0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00		0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00		0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00		0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.00		0.00	0.00
10.00	0.061	0.50	0.00	0.00	0.00	0.02		0.02	0.01
11.00	0.067	0.55	0.01	0.00	0.00	0.03		0.03	0.02
12.00	0.073	0.60	0.01	0.00	0.00	0.04		0.04	0.03
13.00	0.079	0.65	0.02	0.01	0.00	0.03		0.03	0.04
14.00	0.085	0.70	0.03	0.01	0.00	0.03		0.03	0.05
15.00	0.091	0.75	0.04	0.02	0.00	0.04		0.04	0.05
16.00	0.097	0.80	0.05	0.02	0.00	0.04		0.04	0.06
17.00	0.103	0.85	0.06	0.03	0.00	0.05		0.05	0.07
18.00	0.110	0.91	0.08	0.03	0.00	0.11		0.11	0.09
19.00	0.116	0.96	0.10	0.04	0.00	0.12		0.12	0.09
20.00	0.122	1.01	0.12	0.05	0.00	0.12		0.12	0.09
21.00	0.128	1.05	0.13	0.06	0.00	0.13		0.13	0.10
22.00	0.134	1.10	0.15	0.07	0.00	0.14		0.14	0.10
23.00	0.140	1.15	0.18	0.07	0.00	0.15		0.15	0.11
24.00	0.146	1.20	0.20	0.08	0.00	0.15		0.15	0.11
25.00	0.155	1.28	0.23	0.10	0.00	0.16		0.16	0.18
26.00	0.164	1.35	0.27	0.11	0.00	0.17		0.17	0.20
27.00	0.173	1.43	0.31	0.13	0.01	0.27		0.27	0.20
28.00	0.182	1.50	0.35	0.15	0.01	0.28		0.28	0.21
29.00	0.190	1.57	0.38	0.16	0.00	0.19		0.19	0.19
30.00	0.199	1.64	0.42	0.18	0.00	0.20		0.20	0.21
31.00	0.208	1.71	0.47	0.20	0.00	0.20		0.20	0.22
32.00	0.217	1.79	0.51	0.22	0.00	0.21		0.21	0.23
33.00	0.226	1.86	0.56	0.24	0.00	0.21		0.21	0.25

25 YEAR / 72 HR STORM EVENT

Outfall #5

34.00	0.235	1.94	0.61	0.26	0.00	0.22	0.22	0.26
35.00	0.244	2.01	0.66	0.28	0.01	0.34	0.34	0.25
36.00	0.252	2.08	0.70	0.30	0.00	0.23	0.23	0.23
37.00	0.261	2.15	0.75	0.32	0.00	0.23	0.23	0.24
38.00	0.270	2.22	0.80	0.34	0.00	0.24	0.24	0.25
39.00	0.279	2.30	0.85	0.36	0.00	0.24	0.24	0.26
40.00	0.288	2.37	0.91	0.39	0.01	0.24	0.24	0.27
41.00	0.297	2.45	0.96	0.41	0.01	0.25	0.25	0.29
42.00	0.306	2.52	1.01	0.43	0.01	0.25	0.25	0.30
43.00	0.315	2.60	1.07	0.46	0.01	0.38	0.38	0.28
44.00	0.324	2.67	1.12	0.48	0.01	0.38	0.38	0.29
45.00	0.332	2.74	1.17	0.50	0.01	0.26	0.26	0.27
46.00	0.341	2.81	1.23	0.52	0.01	0.26	0.26	0.28
47.00	0.350	2.88	1.29	0.55	0.01	0.26	0.26	0.29
48.00	0.359	2.96	1.35	0.57	0.01	0.27	0.27	0.29
49.00	0.369	3.04	1.41	0.60	0.01	0.27	0.27	0.33
50.00	0.379	3.12	1.48	0.63	0.01	0.27	0.27	0.34
51.00	0.391	3.22	1.55	0.66	0.01	0.41	0.41	0.40
52.00	0.404	3.33	1.64	0.70	0.01	0.55	0.55	0.44
53.00	0.421	3.47	1.76	0.75	0.01	0.56	0.56	0.59
54.00	0.442	3.64	1.90	0.81	0.01	0.71	0.71	0.73
55.00	0.467	3.85	2.07	0.88	0.02	0.86	0.86	0.89
56.00	0.496	4.09	2.28	0.97	0.02	1.17	1.17	1.03
57.00	0.530	4.37	2.52	1.07	0.03	1.33	1.33	1.24
58.00	0.572	4.71	2.82	1.20	0.03	1.65	1.65	1.54
59.00	0.628	5.17	3.23	1.38	0.05	2.44	2.44	2.11
60.00	1.015	8.36	6.20	2.65	0.56	27.03	27.03	16.02
61.00	1.126	9.28	7.08	3.02	0.06	3.10	3.10	6.40
62.00	1.177	9.70	7.48	3.19	0.04	1.80	1.80	2.58
63.00	1.209	9.96	7.74	3.30	0.02	1.15	1.15	1.46
64.00	1.239	10.21	7.98	3.40	0.02	1.15	1.15	1.26
65.00	1.257	10.36	8.12	3.46	0.01	0.66	0.66	0.83
66.00	1.275	10.51	8.26	3.53	0.01	0.66	0.66	0.75
67.00	1.293	10.65	8.41	3.59	0.01	0.66	0.66	0.74
68.00	1.311	10.80	8.55	3.65	0.01	0.66	0.66	0.74
69.00	1.323	10.90	8.65	3.69	0.01	0.50	0.50	0.53
70.00	1.335	11.00	8.74	3.73	0.01	0.50	0.50	0.50
71.00	1.347	11.10	8.84	3.77	0.01	0.50	0.50	0.50
72.00	1.359	11.20	8.93	3.81	0.01	0.50	0.50	0.50

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #6

Total Basin Area [A] = **149.5** **ac** *Note: includes 3 water bodies Lakes*

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	12.19	8%	0	0.00	
BUILDINGS/ROOFS	35.98	24%	98	3526.04	
PAVEMENT / ROADWAY	23.32	16%	98	2285.4	
OPEN SPACE AREA	78.03	52%	80	6242.4	⇩
Total ===>	149.52			12053.8	**80.6**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 2.40 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 30%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 7.80 ==> 0.63 inches

Final Computed Soil Storage [S] = **3.03** **inches** *Note! Lake attenuation and storage is not included*

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.10

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number [**CN**] = 80.6

Computed Site Storage (**S**) = 2.40 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL = $\frac{L^{0.8}(S+1)^{0.7}}{1900 * Sb^{0.5}}$**

b) Watershed Lag Time

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time [**TL**] = 0.35 Hrs

Estimated Time of Concentration [**Tc**] = 0.58 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc = $\frac{0.007*(n*L)^{0.8}}{(P2)^{0.5}*Sb^{0.4}}$**

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County [**P2**} = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration [**Tc**] = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.30 Hrs ==> 18 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved 1 **V = 16.1345*Sb^0.5**

Paved 2 **V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #6

Select Surface ==> 1

Estimated Segment Travel Distance [L] = 850 Ft

Estimated Flowpath Slope [Sb] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft

Estimated Flow Velocity [V] = 0.51 ft/sec

Time of Concentration for this segment [Tc] = 0.46 Hrs ==> 28 mins

Estimated Tc for both segments = **0.76 Hrs ==>** **46 mins**

Final Tc adjust + 50% for additional surface ponding & storage = **1.14** **Hrs ==>** **69 mins**

D. Santa Barbara Hydrograph Procedure...

Estimated Basin Time of Concentration = **1.14** **Hrs**

Using SFWMD Mass Distribution Input ...

