SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
RESOURCE REGULATION
TECHNICAL GUIDELINE

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SUBJECT: Definition of "Directly Connected Impervious Area" (DCIA), and its use in calculating surface water quantity rates and volumes in Surface Water Management Systems

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THE PURPOSE OF THIS DOCUMENT IS TO PROVIDE GENERAL GUIDANCE AND TRAINING FOR REGULATORY STAFF. THE GUIDELINES SET FORTH ARE NOT DISTRICT POLICY AND MAY BE MODIFIED IN APPROPRIATE CIRCUMSTANCES. PERMIT APPLICATIONS ARE ISSUED OR DENIED BASED ON COMPLIANCE WITH DISTRICT RULE CRITERIA.

PURPOSE:

This technical guideline will provide information to staff regarding the proper definition of DCIA, and its correct use in calculating quantity flow rates and volumes in existing and/or proposed Surface Water Management Systems.

DESCRIPTION:

Background:

Historically, DCIA's have been used by engineers as part of their storm water calculations to estimate storm water runoff rates and volumes for both existing watersheds, and proposed improvement projects. The concept of DCIA originally came from the British Road Research Laboratory (BRRL) studies (1962) which attempted to provide an accurate means of computing runoff from the paved area portion of an urban watershed.(2) Later improvements to the BRRL work by The Illinois Urban Drainage Area Simulator (ILLUDAS) allowed for another means of computing runoff from the pervious portions of an urban watershed.(3)

In addition to BRRL and ILLUDAS, the Santa Barbara Urban Hydrograph (SBUH) method was developed in 1975 by Mr. James M. Stubchaer of the Santa Barbara County (California) Flood Control and Water Conservation District.(5) This method is particularly suited for small high density urban watersheds.(4) The SCS Unit Hydrograph method can also be used for natural basins, and basins with residential character (moderate density development).(4)

Most engineering consultants/government agencies within the District utilize computer software that calculates storm water runoff by either the SCS Unit Hydrograph or Santa Barbara Urban Hydrograph methods. Both of these methods utilize the DCIA concept. In addition, Table 2-2a of TR-55 [SCS Runoff Curve Numbers (CN's) for Urban Areas] uses the assumption of DCIA's for

select hydrologic conditions in commercial, industrial, and residential areas. Other assumptions of Table 2-2a are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition (grass cover is greater than 75%). Therefore, it is important to understand the definition of DCIA's.

Definition of DCIA's (by selected engineering references):[4, 5, and 6]

In its simplest form, DCIA's (sometimes referred to in literature as the hydraulically effective impervious areas[7]) ***are those impervious areas that are hydraulically connected*** (water flow is continuous[5]) ***to the conveyance system*** (i.e. streets with curbs, catch basins, storm drains, etc.[7]) ***and thence to the basin outlet point*** (i.e. a retention/detention pond, existing storm sewer/ditch system, natural water body, etc.) ***without flowing over pervious areas***.[4 and 7] For instance, if you have a 50 acre drainage basin and 20 acres of the basin consist of roofs, driveways, and roadways which discharge directly to the basin's outlet (via the conveyance system) without flowing over pervious areas, then the DCIA would be 40 percent. The SCS curve number (CN) would then be based on the remaining 30 acres of pervious area.

Conversely, Indirectly Connected Impervious Areas (ICIA's) are those impervious areas which flow over pervious areas before entering the conveyance system, and subsequently flow to the basin outlet.[4] Runoff from these areas is spread over a pervious area as sheet flow.[6]

Impervious areas contributing flow to earthen channels or other conveyance facilities that traverse pervious areas are classified as DCIA's.[4] An impervious area is also considered as a DCIA if runoff from it occurs as concentrated shallow flow (i.e. ditch/swale flow) that runs over a pervious area and then into a drainage system.[6]

DCIA's in Urban Hydrology:[8]

The concept of DCIA is important in urban hydrology, especially for smaller storm events (less than 2 or 3 inches of rainfall). The curve number method in sandy (dry) soils for low density residential areas (CN=61, HSG="B") will not (theoretically) produce any runoff until after 1.28 inches of rainfall occurs because of initial abstraction [Assumes Ia=0.2S, and S=(1000/CN-10)]. In reality, runoff commences almost immediately with rainfall from DCIA's. Therefore, it may be appropriate and important to include DCIA's into rainfall excess calculations, and adjust the curve number(s) for the remainder of the sub-basin in question.