Storm Frequency = **25** YR

Duration = **72** HR

Summary of Results

Maximum Discharge = **298.1** **cfs**

Time Elapsed = **60.25** **Hr**

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE	Instant.	Outfall#6
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]	Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.061	0.50	0.00	0.00	0.00	0.00	0.00	0.00
11.00	0.067	0.55	0.00	0.00	0.00	0.00	0.00	0.00
12.00	0.073	0.60	0.00	0.00	0.00	0.00	0.00	0.00
13.00	0.079	0.65	0.00	0.01	0.00	0.13	0.13	0.06
14.00	0.085	0.70	0.00	0.04	0.01	0.28	0.28	0.21
15.00	0.091	0.75	0.01	0.08	0.01	0.43	0.43	0.41
16.00	0.097	0.80	0.01	0.14	0.01	0.57	0.57	0.61
17.00	0.103	0.85	0.02	0.22	0.01	0.70	0.70	0.82
18.00	0.110	0.91	0.03	0.34	0.03	1.67	1.67	1.10
19.00	0.116	0.96	0.04	0.45	0.04	1.91	1.91	1.25
20.00	0.122	1.01	0.05	0.58	0.04	2.14	2.14	1.42
21.00	0.128	1.05	0.06	0.72	0.05	2.36	2.36	1.58
22.00	0.134	1.10	0.07	0.88	0.05	2.57	2.57	1.75
23.00	0.140	1.15	0.08	1.04	0.06	2.78	2.78	1.91
24.00	0.146	1.20	0.10	1.22	0.06	2.97	2.97	2.06
25.00	0.155	1.28	0.12	1.52	0.07	3.25	3.25	2.96
26.00	0.164	1.35	0.15	1.83	0.07	3.51	3.51	3.52
27.00	0.173	1.43	0.17	2.17	0.12	5.61	5.61	3.77
28.00	0.182	1.50	0.20	2.54	0.12	5.96	5.96	4.12
29.00	0.190	1.57	0.23	2.87	0.09	4.18	4.18	4.21
30.00	0.199	1.64	0.26	3.28	0.09	4.39	4.39	4.51
31.00	0.208	1.71	0.30	3.69	0.09	4.59	4.59	4.83
32.00	0.217	1.79	0.33	4.13	0.10	4.77	4.77	5.08
33.00	0.226	1.86	0.37	4.59	0.10	4.95	4.95	5.40

25 YEAR / 72 HR STORM EVENT

Outfall #6

34.00	0.235	1.94	0.41	5.06	0.11	5.12	5.12	5.64
35.00	0.244	2.01	0.44	5.54	0.16	7.91	7.91	5.65
36.00	0.252	2.08	0.48	5.98	0.11	5.42	5.42	5.61
37.00	0.261	2.15	0.52	6.50	0.11	5.56	5.56	5.86
38.00	0.270	2.22	0.56	7.02	0.12	5.70	5.70	6.06
39.00	0.279	2.30	0.61	7.56	0.12	5.83	5.83	6.30
40.00	0.288	2.37	0.65	8.11	0.12	5.96	5.96	6.49
41.00	0.297	2.45	0.70	8.67	0.13	6.08	6.08	6.76
42.00	0.306	2.52	0.74	9.24	0.13	6.19	6.19	6.95
43.00	0.315	2.60	0.79	9.82	0.20	9.45	9.45	6.85
44.00	0.324	2.67	0.84	10.42	0.20	9.61	9.61	7.04
45.00	0.332	2.74	0.88	10.95	0.13	6.50	6.50	6.86
46.00	0.341	2.81	0.93	11.56	0.14	6.60	6.60	7.06
47.00	0.350	2.88	0.98	12.18	0.14	6.69	6.69	7.29
48.00	0.359	2.96	1.03	12.81	0.14	6.78	6.78	7.45
49.00	0.369	3.04	1.08	13.51	0.14	6.87	6.87	8.09
50.00	0.379	3.12	1.14	14.23	0.14	6.96	6.96	8.42
51.00	0.391	3.22	1.21	15.10	0.22	10.59	10.59	9.48
52.00	0.404	3.33	1.29	16.06	0.30	14.33	14.33	10.53
53.00	0.421	3.47	1.39	17.33	0.30	14.59	14.59	13.49
54.00	0.442	3.64	1.52	18.93	0.38	18.60	18.60	16.86
55.00	0.467	3.85	1.68	20.88	0.47	22.80	22.80	20.70
56.00	0.496	4.09	1.86	23.19	0.64	31.05	31.05	24.53
57.00	0.530	4.37	2.08	25.95	0.74	35.72	35.72	29.68
58.00	0.572	4.71	2.36	29.45	0.92	44.68	44.68	36.76
59.00	0.628	5.17	2.75	34.22	1.38	66.64	66.64	48.56
60.00	1.015	8.36	5.58	69.50	15.69	759.25	759.25	257.07
61.00	1.126	9.28	6.43	80.07	1.82	88.00	88.00	212.81
62.00	1.177	9.70	6.82	84.97	1.06	51.22	51.22	124.44
63.00	1.209	9.96	7.07	88.05	0.68	32.69	32.69	74.21
64.00	1.239	10.21	7.30	90.95	0.68	32.77	32.77	51.30
65.00	1.257	10.36	7.44	92.70	0.39	18.76	18.76	34.46
66.00	1.275	10.51	7.58	94.44	0.39	18.78	18.78	26.65
67.00	1.293	10.65	7.72	96.19	0.39	18.81	18.81	23.43
68.00	1.311	10.80	7.86	97.94	0.39	18.83	18.83	22.11
69.00	1.323	10.90	7.95	99.11	0.29	14.14	14.14	17.68
70.00	1.335	11.00	8.05	100.28	0.29	14.15	14.15	15.61
71.00	1.347	11.10	8.14	101.45	0.29	14.16	14.16	14.76
72.00	1.359	11.20	8.24	102.62	0.29	14.17	14.17	14.41

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #7

Total Basin Area [A] = **34.3** **ac**

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	0.00	0%	0	0.00	
BUILDINGS/ROOFS	8.19	24%	98	802.62	
PAVEMENT / ROADWAY	5.48	16%	98	537.0	
OPEN SPACE AREA	20.67	60%	80	1653.6	⇩
Total ===>	34.34			2993.3	**87.2**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 1.47 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 30%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 2.07 ==> 0.72 inches