Determination of DCIA's:[7]

Although the total impervious areas of most drainage basins can, in most cases, be readily determined from aerial photographs, the determination of DCIA's cannot. This determination is particularly difficult in the case of the roofs of buildings. In some cases all or parts thereof are directly connected by roof drains to the conveyance system. In other cases (many times in the same block), runoff from roof drains flow onto the grassed areas, either by roof drains or directly from the periphery of the roof. Therefore, a detailed field inspection of the buildings, driveways,

etc. in the drainage basin is generally required.

If stream flow records are available, the runoff depths from the small storms on **dry** watersheds may be used to determine the DCIA, (ratio of runoff to precipitation), as almost all of the runoff from small storms will be from those areas. Where no actual data is available, such as where hydrographs for a new development must be computed, values based on similar type developments can be used. Table 2-2a of TR-55 can provide guidance on such DCIA selections.(6)

Computer Implementation of DCIA's and ICIA's (4):

Many computer implementations allow the user to specify percentages of DCIA's and ICIA's, as well as their CN values, where they are applicable to the problem. From this data, rainfall excess can be computed using the following procedure:

1) Compute excess for the ICIA's.

2) Add the resulting excess from (1) to the rainfall falling on the pervious areas.

3) Compute excess for the pervious areas with the adjusted rainfall resulting from (2).

4) Compute excess for the DCIA's.

5) Add results from (3) and (4) to obtain the rainfall excess for the basin.

Permitting Review Guidelines:

Attached for reference are three (3) exhibits showing their respective DCIA's in regard to storm water quantity rates and volumes.

REFERENCES:

1) Chapter 40D-4, F.A.C.
2) "Storm Sewer Design - An Evaluation of the RRL Method" (1972), U.S Environmental Protection Agency, Office of Research and Monitoring, Washington, D.C. 20460
3) "The Illinois Urban Drainage Area Simulator, ILLUDAS" by M. L. Terstriep and J. B. Stall, Illinois State Water Survey, Bulletin 58, State of Illinois, Department of Registration and Education, 1974
4) "Runoff Hydrograph Computational Methods", by Rodney D. Ghioto, P.E. (Ghioto & Associates, Orlando, Florida), as presented as a paper for "Storm Water Management: A Designer's Course", at the Clarion Plaza Hotel, Orlando, Florida, September 24-25, 1991, Sponsored by the Florida Engineering Society.
5) "Hydrology and Water Quantity Control", by Dr. M. P. Wanielista (1990), John Wiley & Sons, Inc., New York.

6) "Technical Release #55 (TR-55)", United States Department of Agriculture, Soil Conservation Service, June, 1986.
7) "Basic Language Programs for Urban Storm Water Management, Planning, and Design", by Bernard L. Golding, 8982 Isleworth Court, Bay Hill, Orlando, Florida, 1983.
8) "Advanced ICPR User's Manual, Version 2", Streamline Technologies, Inc., 7125 University Boulevard, Winter Park, Florida 32792.

ATTACHMENTS:
1) Exhibit "A" - Residential Project Post-Developed Condition Site Plan Showing DCIA's.
2) Exhibit "B" - Commercial Project Post-Developed Condition Site Plan Showing DCIA's.
3) Exhibit "C" - Public Roadway Alteration Project Post-Developed Condition Site Plan Showing DCIA's.

STATUS: New

DISTRIBUTION: P.G. Hubbell, M.D. Farrell, R.V. McLean, E. Helvenston, Technical Services Department, Permitting Departments, Processing & Records, Well Construction Permitting, Permit Data, Central File

APPROVED FOR STAFF USE: Date: _____

This document has been electronically distributed. The original document, signed and/or sealed on the date ascribed, is on file in Technical Services, and a copy is also available in Central Records.