Final Computed Soil Storage [S] = 2.19 inches

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.07

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number [**CN**] = 87.2

Computed Site Storage (**S**) = 1.47 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL =** $\frac{L^{0.8}(S+1)^{0.7}}{1900 \cdot Sb^{0.5}}$

b) Watershed Lag Time

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb ==>** 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time [**TL**] = 0.28 Hrs

Estimated Time of Concentration [**Tc**] = 0.47 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc =** $\frac{0.007(n L)^{0.8}}{(P2)^{0.5} Sb^{0.4}}$

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb ==>** 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County [**P2**} = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration [**Tc**] = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.24 Hrs ==> 14 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved 1 **V = 16.1345*Sb^0.5**

Paved 2 **V = 20.3282*Sb^0.5**

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #7

Select Surface ==> 1

Estimated Segment Travel Distance [**L**] = 1650 Ft
Estimated Flowpath Slope [**Sb**] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft
Estimated Flow Velocity [**V**] = 0.51 ft/sec

Time of Concentration for this segment [Tc] = 0.90 Hrs ==> 54 mins

Estimated Tc for both segments = 1.14 Hrs ==> 68 mins
Final Tc adjust + 50% for additional surface ponding & storage = 1.71 Hrs ==> 103 mins

D. Santa Barbara Hydrograph Procedure...

Estimated Basin Time of Concentration = **1.71** **Hrs**

Using SFWMD Mass Distribution Input ...
Storm Frequency = **25** YR
Duration = **72** HR

Summary of Results
Maximum Discharge = 55.7 cfs
Time Elapsed = 60.25 Hr

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE		Instant.	Outfall#7
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]		Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00		0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00		0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00		0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00		0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00		0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00		0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00		0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00		0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00		0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.01		0.01	0.00
10.00	0.061	0.50	0.00	0.01	0.00	0.11		0.11	0.02
11.00	0.067	0.55	0.01	0.02	0.00	0.20		0.20	0.07
12.00	0.073	0.60	0.01	0.03	0.01	0.29		0.29	0.12
13.00	0.079	0.65	0.02	0.05	0.00	0.19		0.19	0.19
14.00	0.085	0.70	0.03	0.08	0.00	0.23		0.23	0.24
15.00	0.091	0.75	0.04	0.11	0.01	0.26		0.26	0.30
16.00	0.097	0.80	0.05	0.15	0.01	0.30		0.30	0.35
17.00	0.103	0.85	0.06	0.18	0.01	0.33		0.33	0.41
18.00	0.110	0.91	0.08	0.23	0.01	0.72		0.72	0.48
19.00	0.116	0.96	0.10	0.28	0.02	0.78		0.78	0.52
20.00	0.122	1.01	0.12	0.33	0.02	0.83		0.83	0.56
21.00	0.128	1.05	0.13	0.39	0.02	0.88		0.88	0.60
22.00	0.134	1.10	0.15	0.44	0.02	0.93		0.93	0.63
23.00	0.140	1.15	0.18	0.50	0.02	0.98		0.98	0.67
24.00	0.146	1.20	0.20	0.56	0.02	1.02		1.02	0.71
25.00	0.155	1.28	0.23	0.66	0.02	1.08		1.08	0.93
26.00	0.164	1.35	0.27	0.77	0.02	1.14		1.14	1.08
27.00	0.173	1.43	0.31	0.88	0.04	1.78		1.78	1.16
28.00	0.182	1.50	0.35	0.99	0.04	1.86		1.86	1.25
29.00	0.190	1.57	0.38	1.09	0.03	1.28		1.28	1.28
30.00	0.199	1.64	0.42	1.22	0.03	1.32		1.32	1.35
31.00	0.208	1.71	0.47	1.34	0.03	1.36		1.36	1.42
32.00	0.217	1.79	0.51	1.47	0.03	1.40		1.40	1.48
33.00	0.226	1.86	0.56	1.60	0.03	1.44		1.44	1.55

25 YEAR / 72 HR STORM EVENT

Outfall #7

34.00	0.235	1.94	0.61	1.74	0.03	1.47	1.47	1.60
35.00	0.244	2.01	0.66	1.88	0.05	2.25	2.25	1.60
36.00	0.252	2.08	0.70	2.00	0.03	1.53	1.53	1.60
37.00	0.261	2.15	0.75	2.15	0.03	1.56	1.56	1.65
38.00	0.270	2.22	0.80	2.29	0.03	1.59	1.59	1.69
39.00	0.279	2.30	0.85	2.44	0.03	1.61	1.61	1.74
40.00	0.288	2.37	0.91	2.59	0.03	1.64	1.64	1.78
41.00	0.297	2.45	0.96	2.75	0.03	1.66	1.66	1.82
42.00	0.306	2.52	1.01	2.90	0.03	1.68	1.68	1.86
43.00	0.315	2.60	1.07	3.06	0.05	2.55	2.55	1.84
44.00	0.324	2.67	1.12	3.22	0.05	2.58	2.58	1.88
45.00	0.332	2.74	1.17	3.36	0.04	1.74	1.74	1.85
46.00	0.341	2.81	1.23	3.52	0.04	1.75	1.75	1.89
47.00	0.350	2.88	1.29	3.69	0.04	1.77	1.77	1.93
48.00	0.359	2.96	1.35	3.85	0.04	1.79	1.79	1.96
49.00	0.369	3.04	1.41	4.04	0.04	1.80	1.80	2.09
50.00	0.379	3.12	1.48	4.23	0.04	1.82	1.82	2.17
51.00	0.391	3.22	1.56	4.45	0.06	2.75	2.75	2.38
52.00	0.404	3.33	1.64	4.70	0.08	3.71	3.71	2.62
53.00	0.421	3.47	1.76	5.03	0.08	3.75	3.75	3.23
54.00	0.442	3.64	1.90	5.44	0.10	4.76	4.76	3.97
55.00	0.467	3.85	2.07	5.93	0.12	5.79	5.79	4.84
56.00	0.496	4.09	2.28	6.52	0.16	7.83	7.83	5.74
57.00	0.530	4.37	2.52	7.21	0.18	8.94	8.94	6.88
58.00	0.572	4.71	2.82	8.08	0.23	11.09	11.09	8.42
59.00	0.628	5.17	3.24	9.26	0.34	16.39	16.39	10.85
60.00	1.015	8.36	6.21	17.76	3.75	181.29	181.29	47.04
61.00	1.126	9.28	7.08	20.26	0.43	20.81	20.81	46.33
62.00	1.177	9.70	7.49	21.42	0.25	12.09	12.09	32.34
63.00	1.209	9.96	7.74	22.15	0.16	7.71	7.71	22.08
64.00	1.239	10.21	7.98	22.83	0.16	7.72	7.72	15.95
65.00	1.257	10.36	8.12	23.24	0.09	4.41	4.41	11.24
66.00	1.275	10.51	8.27	23.65	0.09	4.42	4.42	8.46
67.00	1.293	10.65	8.41	24.06	0.09	4.42	4.42	6.91
68.00	1.311	10.80	8.55	24.47	0.09	4.43	4.43	6.06
69.00	1.323	10.90	8.65	24.75	0.07	3.32	3.32	4.89
70.00	1.335	11.00	8.74	25.02	0.07	3.32	3.32	4.20
71.00	1.347	11.10	8.84	25.30	0.07	3.32	3.32	3.81
72.00	1.359	11.20	8.94	25.57	0.07	3.33	3.33	3.59

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #8

Total Basin Area [A] = **48.4** **ac**

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	0.00	0%	0	0.00	
BUILDINGS/ROOFS	12.12	25%	98	1187.76	
PAVEMENT / ROADWAY	8.80	18%	98	862.4	
OPEN SPACE AREA	27.45	57%	80	2196.0	
Total ===>	48.37			4246.2	**87.8**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 1.39 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 30%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 2.75 ==> 0.68 inches

Final Computed Soil Storage [S] = 2.07 inches

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.07

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number **[CN]** = 87.8

Computed Site Storage **(S)** = 1.39 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL = L^0.8*(S +1)^0.7**
1900 * Sb^0.5

b) Watershed Lag Time

Estimated Segment Travel Distance **[L]** = 100 Ft

Estimated Flowpath Slope **[Sb]** = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time **[TL]** = 0.27 Hrs

Estimated Time of Concentration **[Tc]** = 0.46 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc = 0.007*(n*L)^0.8**
(P2)^0.5*Sb^0.4

Estimated Segment Travel Distance **[L]** = 100 Ft

Estimated Flowpath Slope **[Sb]** = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County **[P2}** = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration **[Tc]** = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.24 Hrs ==> 14 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved 1 **V = 16.1345*Sb^0.5**
Paved 2 **V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #8

Select Surface ==> 1

Estimated Segment Travel Distance [L] = 1600 Ft
Estimated Flowpath Slope [Sb] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft
Estimated Flow Velocity [V] = 0.51 ft/sec

Time of Concentration for this segment [Tc] = **0.87** Hrs ==> 52 mins

Estimated Tc for both segments = **1.11 Hrs ==>** **66 mins**
Final Tc adjust + 50% for additional surface ponding & storage = **1.66** **Hrs ==>** **100 mins**

D. Santa Barbara Hydrograph Procedure…

Estimated Basin Time of Concentration = **1.66** **Hrs**

Using SFWMD Mass Distribution Input …
Storm Frequency = **25** YR
Duration = **72** HR

Summary of Results
Maximum Discharge = **80.6** **cfs**
Time Elapsed = **60.25** **Hr**

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE	Instant.	Outfall#8
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]	Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.09	0.09	0.01
10.00	0.061	0.50	0.00	0.01	0.00	0.23	0.23	0.06
11.00	0.067	0.55	0.01	0.03	0.01	0.37	0.37	0.14
12.00	0.073	0.60	0.02	0.06	0.01	0.49	0.49	0.22
13.00	0.079	0.65	0.02	0.10	0.01	0.31	0.31	0.32
14.00	0.085	0.70	0.03	0.14	0.01	0.36	0.36	0.41
15.00	0.091	0.75	0.05	0.19	0.01	0.41	0.41	0.49
16.00	0.097	0.80	0.06	0.24	0.01	0.46	0.46	0.56
17.00	0.103	0.85	0.08	0.30	0.01	0.51	0.51	0.64
18.00	0.110	0.91	0.09	0.38	0.02	1.10	1.10	0.75
19.00	0.116	0.96	0.11	0.45	0.02	1.18	1.18	0.80
20.00	0.122	1.01	0.13	0.53	0.03	1.26	1.26	0.85
21.00	0.128	1.05	0.15	0.61	0.03	1.33	1.33	0.91
22.00	0.134	1.10	0.17	0.69	0.03	1.39	1.39	0.96
23.00	0.140	1.15	0.19	0.78	0.03	1.46	1.46	1.01
24.00	0.146	1.20	0.22	0.88	0.03	1.52	1.52	1.06
25.00	0.155	1.28	0.25	1.02	0.03	1.60	1.60	1.39
26.00	0.164	1.35	0.29	1.18	0.03	1.68	1.68	1.61
27.00	0.173	1.43	0.33	1.34	0.05	2.63	2.63	1.72
28.00	0.182	1.50	0.37	1.50	0.06	2.73	2.73	1.86
29.00	0.190	1.57	0.41	1.66	0.04	1.88	1.88	1.89
30.00	0.199	1.64	0.46	1.84	0.04	1.94	1.94	1.99
31.00	0.208	1.71	0.50	2.02	0.04	1.99	1.99	2.09
32.00	0.217	1.79	0.55	2.21	0.04	2.05	2.05	2.18
33.00	0.226	1.86	0.60	2.40	0.04	2.10	2.10	2.26

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #8

34.00	0.235	1.94	0.64	2.60	0.04	2.14	2.14	2.34
35.00	0.244	2.01	0.69	2.80	0.07	3.27	3.27	2.33
36.00	0.252	2.08	0.74	2.98	0.05	2.22	2.22	2.32
37.00	0.261	2.15	0.79	3.19	0.05	2.26	2.26	2.39
38.00	0.270	2.22	0.84	3.40	0.05	2.30	2.30	2.45
39.00	0.279	2.30	0.90	3.62	0.05	2.33	2.33	2.52
40.00	0.288	2.37	0.95	3.84	0.05	2.36	2.36	2.57
41.00	0.297	2.45	1.01	4.06	0.05	2.39	2.39	2.64
42.00	0.306	2.52	1.06	4.28	0.05	2.42	2.42	2.69
43.00	0.315	2.60	1.12	4.51	0.08	3.67	3.67	2.66
44.00	0.324	2.67	1.18	4.74	0.08	3.71	3.71	2.71
45.00	0.332	2.74	1.23	4.94	0.05	2.50	2.50	2.67
46.00	0.341	2.81	1.28	5.18	0.05	2.52	2.52	2.72
47.00	0.350	2.88	1.34	5.41	0.05	2.54	2.54	2.77
48.00	0.359	2.96	1.40	5.65	0.05	2.56	2.56	2.82
49.00	0.369	3.04	1.47	5.92	0.05	2.59	2.59	3.00
50.00	0.379	3.12	1.53	6.18	0.05	2.61	2.61	3.11
51.00	0.391	3.22	1.62	6.51	0.08	3.95	3.95	3.43
52.00	0.404	3.33	1.70	6.87	0.11	5.31	5.31	3.76
53.00	0.421	3.47	1.82	7.34	0.11	5.37	5.37	4.66
54.00	0.442	3.64	1.97	7.92	0.14	6.80	6.80	5.73
55.00	0.467	3.85	2.14	8.63	0.17	8.27	8.27	6.97
56.00	0.496	4.09	2.35	9.46	0.23	11.17	11.17	8.25
57.00	0.530	4.37	2.59	10.45	0.26	12.73	12.73	9.89
58.00	0.572	4.71	2.90	11.69	0.33	15.79	15.79	12.10
59.00	0.628	5.17	3.32	13.37	0.48	23.31	23.31	15.58
60.00	1.015	8.36	6.31	25.42	5.30	256.67	256.67	68.14
61.00	1.126	9.28	7.18	28.96	0.61	29.43	29.43	66.30
62.00	1.177	9.70	7.59	30.59	0.35	17.09	17.09	45.72
63.00	1.209	9.96	7.84	31.62	0.23	10.89	10.89	30.89
64.00	1.239	10.21	8.08	32.59	0.23	10.91	10.91	22.18
65.00	1.257	10.36	8.23	33.17	0.13	6.24	6.24	15.54
66.00	1.275	10.51	8.37	33.75	0.13	6.24	6.24	11.68
67.00	1.293	10.65	8.52	34.33	0.13	6.25	6.25	9.57
68.00	1.311	10.80	8.66	34.91	0.13	6.25	6.25	8.42
69.00	1.323	10.90	8.76	35.30	0.10	4.69	4.69	6.80
70.00	1.335	11.00	8.85	35.68	0.10	4.69	4.69	5.84
71.00	1.347	11.10	8.95	36.07	0.10	4.70	4.70	5.32
72.00	1.359	11.20	9.05	36.46	0.10	4.70	4.70	5.04