(SEAL)

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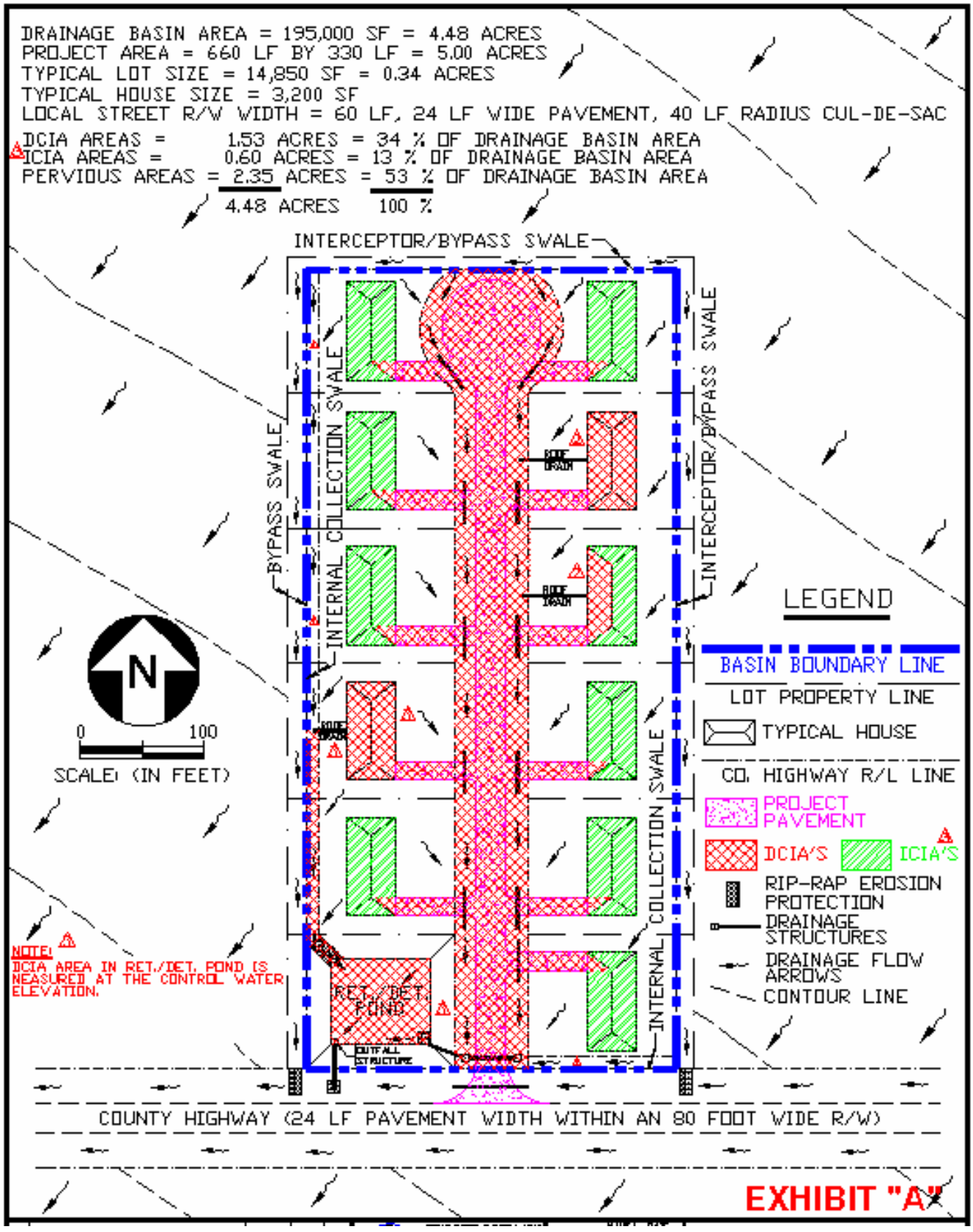