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #9

Total Basin Area [A] = **9.5** **ac**

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	0.00	0%	0	0.00	
BUILDINGS/ROOFS	2.50	26%	98	245.00	
PAVEMENT / ROADWAY	1.23	13%	98	120.5	
OPEN SPACE AREA	5.78	61%	80	462.4	
Total ===>	9.51			827.9	**87.1**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 1.49 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 30%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 0.58 ==> 0.73 inches

Final Computed Soil Storage [S] = **2.22** **inches**

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.16

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number [**CN**] = 87.1

Computed Site Storage (**S**) = 1.49 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL = $\frac{L^{0.8}(S+1)^{0.7}}{1900 * Sb^{0.5}}$**

b) Watershed Lag Time

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time [**TL**] = 0.28 Hrs

Estimated Time of Concentration [**Tc**] = 0.47 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc = $\frac{0.007*(n*L)^{0.8}}{(P2)^{0.5}*Sb^{0.4}}$**

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County [**P2**] = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration [**Tc**] = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.24 Hrs ==> 15 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved 1 **V = 16.1345*Sb^0.5**

Paved 2 **V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #9

Select Surface ==> 1

Estimated Segment Travel Distance [**L**] = 350 Ft
Estimated Flowpath Slope [**Sb**] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft
Estimated Flow Velocity [**V**] = 0.51 ft/sec

Time of Concentration for this segment [Tc] = 0.19 Hrs ==> 11 mins

Estimated Tc for both segments = 0.43 Hrs ==> 26 mins
Final Tc adjust + 50% for additional surface ponding & storage = 0.65 Hrs ==> 39 mins

D. Santa Barbara Hydrograph Procedure…

Estimated Basin Time of Concentration = **0.65** **Hrs**

Using SFWMD Mass Distribution Input …
Storm Frequency = **25** YR
Duration = **72** HR

Summary of Results
Maximum Discharge = 26.6 cfs
Time Elapsed = 60.25 Hr

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE	Instant.	Outfall#9
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]	Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.061	0.50	0.00	0.00	0.00	0.03	0.03	0.01
11.00	0.067	0.55	0.01	0.00	0.00	0.05	0.05	0.03
12.00	0.073	0.60	0.01	0.01	0.00	0.08	0.08	0.05
13.00	0.079	0.65	0.02	0.01	0.00	0.05	0.05	0.07
14.00	0.085	0.70	0.03	0.02	0.00	0.06	0.06	0.08
15.00	0.091	0.75	0.04	0.03	0.00	0.07	0.07	0.10
16.00	0.097	0.80	0.05	0.04	0.00	0.08	0.08	0.11
17.00	0.103	0.85	0.06	0.05	0.00	0.09	0.09	0.13
18.00	0.110	0.91	0.08	0.06	0.00	0.20	0.20	0.15
19.00	0.116	0.96	0.10	0.08	0.00	0.21	0.21	0.16
20.00	0.122	1.01	0.11	0.09	0.00	0.23	0.23	0.16
21.00	0.128	1.05	0.13	0.10	0.00	0.24	0.24	0.17
22.00	0.134	1.10	0.15	0.12	0.01	0.25	0.25	0.18
23.00	0.140	1.15	0.17	0.14	0.01	0.27	0.27	0.19
24.00	0.146	1.20	0.19	0.15	0.01	0.28	0.28	0.20
25.00	0.155	1.28	0.23	0.18	0.01	0.30	0.30	0.31
26.00	0.164	1.35	0.26	0.21	0.01	0.31	0.31	0.35
27.00	0.173	1.43	0.30	0.24	0.01	0.49	0.49	0.35
28.00	0.182	1.50	0.34	0.27	0.01	0.51	0.51	0.37
29.00	0.190	1.57	0.38	0.30	0.01	0.35	0.35	0.36
30.00	0.199	1.64	0.42	0.33	0.01	0.36	0.36	0.38
31.00	0.208	1.71	0.46	0.37	0.01	0.38	0.38	0.41
32.00	0.217	1.79	0.51	0.40	0.01	0.39	0.39	0.42
33.00	0.226	1.86	0.55	0.44	0.01	0.40	0.40	0.45

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #9

34.00	0.235	1.94	0.60	0.48	0.01	0.41	0.41	0.47
35.00	0.244	2.01	0.65	0.51	0.01	0.62	0.62	0.46
36.00	0.252	2.08	0.69	0.55	0.01	0.42	0.42	0.44
37.00	0.261	2.15	0.74	0.59	0.01	0.43	0.43	0.46
38.00	0.270	2.22	0.79	0.63	0.01	0.44	0.44	0.47
39.00	0.279	2.30	0.85	0.67	0.01	0.44	0.44	0.49
40.00	0.288	2.37	0.90	0.71	0.01	0.45	0.45	0.50
41.00	0.297	2.45	0.95	0.75	0.01	0.46	0.46	0.53
42.00	0.306	2.52	1.01	0.80	0.01	0.46	0.46	0.54
43.00	0.315	2.60	1.06	0.84	0.01	0.70	0.70	0.52
44.00	0.324	2.67	1.12	0.88	0.01	0.71	0.71	0.53
45.00	0.332	2.74	1.17	0.92	0.01	0.48	0.48	0.50
46.00	0.341	2.81	1.22	0.97	0.01	0.48	0.48	0.52
47.00	0.350	2.88	1.28	1.01	0.01	0.49	0.49	0.54
48.00	0.359	2.96	1.34	1.06	0.01	0.49	0.49	0.55
49.00	0.369	3.04	1.40	1.11	0.01	0.50	0.50	0.60
50.00	0.379	3.12	1.47	1.16	0.01	0.50	0.50	0.62
51.00	0.391	3.22	1.55	1.23	0.02	0.76	0.76	0.72
52.00	0.404	3.33	1.63	1.29	0.02	1.02	1.02	0.80
53.00	0.421	3.47	1.75	1.38	0.02	1.04	1.04	1.05
54.00	0.442	3.64	1.89	1.50	0.03	1.31	1.31	1.31
55.00	0.467	3.85	2.06	1.63	0.03	1.60	1.60	1.59
56.00	0.496	4.09	2.27	1.80	0.04	2.16	2.16	1.85
57.00	0.530	4.37	2.51	1.99	0.05	2.47	2.47	2.23
58.00	0.572	4.71	2.81	2.23	0.06	3.07	3.07	2.76
59.00	0.628	5.17	3.22	2.55	0.09	4.53	4.53	3.72
60.00	1.015	8.36	6.19	4.90	1.04	50.16	50.16	24.65
61.00	1.126	9.28	7.06	5.60	0.12	5.76	5.76	13.57
62.00	1.177	9.70	7.47	5.92	0.07	3.35	3.35	5.98
63.00	1.209	9.96	7.72	6.12	0.04	2.13	2.13	3.22
64.00	1.239	10.21	7.96	6.31	0.04	2.14	2.14	2.48
65.00	1.257	10.36	8.10	6.42	0.03	1.22	1.22	1.67
66.00	1.275	10.51	8.25	6.54	0.03	1.22	1.22	1.44
67.00	1.293	10.65	8.39	6.65	0.03	1.22	1.22	1.39
68.00	1.311	10.80	8.53	6.76	0.03	1.22	1.22	1.38
69.00	1.323	10.90	8.63	6.84	0.02	0.92	0.92	1.03
70.00	1.335	11.00	8.73	6.92	0.02	0.92	0.92	0.94
71.00	1.347	11.10	8.82	6.99	0.02	0.92	0.92	0.92
72.00	1.359	11.20	8.92	7.07	0.02	0.92	0.92	0.92

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #10

Total Basin Area [A] = **13.6** **ac**

A. Land Use Table...

LAND USE DESCRIPTION	AREA [ac]	[%]	Selected CN	CN PRODUCT	Weighted "CN"
LAKES	0.00	0%	0	0.00	
BUILDINGS/ROOFS	2.76	20%	98	270.48	
PAVEMENT / ROADWAY	2.53	19%	98	247.9	
OPEN SPACE AREA	8.28	61%	80	662.4	
Total ===>	13.57			1180.8	**87.0**

B. Soil Storage Calculation...

1. Soil Storage from weighted CN

Using SCS computation method = 1.49 inches

2. Depressional Site Storage

Estimated Depressional Storage [% of Open space] = 30%

Estimated Average storage Depth [ins] = 4

Computed Vol.[ac-ft] = 0.83 ==> 0.73 inches

Final Computed Soil Storage [S] = 2.22 inches

C. Basin Runoff Computation...

Rainfall Event 24-Hr Total [P] = 8.2 ins

Computation Time step [Dt] = 900.00 secs ==> 0.25 Hr

SBUH Basin Routing Coefficient [K] = 0.12

D. Time of Concentration Computation...

Computation using sequential cumulative flow segments as per below

1st Step: **Initial Overland Flow ~ Unconcentrated Sheetflow Segment**

Method 1. **Using SCS Lag Equation**

Using SCS Runoff Equation .. **S = 1000/CN -10**

a) Site Storage Calculation

Estimated sub-basin SCS Curve Number [**CN**] = 87.0

Computed Site Storage (**S**) = 1.49 inches

Using SCS Lag Equation .. **Tc = 1.67 * TL** **TL = $\frac{L^{0.8}*(S+1)^{0.7}}{1900 * Sb^{0.5}}$**

b) Watershed Lag Time

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft (1ft / Mile)

Computed Basin Lag Time [**TL**] = 0.28 Hrs

Estimated Time of Concentration [**Tc**] = 0.47 Hrs

Method 2. **Using Manning's Kinematic Solution**

Using Manning's Kinematic Solution (TR-55) **Tc = $\frac{0.007*(n*L)^{0.8}}{(P2)^{0.5}*Sb^{0.4}}$**

Estimated Segment Travel Distance [**L**] = 100 Ft

Estimated Flowpath Slope [**Sb**] = 20.0 ft/1000ft **Sb** ==> 0.0200 Ft/Ft

Rainfall ~ 2yr/ 24 hr Collier County [**P2**} = 4.50 inches

Estimated Overland Flow Friction factor- **Manning's "n"** = 0.01 *(TR-55: smooth pavement)*

Estimated Time of Concentration [**Tc**] = 0.02 Hrs

Time of Concentration for this segment [Tc] = 0.24 Hrs ==> 15 mins

2nd Step: **Shallow Concentrated Flow Segment**

Using TR-55 Equation

Using TR-55 Solution (Appendix F, Fig 3-1)

Unpaved 1 **V = 16.1345*Sb^0.5**

Paved 2 **V = 20.3282*Sb^0.5**

SUB-BASIN RUNOFF

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #10

Select Surface ==> 1

Estimated Segment Travel Distance [L] = 660 Ft
Estimated Flowpath Slope [Sb] = 1.0 ft/1000ft **Sb** ==> 0.0010 Ft/Ft
Estimated Flow Velocity [V] = 0.51 ft/sec

Time of Concentration for this segment [Tc] = 0.36 Hrs ==> 22 mins

Estimated Tc for both segments = 0.60 Hrs ==> 36 mins
Final Tc adjust + 50% for additional surface ponding & storage = 0.90 Hrs ==> 54 mins

D. Santa Barbara Hydrograph Procedure...

Estimated Basin Time of Concentration = **0.90** **Hrs**

Using SFWMD Mass Distribution Input ...
Storm Frequency = **25** YR
Duration = **72** HR

Summary of Results
Maximum Discharge = 32.3 cfs
Time Elapsed = 60.25 Hr

72-HR SFWMD HYDROGRAPH			ONSITE SOURCE			ONSITE	Instant.	Outfall#10
Time Hr	Unit Hydrograph	Total Rainfall ins	Runoff ins	Cum. Vol. ac-ft	Incr. Vol. [ac-ft]	Runoff [cfs]	Runoff [cfs]	Runoff [cfs]
0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.006	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.012	0.10	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.018	0.15	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.024	0.20	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.030	0.25	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.036	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.043	0.35	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.049	0.40	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.055	0.45	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.061	0.50	0.00	0.00	0.00	0.04	0.04	0.01
11.00	0.067	0.55	0.00	0.01	0.00	0.08	0.08	0.03
12.00	0.073	0.60	0.01	0.01	0.00	0.11	0.11	0.06
13.00	0.079	0.65	0.02	0.02	0.00	0.07	0.07	0.09
14.00	0.085	0.70	0.03	0.03	0.00	0.09	0.09	0.11
15.00	0.091	0.75	0.04	0.04	0.00	0.10	0.10	0.13
16.00	0.097	0.80	0.05	0.06	0.00	0.11	0.11	0.15
17.00	0.103	0.85	0.06	0.07	0.00	0.13	0.13	0.17
18.00	0.110	0.91	0.08	0.09	0.01	0.28	0.28	0.21
19.00	0.116	0.96	0.10	0.11	0.01	0.30	0.30	0.22
20.00	0.122	1.01	0.11	0.13	0.01	0.32	0.32	0.23
21.00	0.128	1.05	0.13	0.15	0.01	0.34	0.34	0.24
22.00	0.134	1.10	0.15	0.17	0.01	0.36	0.36	0.26
23.00	0.140	1.15	0.17	0.19	0.01	0.38	0.38	0.27
24.00	0.146	1.20	0.19	0.22	0.01	0.40	0.40	0.29
25.00	0.155	1.28	0.23	0.26	0.01	0.42	0.42	0.41
26.00	0.164	1.35	0.26	0.30	0.01	0.44	0.44	0.47
27.00	0.173	1.43	0.30	0.34	0.01	0.70	0.70	0.49
28.00	0.182	1.50	0.34	0.38	0.01	0.73	0.73	0.52
29.00	0.190	1.57	0.38	0.42	0.01	0.50	0.50	0.52
30.00	0.199	1.64	0.42	0.47	0.01	0.52	0.52	0.54
31.00	0.208	1.71	0.46	0.52	0.01	0.53	0.53	0.58
32.00	0.217	1.79	0.51	0.57	0.01	0.55	0.55	0.60
33.00	0.226	1.86	0.55	0.62	0.01	0.56	0.56	0.63