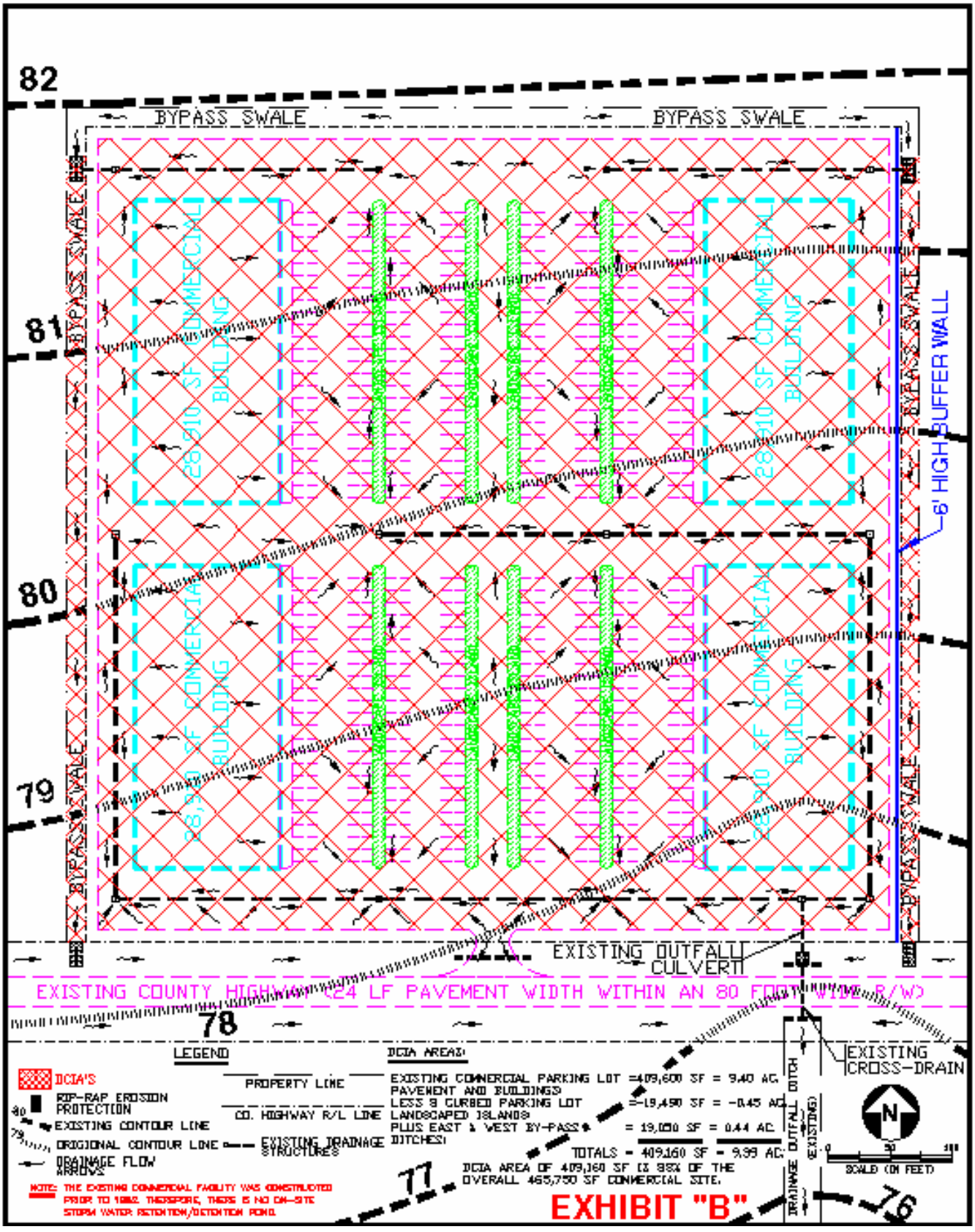
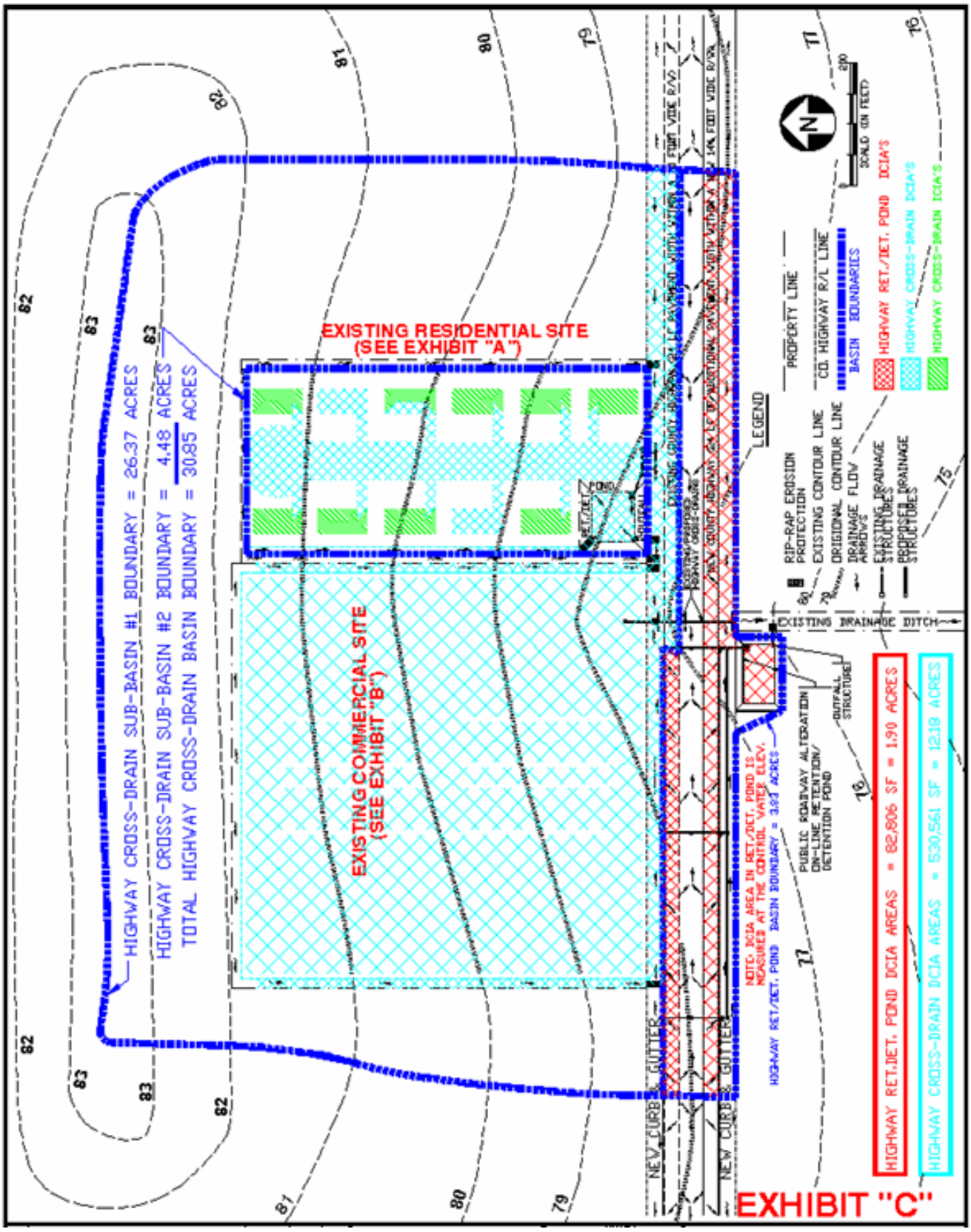