NAPLES BEACH OUTFALLS ~ CONTRIBUTING AREAS

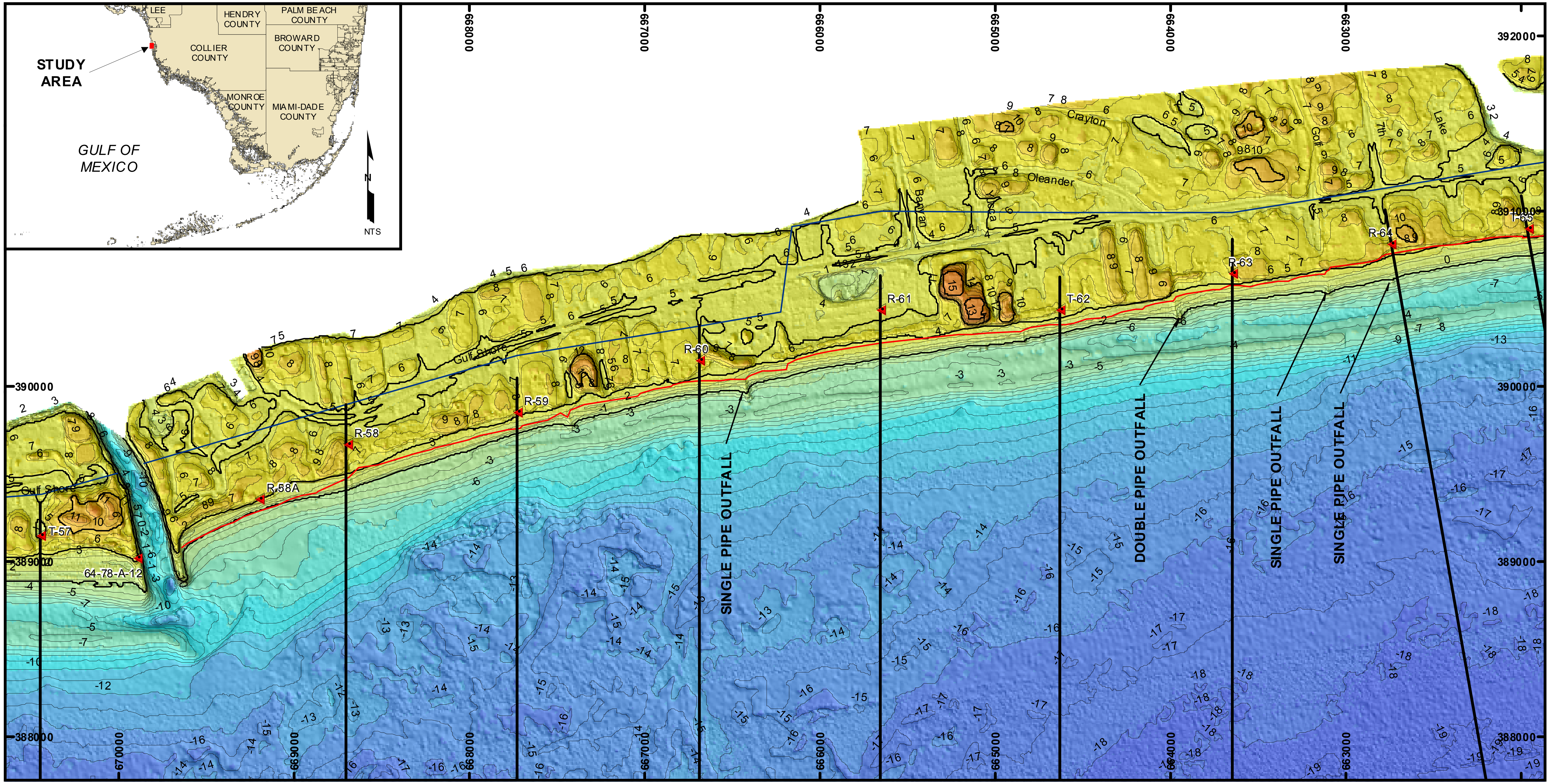
Gulfshore Engineering, Inc.

25 YEAR / 72 HR STORM EVENT

Outfall #10

34.00	0.235	1.94	0.60	0.68	0.01	0.58	0.58	0.65
35.00	0.244	2.01	0.65	0.73	0.02	0.88	0.88	0.64
36.00	0.252	2.08	0.69	0.78	0.01	0.60	0.60	0.63
37.00	0.261	2.15	0.74	0.84	0.01	0.61	0.61	0.65
38.00	0.270	2.22	0.79	0.89	0.01	0.62	0.62	0.67
39.00	0.279	2.30	0.84	0.95	0.01	0.63	0.63	0.69
40.00	0.288	2.37	0.90	1.01	0.01	0.64	0.64	0.71
41.00	0.297	2.45	0.95	1.07	0.01	0.65	0.65	0.74
42.00	0.306	2.52	1.00	1.13	0.01	0.66	0.66	0.75
43.00	0.315	2.60	1.06	1.20	0.02	1.00	1.00	0.73
44.00	0.324	2.67	1.11	1.26	0.02	1.01	1.01	0.75
45.00	0.332	2.74	1.16	1.31	0.01	0.68	0.68	0.72
46.00	0.341	2.81	1.22	1.38	0.01	0.69	0.69	0.74
47.00	0.350	2.88	1.28	1.44	0.01	0.70	0.70	0.76
48.00	0.359	2.96	1.33	1.51	0.01	0.70	0.70	0.78
49.00	0.369	3.04	1.40	1.58	0.01	0.71	0.71	0.85
50.00	0.379	3.12	1.46	1.65	0.01	0.72	0.72	0.88
51.00	0.391	3.22	1.54	1.74	0.02	1.08	1.08	0.99
52.00	0.404	3.33	1.63	1.84	0.03	1.46	1.46	1.10
53.00	0.421	3.47	1.74	1.97	0.03	1.48	1.48	1.43
54.00	0.442	3.64	1.89	2.13	0.04	1.87	1.87	1.78
55.00	0.467	3.85	2.06	2.33	0.05	2.28	2.28	2.17
56.00	0.496	4.09	2.26	2.56	0.06	3.08	3.08	2.54
57.00	0.530	4.37	2.50	2.83	0.07	3.52	3.52	3.06
58.00	0.572	4.71	2.81	3.17	0.09	4.37	4.37	3.77
59.00	0.628	5.17	3.22	3.64	0.13	6.46	6.46	4.99
60.00	1.015	8.36	6.18	6.99	1.48	71.55	71.55	28.67
61.00	1.126	9.28	7.06	7.98	0.17	8.22	8.22	20.36
62.00	1.177	9.70	7.46	8.44	0.10	4.77	4.77	10.51
63.00	1.209	9.96	7.71	8.72	0.06	3.04	3.04	5.84
64.00	1.239	10.21	7.95	8.99	0.06	3.05	3.05	4.11
65.00	1.257	10.36	8.10	9.16	0.04	1.74	1.74	2.75
66.00	1.275	10.51	8.24	9.32	0.04	1.74	1.74	2.22
67.00	1.293	10.65	8.38	9.48	0.04	1.75	1.75	2.05
68.00	1.311	10.80	8.53	9.64	0.04	1.75	1.75	1.99
69.00	1.323	10.90	8.62	9.75	0.03	1.31	1.31	1.56
70.00	1.335	11.00	8.72	9.86	0.03	1.31	1.31	1.39
71.00	1.347	11.10	8.81	9.97	0.03	1.31	1.31	1.34
72.00	1.359	11.20	8.91	10.08	0.03	1.31	1.31	1.32

Appendix D:
2006 LIDAR Survey Contour Maps



G:\Collier\8500.62\mxd\CollierLIDAR_Figure1.mxd

NOTES

1) TOPOGRAPHY DERIVED FROM AIRBORNE LIDAR DATA FLOWN IN MAY, 2006.

2) AIRBORNE LIDAR POINTS WERE CLASSIFIED BY COASTAL PLANNING & ENGINEERING.

3) ONLY POINTS CLASSIFIED AS GROUND WERE USED TO GENERATE THE DIGITAL ELEVATION MODEL AND CONTOURS.

LEGEND

▲ FDEP RANGE MONUMENTS

— COASTAL CONSTRUCTION CONTROL LINE

— EROSION CONTROL LINE

N

0 500 1,000 Feet

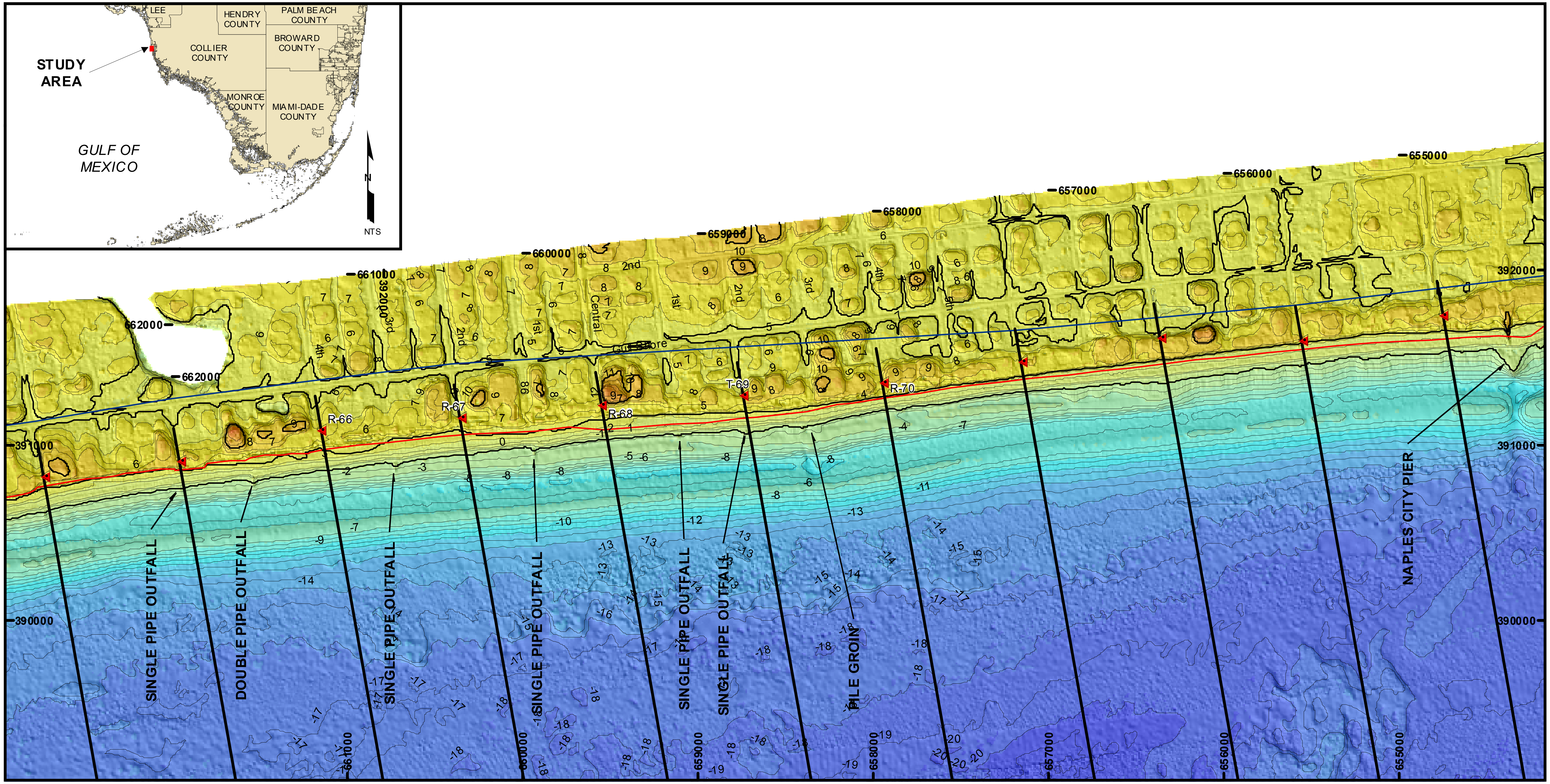
1 inch = 600 feet

TITLE:

COLLIER COUNTY CONTOUR MAP

COASTAL PLANNING & ENGINEERING, INC
2481 NW BOCA RATON BLVD.
BOCA RATON, FL 33431
PH. (561) 391-8102
FAX.(561) 391-9116

DATE: 06/05/09 | BY: WRV | COMM NO: 8500.62 | **FIGURE 01**



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FAX.(561) 391-9116

DATE: 06/15/09	BY: WRV	COMM NO: 8500.62	**FIGURE 02**

G:\Collier\85062\mxd\CollierLIDAR_Figure2.mxd