DRAINAGE BASIN AREA = 195,000 SF = 4.48 ACRES
PROJECT AREA = 660 LF BY 330 LF = 5.00 ACRES
TYPICAL LOT SIZE = 14,850 SF = 0.34 ACRES
TYPICAL HOUSE SIZE = 3,200 SF
LOCAL STREET R/W WIDTH = 60 LF, 24 LF WIDE PAVEMENT, 40 LF RADIUS CUL-DE-SAC
DCIA AREAS = 1.53 ACRES = 34 % OF DRAINAGE BASIN AREA
ICIA AREAS = 0.60 ACRES = 13 % OF DRAINAGE BASIN AREA
PERVIOUS AREAS = 2.35 ACRES = 53 % OF DRAINAGE BASIN AREA
4.48 ACRES 100 %
INTERCEPTOR/BYPASS SWALE
BYPASS SWALE
INTERNAL COLLECTION SWALE
INTERCEPTOR/BYPASS SWALE
INTERNAL COLLECTION SWALE
RET./DET. POND
OUTFALL STRUCTURE
N
0
100
SCALE: (IN FEET)
NOTE:
DCIA AREA IN RET./DET. POND IS MEASURED AT THE CONTROL WATER ELEVATION.
LEGEND
BASIN BOUNDARY LINE
LOT PROPERTY LINE
TYPICAL HOUSE
CO. HIGHWAY R/L LINE
PROJECT PAVEMENT
DCIA'S
ICIA'S
RIP-RAP EROSION PROTECTION
DRAINAGE STRUCTURES
DRAINAGE FLOW ARROWS
CONTOUR LINE
COUNTY HIGHWAY (24 LF PAVEMENT WIDTH WITHIN AN 80 FOOT WIDE R/W)
EXHIBIT "A"


82
81
80
79
78
77
76
BYPASS SWALE
BYPASS SWALE
BYPASS SWALE
BYPASS SWALE
BYPASS SWALE
6' HIGH BUFFER WALL
28,910 SF COMMERCIAL BUILDING
28,910 SF COMMERCIAL BUILDING
28,910 SF COMMERCIAL BUILDING
28,910 SF COMMERCIAL BUILDING
EXISTING OUTFALL CULVERT
EXISTING COUNTY HIGHWAY - 624 LF PAVEMENT WIDTH WITHIN AN 80 FOOT WIDE R/W
EXISTING CROSS-DRAIN
LEGEND
DCIA'S
RIP-RAP EROSION PROTECTION
EXISTING CONTOUR LINE
ORIGIONAL CONTOUR LINE
DRAINAGE FLOW ARROWS
PROPERTY LINE
CO. HIGHWAY R/L LINE
EXISTING DRAINAGE STRUCTURES
DCIA AREAS:
EXISTING COMMERCIAL PARKING LOT PAVEMENT AND BUILDINGS = 409,600 SF = 9.40 AC.
LESS 8 CURBED PARKING LOT LANDSCAPED ISLANDS = -19,490 SF = -0.45 AC.
PLUS EAST & WEST BY-PASS DITCHES = 19,050 SF = 0.44 AC.
TOTALS = 409,160 SF = 9.39 AC.
DCIA AREA OF 409,160 SF IS 88% OF THE OVERALL 465,750 SF COMMERCIAL SITE.
NOTE: THE EXISTING COMMERCIAL FACILITY WAS CONSTRUCTED PRIOR TO 1982. THEREFORE, THERE IS NO ON-SITE STORM WATER RETENTION/DETENTION POND.
DRAINAGE OUTFALL DITCH (EXISTING)
N
SCALE (IN FEET)
EXHIBIT "B"


EXISTING RESIDENTIAL SITE
(SEE EXHIBIT "A")
EXISTING COMMERCIAL SITE
(SEE EXHIBIT "B")
HIGHWAY CROSS-DRAIN SUB-BASIN #1 BOUNDARY = 26.37 ACRES
HIGHWAY CROSS-DRAIN SUB-BASIN #2 BOUNDARY = 4.48 ACRES
TOTAL HIGHWAY CROSS-DRAIN BASIN BOUNDARY = 30.85 ACRES
LEGEND
PROPERTY LINE
CO. HIGHWAY R/L LINE
BASIN BOUNDARIES
HIGHWAY RET./DET. POND DCIA'S
HIGHWAY CROSS-DRAIN DCIA'S
HIGHWAY CROSS-DRAIN DCIA'S
RIP-RAP EROSION PROTECTION
EXISTING CONTOUR LINE
ORIGINAL CONTOUR LINE
DRAINAGE FLOW ARROWS
EXISTING DRAINAGE STRUCTURES
PROPOSED DRAINAGE STRUCTURES
EXISTING DRAINAGE DITCH
PUBLIC ROADWAY ALTERATION
ON-LINE RETENTION/
DETENTION POND
OUTFALL STRUCTURE
NOTE: DCIA AREA IN RET./DET. POND IS MEASURED AT THE CONTROL WATER ELEV.
HIGHWAY RET./DET. POND BASIN BOUNDARY = 3.83 ACRES
NEW CURB & GUTTER
HIGHWAY RET.DET. POND DCIA AREAS = 82,806 SF = 1.90 ACRES
HIGHWAY CROSS-DRAIN DCIA AREAS = 530,561 SF = 12.18 ACRES
EXHIBIT "C"